Distant Writing

A History of the Telegraph Companies in Britain between 1838 and 1868

CONTENTS

Steven Roberts, the writer, can be contacted by email at distantwriting@hotmail.co.uk

Miscellany

THE ELECTRIC TELEGRAPH
Anonymous, 1851

Hark, the warning needles click,
Hither – thither – clear and quick
Swinging lightly too and fro,
Tidings from afar they show,
While the patient watcher reads
As the rapid movement leads.
He who guides their speaking play
Stands a thousand miles away.
Sing who will of Orphean lyre,
Ours the wonder working wire!
Eloquent, though all unheard,
Swiftly speeds the secret word,
Light or dark or foul or fair,
Still a message prompt to bear:
None can read it on the way,
None its unseen transit stay,
Now it comes in sentence brief,
Now it tells of loss and grief,
Now of sorrow, now of mirth,
Now a wedding, now a birth,
Now of cunning, now of crime,
Now of trade in wane or prime,
Now of safe or sunken ships,
Now the murderer outstrips,
Now it warns of failing breath,
Strikes or stays the stroke of death.
Sing who will of Orphean Lyre,
Our the wonder working wire!
Now what stirring news it brings,
Plots of emperors and kings,
Or of people grown to strength,
Rising from their knees at length;
These to win a state – or school;
Those for flight or stronger rule.
All that nations dare or feel,
All that serves the commonweal,
All that tells of government,
On the wondrous impulse sent,
Marks how bold Inventions' flight
Makes the widest realms unite.
It can fetters break or bind,
Foster or betray the mind,
Urge to war, incite to peace,
Toil impel, or bid it cease.
Sing who will of Orphean lyre,
Ours the wonder working wire!

Speak the word, and think the thought,
Quick 'tis as with lightning caught,
Over – under- lands or seas,
To the far antipodes.
Now o'er cities thronged with men,
Forest now or lonely glen,
Now where busy commerce broods,
Now in wildest solitudes;
Now where Christian temples stand,
Now in far Pagan land.
Here again as soon as gone,
Making all the earth as one.
Moscow speaks at twelve o'clock
London reads ere noon the shock,
Seems it not a feat sublime –
Intellect hath conquer'd Time!
Sing who will of Orphean lyre,
Our the wonder working wire.
Flash all ignorance away,
Knowledge seeks the freest play;
Flash sincerity of speech,
Noblest aims to all who teach;
Flash till bigotry be dumb,
Deed instead of doctrine come,
Flash to all who truly strive,
Hopes that keep the heart alive;
Flash real sentiments of worth,
Merits claims to rank with Birth,
Flash till Power shall learn the Right,
Flash till Reason conquer Might,
Flash resolve to every mind,
Manhood flash to all mankind.
Sing who will of Orphean lyre,
Our the wonder working wire.

These verses were published in "Electric Communication" in 'Chambers's Papers for the People', Volume IX, by William & Robert Chambers, Edinburgh, 1851

Distant Writing

PREFACE

Distant Writing is intended to be a chronology of the growth and performance of all of the domestic public telegraph companies formed in Britain from 1838 to 1868, as well as of their associated cable companies. In addition, their working practices are dealt with in some detail; as is the electrical technology that is inextricably and unavoidably linked to their development.

The early histories of railway signalling, cipher machines, blasting machines, burglar alarms, all connected with the electric telegraph, are also included.

As this is the story of the telegraph companies, with the main emphasis on the domestic companies, history, as far as they are concerned, ends in 1870. The subsequent workings of the telegraphs by the Post Office and of post-1870 concerns such as the Exchange Telegraph Company are not dealt with. If cover of the heroic cable companies of the 1860s and 1870s appears cursory that is because they have been effectively dealt with elsewhere by others more qualified.

As the writer is not an electrical engineer errors and omissions must be allowed for in the explanations of the principles and apparatus connected with the electric telegraph. Corrections are most welcome.

INTRODUCTION

"Canst thou send lightnings, that they may go, and say unto thee, Here we are?" Job 38:35

Before the electric telegraph made its popular appearance in the 1840s the written letter was the sole means for individuals to communicate with each other over distance. From roman times, for over eighteen hundred years, the letter generally travelled at its best speed overland at that of the waggon-horse.

It is difficult to imagine an age when an inky pen and a sheet of paper were the only way messages could be sent; when even these were rare, expensive items to many in town and country; and that days might pass before a thought, an order or a piece of news could travel from a distant place, or even weeks or months if that place were overseas.

But then, in a period of just four years, by 1850 anyone in a large town, with the price, could write a message, albeit a short message, on a piece of paper and have a copy of it sent to arrive within minutes to a distance of over five hundred miles.

If it was arranged properly two people could (and often did) sit in an office in a railway station or a city street and "converse" over hundreds of miles by giving questions and answers across a counter to clerks.

In the following five years that message would flow under the seas, cross continents and be one thousand miles distant within the hour.

This was a *revolution*. It affected business, it affected government, it affected news. It was a revolution that even affected *time* itself. But it was oddly peripheral to the individual. It was an invisible revolution, with little or no disruption to most people's environment or even to their purse.

And it just *happened*. In Britain there was no central guiding force, no political will, no tax, no regulation or overweening administration. Instead there was a veritable jungle of inventors and scientists who competed for capital to implement their ideas for something that only they understood.

The electric telegraph was part of a long process of discovery and development dating at least from the turn of the century driven by academics. Scholars such as Volta, Ampere, Oersted, Schweigger, Gauss, Weber, Steinheil, Schilling, Ohm, Wheatstone, Daniell, Faraday and Henry (and others in many countries) all contributed elements to understanding the magical, and, so far, unimagined, power of electricity.

Using these discoveries a number of inventors or rather 'adapters' appeared, taking this new knowledge, transforming it into useful ideas with commercial utility; the first of these 'products' was the use of electricity to transmit information between distant points, the electric telegraph.

However, the grasp of even these earliest, primitive theories relating to electricity by the inventors was slender; only gradually did they evolve into a separate recognised technical discipline. None of them "invented" the electric telegraph, they adopted and applied combinations of several of the academic discoveries and patented them for their own use and profit. The early adaptors of the new technology, it must be said from the outset, were a '*rum lot*'. With few exceptions they squabbled and litigated with each other incessantly during the 1840s, making claims of invention based on the flimsiest of evidence, as well as shamelessly parading their ignorance of science. As regards their several claims, this work relies solely on their patent specifications and news reports of the instance, rather than on any partisan recollection of distant thoughts and apparent slights by contemporaries.

In Britain the primary academic influence was Professor Charles Wheatstone; the original inventor/adaptor in electric telegraphy was William Fothergill Cooke.

On June 10, 1837 W F Cooke and Charles Wheatstone obtained their first patent for the electric telegraph, a comprehensive set of claims that left few loop-holes for any challengers. Just over thirty years later, by the Telegraph Act, 1868, the British Parliament acquired for the General Post Office a national network comprising 16,879 miles of telegraph line and 2,155 telegraph stations, with the services of the 5,339 people employed in the telegraph industry.

Periculum privatum utilitas publica!

This work deals with the introduction, development and operation of the electric telegraph in Britain in those intervening thirty years. It deals briefly with the initial stage, between 1838 and 1846, when the two partners, Cooke and Wheatstone, attempted - with very limited success - to introduce telegraphy to the public. Then follows a précis of the much-neglected period between 1846, when organised capital was first applied, creating a dozen or so competitive companies that soon consolidated into three national networks, covering the entire country with electric communication, and 1868 when the government of the day finally appropriated the entire domestic telegraph system.

This is therefore primarily a summary history of the several joint-stock companies that constructed the original British telegraph system without cost or risk to the general public, their remarkable innovations, their systems and working practices, and their technology. To create this nationwide system the companies expended £2,500,000 – to acquire it the government eventually spent £12,000,000.

For the fourteen years between 1837 and 1851 the comprehensive master patent of Messrs Cooke and Wheatstone prevented others entering the public telegraphic business in Britain. However, several patents for improved telegraphic instruments and materials were granted to inventive individuals in that time that were subsequently acquired by or used to create several new telegraph companies.

W F Cooke and Charles Wheatstone did not invent the electric telegraph, and they did not claim to; however it might also be added gratuitously here that the United States Patent acquired by Cooke and Wheatstone was dated June 10, 1840 and that of S F B Morse was dated June 20, 1840. The owners of the Morse patent never challenged this priority.

1.] COOKE AND WHEATSTONE

In July 2010 John Liffen, Curator of Communications at the Science Museum in London, published the definitive history of Cooke and Wheatstone's earliest telegraph instruments and their use between 1837 and 1842; it is very different from accepted history. This chapter has been extensively revised by this writer to include John Liffen's researches:

The patent was one of the last signed by William IV before his niece Victoria assumed the Crown of Britain in 1837. At this moment the country was in the throes of its first great *Railway Mania*, it saw the raising of huge sums of capital for companies to connect the major cities with each other by steam-powered railways. The end of the French wars saw government contract radically, its fiscal needs reduced and its need for loans, the commonest public investment, vanished; money was cheap. It was the advent of an era; where capital could be raised with ease and applied to great projects for public and private good, for gas and water utilities, banking, insurance, even cemeteries, as well as rails.

It was not at this stage a speculative mania but primarily original investment; the concerns formed between 1836 and 1841, by and large, survived and prospered - although suffering considerably when the boom declined in 1840. It was into this optimistic market that telegraphy entered.

As their first business step W F Cooke and Charles Wheatstone established a formal partnership in a document dated November 19, 1837 to exploit their initial patent; such capital as was needed being raised on their own personal and limited security. The master English patent of June 10, 1837 was followed by one for Scotland on December 12, 1837 and for Ireland during April 1838. A Mr Lancaster purchased a one-third share in the Irish patent. These legal necessities cost, in all, £800 to secure; over forty times the average male's annual earnings. Cooke was to spend a similar sum on experimental instruments and materials by 1838.

It is not useful to rehearse the tiresome arguments that immediately ensued between Cooke and Wheatstone regarding just about everything connected with the details of their many patents and their respective contributions; these have been effectively covered elsewhere. They quarrelled endlessly. But it is necessary to record the progress of their partnership from 1837.

The Patentees

At this time W F Cooke was styled a 'gentleman', that is a man without any formal occupation, in fact relying on limited family money. Cooke had acquired a superficial knowledge of electricity attending lectures in German universities and had devised or adapted telegraphic apparatus. It can be fairly said that his contribution to the partnership was managerial and promotional; he controlled the business aspects and undertook all the negotiations, contracting in his own name to build lines of electric telegraph. His commitment to establishing the telegraph, his energy and enthusiasm, if occasionally misguided, was undoubted. That being so he remained connected with the development of the Cooke & Wheatstone electric telegraph system in its subsequent corporate phase as a company director until 1868.

Cooke filed no more telegraphic patents after his partnership with Wheatstone ended. In his later years he used the considerable capital he acquired from the telegraph in mining ventures and lost it all.

During the summer of 1816, at the end of the Bonapartiste Wars, Francis Ronalds built an electric telegraph in the gardens of his house at 26 Upper Mall in Hammersmith, west of London. In its original form it consisted of two large wooden frames, twenty yards apart each with nineteen horizontal wooden bars from which were suspended thirty-seven iron hooks. Between the hooks was run a single length of eight miles of thin iron wire. This being before the awareness of the innovations of Volta or Galvani, the telegraph used static electricity, "lightning"! A Leyden jar was kept charged by a frictional electric machine, this was to be the transmitter. A Canton pith-ball electrometer, two resin spheres suspended on silk threads, acted as the receiver. Once the Leyden jar was attached to the long iron wire the two pith-balls momentarily were attracted together as the electric power passed between them. A little later

Ronalds improved his telegraph by excavating a 525 foot long four-foot deep trench in the garden and buried within it a two-inch square wooden trough lined with pitch containing another iron wire protected by thick glass tubes; this he connected to the Leyden Jar, the static electricity machine and the electrometer, successfully sending momentary electrical signals underground.

Unfortunately the discharge of frictional or static electricity is momentary; unlike the continuous current made by means of Voltaic cells or electro-magnetism. Each discharge has to be generated individually.

To communicate messages Ronalds had made two identical clock-like machines, each with a slow-moving index or hand, with the alphabet engraved around the dial. The two machines were set running simultaneously - as the first index passed the appropriate letter the Leyden jar was applied to the wire and the electrometer moved instantaneously, indicating to the recipient by the moving hand on the second machine the same letter.

In 1817 a man took his curious fifteen-year old nephew from London to view the telegraph in Mr Ronalds' garden. The boy's name was Charles Wheatstone.

Charles Wheatstone was one of the outstanding academics of the 19th Century; devoted to developing theories and practical applications in many fields of physics. It is worth noting that Wheatstone, apparently the shy academic, was also partner with his brother in a flourishing musical instrument business – he had invented, patented and continued to develop the *concertina* between 1822 and 1844. In the 1820s and 1830s he investigated an acoustic communication process that he called the *telephone.* Always fascinated by language he used the word *microphone*, before such a thing was perfected.

In 1837, Professors Wheatstone, John Frederick Daniell, Joseph Henry and Alexander Dallas Bache, the latter eminent pair visiting from America, created a *thermo-electric machine*, in his rooms at King's College; still the El Dorado of electric power sources, but having established that it could be done went on to other things.

With his patent of 1841 Wheatstone introduced several forms of *electro-motor,* or electro-magnetic engine, converting electricity into rotary motive power, as well as the first *linear electric motor*, controlling their speed with a *rheostat* of his own devising.

He invented a *magnetic clock*, and the *stereoscope* for viewing stereoscopic images, as well as making manifold improvements and innovations in electric telegraphy over forty years, including the first electric *type-printing telegraph* in 1840 and the *automatic telegraph* to carry bulk traffic in 1858.

Wheatstone was the first to give credence to underwater telegraphy in 1840. In the same year he devised an electric *daisy-wheel printer* for the telegraph which he perfected in 1862; and the *chronoscope* for measuring small intervals of time. In 1843 he produced the *thermometer-telegraph* for measuring temperature in the upper atmosphere using a balloon or within the depths of the earth in bore-holes. The commercial value of these innovations seems to have escaped him.

In contrast to this naïveté he developed the *Universal telegraph* for business, domestic and personal use between 1840 and 1868. In 1856 he devised the *cryptograph*, what might be termed a precursor of the Enigma cipher machine. He invented the *magnetic exploder* or electric blasting machine for mining in 1860 and latterly, in 1867, simultaneously with Siemens and others, perfected the *dynamo* or electric generator.

Wheatstone allowed his business affairs to be managed by others, initially by his brother as William Wheatstone & Company, "inventors and patentees of the concertina and manufacturers of harmoniums, music sellers and concertina makers." This was paralled by his involvement with Cooke. Latterly, after the failure of his working relationship with him, he was long associated in business with the electrical engineer, Nathaniel Holmes, the instrument maker, Augustus Stroh, and, finally, from 1870, with Robert Sabine at the British Telegraph Manufactory, which made his patent instruments and dynamos. He had a similarly long-standing relationship with Louis Lachenal, who manufactured his patent concertina from 1845 until his death in 1861. From 1859 he was deeply involved in establishing his Universal telegraph, recruiting many of his scientific friends in its promotion. Wheatstone, unlike Cooke, was to die a successful and wealthy family man.

Subsequent to the grant of the patent in 1837, the first of many that Cooke and Wheatstone obtained, together and separately, the partnership constructed lines of telegraph in its own name and granted licences to others to use its instruments and materials. The business had a *very* slow start – not least because the seed capital used to build lines of wire had to be borrowed of individuals and banks as the partners had the most limited means. None of these earliest lines were open to the general public for messages.

The London & Birmingham Railway 1837

The "First" Telegraph

On June 27, 1837, just two weeks after the grant of the patent, W F Cooke, whilst lobbying the London & Birmingham Railway Company, was introduced to the legendary Robert Stephenson, its engineer. Time would show that Stephenson was impressed and was to retain an interest in the telegraph for the rest of his life.

Cooke and Wheatstone's *very first telegraph line* was tested on July 4, 1837 within a newly-built carriage shed at Camden Town in north London on the London & Birmingham Railway. The trial was conducted at W F Cooke's risk to demonstrate the utility of the electric telegraph to the railway. Cooke had installed a total of thirteen miles of five-wire circuit, made from seventy miles of copper wire, along the walls of the shed, connected to his own design of telegraph instruments, the "old" mechanical and *three-needle* instruments. Twenty of the railway company's directors attended the demonstration. On July 10 this indoor telegraph was shown to Robert Stephenson, the company's engineer.

The telegraph that the railway intended to commission had to address a prosaic need for traffic control between the Euston Square and Camden Town stations in London. It was to signal stationary steam engines working cables to haul trains of carriages up a steep one-mile long incline before attaching locomotives for the journey to Birmingham.

In support of his pitch, on July 17 Cooke commenced laying a temporary four-wire "rope" between Euston Square and the stationary engine house at Camden Town, again at his own expense. The specification of this is vague, the "rope" of loose insulated wires seems to have been placed alongside the rails, crossing the track at least once by being hung from nails in a tunnel. On July 25, the temporary mile long "rope" was tried with two of Wheatstone's latest four-needle instruments and a "permutating" keyboard that allowed for twelve signals, and through the thirteen mile indoor carriage shed circuit in the presence of Robert Stephenson. He was sufficiently impressed to instruct Cooke to make a permanent circuit at the railway's expense.

The *first near-permanent telegraph* line was laid to Cooke's specification with remarkable speed by the railway company's contractors, supervised by Charles Fox, one of its engineers, from Euston to Camden in just one month. By August 31, 1837 five parallel thickly-varnished copper wires had been buried underground, embedded in tar-soaked wooden battens between the stations. Cooke's trial instruments were replaced by Wheatstone's "new" patent *five-needle* or permutating telegraph that signalled the roman alphabet and so could be worked by anyone who could read and write, in circuit with galvanic batteries. This is customarily thought to be the first commercial electric telegraph line in the world. There was an hour long trial of the whole circuit on September 6, 1837.

The first pair of five-needle instruments used in August 1837 were exceptionally-large versions for public demonstration with a diamond-shaped open "dial" twenty-four inches wide and forty-two inches tall, on a mahogany board thirty inches by forty-eight inches, with the row of electro-magnetic coils for the five needles protected by a box on the back, most likely hung on a wall. These instruments still exist. There was a separate brass and mahogany desk-top permutating twenty-key set to work the needles on the dial board.

Most of these early instruments were made by Moore Brothers, church and house clock makers, of 38 Clerkenwell Close, Clerkenwell, London. There were then three brothers Moore, Benjamin, Richard and Josiah, engaged in the clock business. The firm was also known as John Moore & Sons. Wheatstone's earliest electrical apparatus was made by Watkins & Hill, philosophical instrument makers, of 5 Charing Cross. Subsequently, from about 1838, Cooke & Wheatstone commissioned William Reid, of 25 University Street, St Pancras, to make their telegraph models and other electrical implements. Reid was to become one of the largest telegraph manufacturers and contractors for works in Britain, and was to be associated with Wheatstone until his death in the 1860s.

Cooke's very first mechanical telegraph was made by John Brittan, a clockmaker with Moore Brothers in 1836; it was the size of a "barrel organ" and never completed. Brittan went on to build clockwork telegraphs and alarm bells for Cooke in 1837 and 1838, and attended the first demonstration of the electric telegraph on the London & Birmingham Railway on behalf of his employers, Moore Brothers. John Brittan's connection with the telegraph was to last for thirty years; eventually he was to become Superintendent of the Instrument Department of the Electric Telegraph Company.

Independently of Wheatstone's craftsmen, Cooke also worked with Frederick Kerby, a dealer in instruments, of 12 Spann's Buildings, St Pancras, who he later called "his mechanician". Kerby's father, Francis, was a practical chemist, and had been assistant to Dionysius Lardner and to William Ritchie, successive Professors of Natural Philosophy and Astronomy at London University.

It was Moore and Kerby who supplied the first large dial, five-needle telegraphs and their keyboards that were used between Euston Square and Camden Town in July 1837, each providing one of the pair.

Although successfully demonstrated to the railway's directors as well as Stephenson, the telegraph was deemed unnecessarily complicated. The simple task of signalling between Euston Square and the cable engines at Camden Town was lost in the enthusiasm for plans to lay electric circuits to Liverpool, Manchester and Holyhead where the company (as yet) had no rails. The railway's board were not prepared to consider such huge schemes, even if endorsed by Robert Stephenson. On October 12, 1837 the company wrote to Cooke rejecting further use of the electric telegraph.

On December 14, 1837 Cooke bought the two sets of five-needle telegraphic apparatus, with their large display boards and separate keyboards, from the London & Birmingham Railway for £31, about half their cost. He immediately re-sold them to Wheatstone, who kept them at King's College.

This first *near-permanent* line of electric telegraph was in operation from July 15, 1837 until January 16, 1838.

On learning of this first electrical success from the newspapers in faraway New York, S F B Morse, a sometime painter and electrical experimenter, took ship to Liverpool in May 1838 with a view to patenting his own simple telegraphic apparatus in Europe. He arrived in the midst of Queen Victoria's coronation. His mission was a failure. Opposed in London by Cooke and Wheatstone and by Edward Davy, possessors of existing telegraphic patents, and as, additionally, he had his apparatus publicised previously in 'Mechanics' Magazine' in February of that year, the Patent Office rejected his submission as already known and unoriginal. In Europe only France allowed him a provisional patent, which lapsed without use. Morse, however, surreptitiously visited the exhibitions of Cooke, Wheatstone and Davy during June 1838, and carefully copied their ideas into his diary and notebooks.

There was then a hiatus in activity. Without a powerful enthusiast like Stephenson on the "inside" it proved difficult to justify the expenditure needed to hard-headed capitalists whose attention was fixed on the golden calf of the railway. But Stephenson gave the business a personal prod in another direction. On September 22, 1837 Cooke had received a note from I K Brunel, Stephenson's great friend.

The Great Western Railway 1839

The *first permanent line of electric telegraph in England* was completed on July 9, 1839 between the Paddington and West Drayton stations of the Great Western Railway (London-Paddington to Bristol), a distance of thirteen miles, having taken a year to make and costing the railway £2,817. It was constructed at the instance of the Company's engineer, I K Brunel, who had been introduced to Cooke by Robert Stephenson, for the railway company's own experimental use; there were then no public messages.

This line was engineered by W F Cooke, using his techniques and his instruments. The new line comprised six varnished copper wires insulated with india-rubber fabric run within a ¾ inch small-bore, iron gas-pipe. The iron pipe was fixed six inches above the ground, to be free of damp, on longitudinal rails and small wooden posts, two or three feet away from the railway, accessed for maintenance every mile or so by circular iron junction boxes. Originally Cooke contemplated embedding the circuit wires in wooden battens, as with the Euston Square to Camden Town line; but "Mr Brunel seems inclined to change his plans", as he did in all his projects, and chose iron pipes instead.

The small-bore iron pipe was made by James Russell & Co., patent gas tube manufacturers, 69 Upper Thames Street, City, and Wednesbury, Staffordshire; the individual copper wire cores of the "rope", so-called, were insulated and clothed with patented india-rubber-coated cotton by Robert Sievier's London Caoutchouc Company, of 36 King Street, City, at its mill in Tottenham in the north of London.

Contrary to popular belief the five-needle diamond-dial apparatus was *not* used on the Great Western Railway.

The instruments used were Cooke's "improved" *four-needle* telegraphs, which used a separate return wire so that signals could be made by converging two needles and by a single needle, making a total of twenty indications. The sixth wire was included as a "spare". The sending mechanism originally consisted of five of Cooke's rotating "butterfly" commutators, although these were later replaced with Wheatstone's permutating buttons or keys. On April 3, 1838 Cooke quoted his construction costs to the Great Western Railway: £165 per mile for the circuit; £30 for each station; £48 for terminal four-needle instruments, alarms and batteries; £54 for intermediate four-needle instruments with additional "current directors" or switches and £28 for portable two-needle instruments.

Originally the Great Western Railway telegraph had just two instrument stations, Paddington and West Drayton. By December 1839 intermediate instruments were inserted at Ealing and Hanwell stations and at the railway's depot at Bull's Bridge, which could be switched in and out of the line; the first step to creating a system. Sad to relate the railway company soon lost interest and the four-needle telegraphs were little used after February 1840.

I K Brunel's interest in the telegraph was also transient. Apart from insisting on the use of iron pipe to protect the circuits he left everything else to Cooke. This is quite unlike Brunel's usual detailed, and expensive, involvement in his works.

Robert Stephenson's next intervention was far more fruitful and effectively "made" Cooke & Wheatstone's telegraph in the eyes of railway capitalists...

The London & Blackwall Railway 1840

The *second* permanent line was constructed alongside of the short three-mile track of the London & Blackwall Railway. This came about through the influence of George Parker Bidder, the railway's engineer and partner of Robert Stephenson. Bidder was to become, without question, the most important advocate of and investor in electric telegraphy; a critical figure in its early development. The Blackwall telegraph opened on July 4, 1840, the circuit being constructed in six months, costing £2,338. This railway was rope-operated with each of the five original stations having a *single-needle* instrument connected to one *five-dial* instrument in the rope-engine house, so as to stop and start traction. The india-rubber insulated wires were again laid in iron tubes, partly on pillars and partly underground. The telegraph was used initially entirely for railway traffic control.

Although a very short line, only 3½ miles long, the London & Blackwall Railway was remarkably aggressive and innovative. It was to have many novel attributes. Authorised on July 1836 it adopted its own gauge, 5 feet rather than the common 4 feet 8½ inches, and its own mode of traction, cable-hauled carriages rather than steam locomotives. Most of it was made on a brick viaduct, from Minories, a road in Stepney, on the edge of the City of London, to the Brunswick steam packet wharf at Blackwall on the Thames river.

Morton Peto was one of three contractors responsible for the construction of the London & Blackwall Railway; he and his then partner, Thomas Grissell, built "the Blackwall end". As with Robert Stephenson and G P Bidder, Peto was to be deeply impressed with the effect of the telegraph on railways. He, too, became a vitally important investor in the new medium.

In 1837 the Blackwall company began a parliamentary battle to obtain powers to enter the City of London, succeeding in 1839, extending its rails from Minories, where it had its western engine house to work the cable, 600 yards to Fenchurch Street, where it erected its terminus in 1841, giving it eight stations in all, and doubling its passenger numbers. It was the only railway station permitted in the City for over twenty years.

As well as owning the steam wharf at Blackwall, which quickly became the main London passenger station for continental steamers, its directors contrived to create an integrated transport system: promoting the *London & Blackwall Steam Packet Company* independently of the railway to work its own excursion steamers along the Thames to Gravesend, and smaller vessels to collect passengers for the City from Greenwich. The combination of railway and steamer was condemned by Parliament as an abuse of powers, but the directors defied the lawmakers and kept the capital of each separate.

Francis Whishaw described their telegraph in his book, 'Railways of Great Britain and Ireland' of 1842:

"We must not omit to mention briefly the beautiful apparatus of Messrs Wheatstone and Cooke, by which instantaneous communication is effected between the terminal stations, or between any one station and any other on the line. Without this, one of the most splendid inventions of modern times, the working of the Blackwall Railway according to the present system would have been rendered rather hazardous."

"There are three persons employed at the terminal stations to work the electro-galvanic telegraph, each of whom attends nine hours a day, which time is separated by an interval of four hours, as it requires too much attention on the part of the manipulator to enable him to remain at it for nine hours consecutively. At the intermediate stations it is the duty of the policemen to attend to the signals, which are very easily understood and readily managed. There will be altogether about twenty miles of wire to work effectually the signals on this short railway."

There were thirty single-needle telegraph instruments working continuously from 8 o'clock in the morning until 10 o'clock at night on the Blackwall circuits. The dealer, Frederick Kerby, and his machinist brother-in-law, John Warner, of Spann's Buildings, St Pancras, appear to have supplied the instruments used by Cooke on the London & Blackwall Railway in 1840. These were the first single-needle telegraphs actually in service; the first, too, with vertical commutators or "drop handles", utilised in Cooke & Wheatstone's subsequent needle instruments, replacing Cooke's "butterfly" switches.

The circuit had fourteen insulated wires within the iron tube in 440 yard sections connected by junction boxes. The 'Railway Times' quoted Cooke in July 1841 describing the preparation of the circuits: "Each wire is separately covered with cotton and india-rubber solution, and the set of wires made into a rope, which is passed though a hot resinous varnish before being introduced into the tubes."

As it was found vulnerable to the intrusion of moisture a "Galvanic Rope" was kept to hand at Blackwall. This was a 440 yard electric cable, the first ever made, produced by the London Caoutchouc Company at its works in High Road, Tottenham, north London. It had fourteen wire cores insulated with india-rubber bound together in cotton webbing and 'water-proofed', wound on to a reel. When the line required repair the "Rope" was connected between two section junction boxes to maintain the circuit and the decayed wire replaced without any disruption to traffic. This was one of the many ingenious ideas of W F Cooke.

A code, one hundred common phrases represented by the movement of two or three deflections of each needle, printed on a wall-chart was quickly introduced during 1840 to enable railway company messages to be sent between the stations and to the rope-engine house; turning it into what the plain-speaking George Stephenson (Robert's father) called at the time a "talking machine". A second, parallel telegraph circuit just for "talking" was built by the partners for the Blackwall Railway in 1841. The unique 440 yard "Galvanic Rope" or cable on its portable reel became surplus to need and was lent to (or otherwise carried off by) Wheatstone for submarine telegraphic experiments.

Signalling the Railways

The successful traffic control of the London & Blackwall Railway immediately inspired several other short cable-worked lines, railway lines in long tunnels and single track lines to adopt Cooke & Wheatstone's electric telegraph for train management over limited distances, but not yet for public messages.

W F Cooke was particularly keen in this period to promote the use of the telegraph for safety and signalling on railways. He wrote the pamphlet *Telegraphic Railways* in 1842 recommending "block signalling" in which track, especially on single lines, was divided into blocks or sections into which only one train might enter, their movement in and out monitored electrically. He was the first to define, and to implement, a traffic management system for railways, providing for their efficient and safe operation.

The end of the first railway boom in 1841, brought about by tightening credit and world-wide foreign trade problems, had hindered the partners' prospects. Capital for the next four years was to be applied to finishing authorised railways rather than to new projects with an unknown future, hence Cooke's emphasis on utilitarian railway signalling.

The trains of the 20 mile single-track line of the Yarmouth & Norwich Railway were controlled by Cooke & Wheatstone's telegraph from May 1, 1844. This had a complex and unique arrangement using a large *five-dial* railway signal instrument with single-needles, similar to that on the Blackwall railway, at *each* of the five stations on the line, and a separate *two-needle* message circuit. Though effective, maintenance of such a complicated system with eight wires was excessive; so the five-dial instruments were soon replaced by single-needle telegraphs in series. The Yarmouth & Norwich was absorbed into the Eastern Counties Railway.

On the Edinburgh & Glasgow Railway in 1841 Cooke constructed a short line for train control from Queen

Street station, Glasgow, through a tunnel to the engine house at Cowlairs; the first in Scotland.

Cooke's earliest pipe-conduit-and-post method of conducting wire circuits was to be used on the Blackwall, Leeds & Manchester and Edinburgh & Glasgow railways, as well as on the original West Drayton circuit on the Great Western Railway.

Pursuing their foreign interests Cooke and Wheatstone obtained a patent in the United States on June 10, 1840 based upon their original English brevet. They then sold a half-share to three American citizens. George Peabody, the New York banker and philanthropist resident in London, was party to the negotiations.

So Many New Ideas
The Second Patent 1840
It the same year, 1840, they acquired their second English patent which introduced the *dial telegraph*; in which the letters of the alphabet were indicated on the edge of rotating disc, the rotation past an index being electrically dictated by a miniature "capstan" at a distant station. The first dial telegraph, designed by Wheatstone, had the disc driven by clockwork with an electrical escapement, and used the power of galvanic batteries to release the escapement. Another, by Cooke, was more compact; with the clockwork and an electrically-moderated escapement driving a pointer, pulses of electricity being generated by rotating the outer rim of the dial by means of an annular finger piece.

The patent of 1840 also included the first *type-printing telegraph*. This had steel type fixed at the tips of petals of a rotating brass daisy-wheel, struck by an "electric hammer" to print roman letters through carbon paper onto a moving paper tape.

The earliest arrangements of the electric telegraph were based on the railway company acquiring a licence of the patentees and commissioning the partners to build a line of wire at a rate per mile; requiring Cooke & Wheatstone to purchase materials in advance of full payment. Licences and the profit from construction were the principle sources of income. Regarding licences; the London & Blackwall were charged £100 a mile on four miles of line; the Edinburgh & Glasgow £100 a mile for a one mile circuit for a tunnel, and the Yarmouth & Norwich £110 a mile for 40 miles. The London & Croydon Railway resisted a demand for a £70 a mile licence; and the Manchester & Leeds rejected outright a licence payment, although both had the telegraph installed by Cooke.

In all of these negotiations on behalf of the patentees and the subsequent project management W F Cooke was the principal, he also engaged – independently of Wheatstone - to manage the construction of the works and purchase materials. Usage of the wire was at the discretion of the railway; until 1843 this did not include general public access.

Whilst Cooke was so active with managing and promoting the patents, with astonishing prescience on February 6, 1840 Wheatstone laid before the House of Commons' Select Committee on Railways his proposal for an underwater telegraph between England and France. This comprised a cable of seven conductors insulated with yarn saturated with tar and protected by iron wire. It was comprehensive; he presented the design of the cable, the cable-making machine, a profile of the sea-bed, depth soundings between Dover and Cap Griz Nez, the machinery for laying the cable and its installation in a barge. On August 28 and 29, 1844 Wheatstone was to be found laying an experimental submarine cable in Swansea Bay, South Wales. With his eye for business Cooke complained when Wheatstone would not patent these innovations.

On August 21, 1842 Wheatstone gained permission of the Waterloo Bridge Company to lay an india-rubber insulated single core wire along the parapet of their span across the Thames between the Strand and Lambeth. By September 1842, after reassuring the bridge company that he would make good any damage, he had laid a wire from his rooms at King's College along the parapet of Somerset House overlooking the river, which backed onto the College, over the parapet of Waterloo Bridge and up Walkers, Parker & Company's 150 foot Shot Tower at their lead works on Belvedere Road on the far bank of the Thames. The return circuit was, for the first time, "wireless", being zinc metal plates inserted on either bank of the river. Electric signals were regularly sent and flags raised on the Shot Tower to indicate reception.

At the end of June 1843 Wheatstone demonstrated this circuit and his latest dial telegraph that sent roman alphabet rather than code or cipher, to Prince Albert, the Queen's consort, on the occasion of the opening of a Royal Museum of Scientific Instruments at King's College, on the terrace of Somerset House.

The partners, despite their continual arguments, were granted a new patent in 1842 defining a simpler, much more economic telegraph system.

Cooke & Wheatstone's Telegraphic System
The Third patent 1842
In January 1843, Cooke renegotiated the agreement with the Great Western Railway, extending the line a further four miles to the more important Slough station. The four-needle telegraph instruments were replaced by a *two-needle* apparatus that used cipher; and the gas-pipe conduit was replaced by overhead suspension of just *two* wires secured to glazed pottery insulators pinned to the sides of tall poles. This arrangement of two-needle instruments and the overhead suspension of wires was to be "Cooke & Wheatstone's Telegraphic System" for the next fifteen years - protected by their patents of 1838 and 1842.

Cooke had experimented with twisted copper wire rope attached to poles on the Great Western line before settling on simple, inexpensive galvanized iron wire as the conductor. He had first used iron wire previously in the year 1843 when the telegraph was introduced into Ireland on the 1½ mile long Dalkey branch of the Dublin & Kingstown Railway. He became a member of the *Galvanized Iron Company*, which was formed by C W

Tupper to work H W Craufurd's patent of 1837 for coating iron and copper with zinc by hot dipping to prevent corrosion. This patent was a communication from the original inventor the French engineer, Stanislas Sorel. Although called "galvanized" it was not a galvanic or electrical process. The iron company's main product was thin galvanized plate for corrugating, wire was a subsidiary item.

Cooke reported in the press during 1843 that the gas-pipe conduit and rubber-coated copper wires had cost £287 per mile; compared with his new system of over-head-suspended iron wires and pottery insulators at £149 per mile, both net of contractor's profit and contingencies. Insulation was considerably improved.

Wheatstone, as an academic, did not wish to engage in the increasingly involved management of the patents; and he also, quite probably, wished to reduce his relationship with the argumentative Cooke. On April 12, 1843 he assigned his patent rights to Cooke, exchanging his share in any profits from licences and contracting for making the works for a one-off royalty on every mile of telegraph laid, on a sliding scale from £15 to £20. The royalty payments that he received under this agreement show the slow progress of the telegraph; in 1844 it was £444 and in 1845, when 175 new miles of line were completed, £2,775. However in this assignment he retained rights to use his latest dial instruments for circuits less than one mile in length; these were intended for domestic and other purposes.

Wheatstone also retained rights to sell licences in the continent of Europe, excepting Austria and Russia. In pursuit of this he commissioned F O Ward, a former medical student at King's College, to act as his agent abroad on January 21, 1846. Wheatstone was to have a royalty of £3 a mile on each mile that he facilitated. It was an abortive agreement; Ward remained in Britain and became well-known as a "sanitary agitator".

First Public Access

On May 16, 1843, the circuit between London and Slough on the Great Western Railway was opened for messages by Cooke & Wheatstone's agent, Thomas Home: this was Britain's first public telegraph service, albeit an exercise in generating publicity. Slough was convenient for the Royal residence at Windsor and the Queen's household and her government were soon patronising the electric telegraph in mutual, widely-reported, exchanges. There were eventually six electric telegraph stations on this early line on the Great Western Railway – Paddington, Ealing, Hanwell, Southall, West Drayton and Slough. The flat rate charge was 1s 0d for a message of any length between any station, delivery by messenger or cab was extra; there was also a 1s 0d entry fee for mere spectators at the "Telegraph Office," Paddington and at the "Telegraph Cottage," Slough, half-price for children and school parties. The offices were open between 9 o'clock in the morning until 8 o'clock in the evening.

In 1843 Thomas Home was aged 18.

As well as introducing the two-needle instrument for public telegraphy in 1843 Thomas Home also announced demonstrations of what he called '*Prof Wheatstone's electro-magnetic telegraph*' in the lengthened Great Western Railway circuits. Unlike the Cooke & Wheatstone two-needle instruments this indicated individual letters and numbers by turning a circular dial and used electricity produced by a rotating magneto device *without* batteries of cells! At the time it was used only to generate publicity; members of the public could send their own messages with this device by turning a hand-sized wheel to send pulses of electricity to move the disc of the dial telegraph.

The publicity attracted celebrity visitors, including, Home declared in 1845, HRH Prince Albert, the Emperor of Russia, the King and Prince William of Prussia, the Duke of Montpensier (son of the King of France), HRH the Duke of Cambridge (the Queen's uncle), the Duke of Wellington, the Prime Minister, Robert Peel, and the Persian Ambassador.

The Emperor Nicholas of Russia, when on a visit to Queen Victoria at Windsor, took the opportunity whilst passing through Paddington station on the Great Western Railway on June 3, 1844 to inspect the workings of the telegraph office. Fortuitously W F Cooke was present to explain the apparatus to his Imperial Majesty.

There survives a diary entry written by Gertrude Sullivan, a young lady in society, in 1844 describing the Telegraph Office at Paddington station. Miss Sullivan and her friends were conducted around by Charles Wheatstone, to whom she had been introduced at an evening party on March 18 at Mrs Maria Drummond's house at 18 Hyde Park Gardens. At the same party, as well as Wheatstone, Miss Sullivan had met Charles Babbage, the inventor of the "difference engine" or computer, and Michael Faraday, the brilliant physicist; such were Mrs Drummond's political, artistic and scientific connections!

April 30, 1844 - "Went with Mrs Drummond to see Wheatstone's electrical telegraph, which is the most wonderful thing I ever saw. It is perfect from the terminus of the Great Western as far as Slough, that is, eighteen miles; the wires being in some places underground in tubes, and in others high up in the air, which last, he says, is by far the best plan. We asked if the weather did not affect the wires, but he said not: a violent thunderstorm might ring a bell, but no more."

"We were taken into a small room, where were several wooden cases, containing different sorts of telegraphs."

"In one sort every word was spelt, and as each letter was placed in turn in a particular position, the machinery caused the electric fluid to run down the line, where it made the letter show itself at Slough, by what machinery he could not undertake to explain. After each word came a sign from Slough, signifying 'I understand,' coming certainly in less than one second from the end of the word."

"Another one is worked by figures which mean whole sentences, there being a book of reference for the purpose."

"Another prints the messages it brings, so that if no one attended to the bell, which they all ring to call attention when they are at work, the message would not be lost. This is effected by the electrical fluid causing a little hammer to strike the letter which presents itself, the letter which is raised hits some manifold writing paper (a new invention, black paper, which, if pressed, leaves an indelible black mark), by which means the impression is left on white paper beneath. This was the most ingenious of all, and apparently Mr. Wheatstone's favourite; he was very good-natured in explaining, but understands it so well himself that he cannot feel how little we know about it, and goes too fast for such ignorant folk to follow him in everything."

"Mrs Drummond told me he is wonderful for the rapidity with which he thinks and his power of invention; he invents so many things that he cannot put half his ideas into execution, but leaves them to be picked up and used by others, who get the credit of them."

Miss Sullivan's journal evidences that Thomas Home had working on the electric circuits between Paddington and Slough in 1844 Cooke & Wheatstone's two-needle telegraph, using a code or phrase book to speed transmission of regular messages, Wheatstone's dial telegraph indicating individual roman letters, and Wheatstone's modification of the dial telegraph to enable it to print roman type on a paper tape; the latter two instruments being for experimental or, more probably, for publicity-seeking purposes.

Thomas Home published the wholly reasonable anecdote that, by the telegraph, he accomplished the apparent paradox of sending a message in the year 1845, and receiving it in the year 1844. Directly after the clock had struck twelve on the night of December 31 he at Paddington signalled his brother at Slough that he wished him a happy new year; an answer was instantly returned, suggesting that the wish was premature, as the year had not yet arrived at Slough. It was to be several years before the telegraph was to enable uniform or mean time from east to west in the country.

Break Through!
The London & South-Western Railway 1844

The momentum for real expansion came at last in August, 1844 when W F Cooke negotiated with the Board of Admiralty for the erection of a long private line of electric telegraph between Whitehall in London and the naval headquarters at Portsmouth alongside of the London & South-Western Railway – replacing a redundant naval semaphore apparatus with Cooke & Wheatstone's new Telegraphic System of two-needle instruments and overhead wires. The Admiralty were to pay £1,200 per annum to use the circuit. As part of this deal he obtained rights for parallel wires for railway messages and for public messages which extended over the entire system of the London & South-Western company – in particular to the port city of Southampton, the gateway to the Mediterranean Sea and India. This, the first long-distance circuit in Britain, opened from Nine Elms, London through to Southampton and Gosport in February 1845, it cost in total £24,000. The contract was so substantial that, for the first time, Cooke employed a resident telegraph engineer, Owen Rowland.

The first trial of the Southampton "long line", just the first 72 miles, took place successfully between Nine Elms, the railway's London terminus, and Bishopstoke in Hampshire as the construction works were still in progress during the week of January 18, 1845. On January 31 Cooke travelled to Gosport to complete the two 88 mile two-wire circuits. At 10 o'clock in the evening he telegraphed the clerk at Nine Elms using the two-needle instruments. The clerk, unfortunately, had dozed off in front of the fire waiting for the first signal. To Cooke's relief the response eventually came back four minutes after ten.

On the following day, February 1, Wheatstone went to Nine Elms and began a series of experimental messages back and forth to Gosport with the two-needle apparatus, all of which were successful. He also took the opportunity to try his new "electro-magnetic" or dial telegraph, worked by a magneto, hence without batteries. This required only a single wire; with one dial instrument in circuit at Nine Elms a return was arranged by connecting two wires of the long line at Gosport. It too was successful.

It was intended that two of the four wires erected between London and Gosport (for Portsmouth) be used for Admiralty traffic and two for railway and for public messages, with a further two-wire public branch circuit to Southampton. The Admiralty was to purchase a pair of two-needle instruments and a pair of the new dial instruments for their ciphered work from Cooke & Wheatstone. The public long lines would be worked entirely by the two-needle telegraph.

Public access to this long line was to be limited for a great many years. Messages could only be sent between the railway's three terminal stations: Nine Elms in London, which was moved to Waterloo Bridge on July 11, 1848, closer to the heart of the metropolis, Southampton and Portsmouth, until well into the next decade.

Shortly after, on February 9, 1845 the newspapers' announced that "Mr Cooke is prepared to accept a challenge to lay down a telegraph line from London to Falmouth, Liverpool or Edinburgh, without any intermediate stages", using "the present system of insulation". This was premature. It took another four years to achieve something approaching that coverage and even then with frequent re-transmission of messages as insulation of the circuits continued to be a problem.

The installation on the London & South-Western Railway was not without competition. Alexander Bain also had a trial circuit laid from Nine Elms, alongside the tracks, eight miles, to Wimbledon in April 1844, intending to extend it to Portsmouth. He used two mechanical telegraphs with both an index dial and a printing mechanism, connected by a single copper wire insulated with asphalt. The apparatus was complex and required perfect synchronisation; it was not a success.

In February 1845 the Queen's Speech on the annual opening of Parliament was transmitted from Nine Elms in London to Portsmouth, at eighty-eight miles the longest circuit then possible in England. The speech contained 3,600 letters and took two hours to transmit, at the rate of 300 letters a minute.

Use of Wheatstone's new alphabet-indicating dial telegraph was continued experimentally in this long circuit on both the Admiralty and the public wires. There was to be a carefully-staged 'on-line' Telegraphic Chess event on April 10, 1845 to publicise the dial telegraph. The giants of chess, Howard Staunton and Hugh Alexander Kennedy, took on a team of six "amateur" players; the giants playing white in Gosport, the "amateurs", with black, at Vauxhall, 90 miles away. Staunton happened, coincidentally, to be chess correspondent of the 'Illustrated London News' – which gave lavish coverage to the exercise. The match lasted from 11.30am until 7pm, and after forty-three moves ended in a draw. Unfortunately it had to be undertaken on the two-needle apparatus; at this stage of development, without Wheatstone's immediate supervision, the dial instruments proved unreliable and were difficult to synchronise.

For those interested, the 'on-line' rematch two days later resulted in a victory for the "amateurs".

In May 1845 Cooke reported to the press that, under his management, the electric telegraph extended over the following routes:

1. London & South-Western Railway – for the government, from the Admiralty at Whitehall to Portsmouth, 90 miles
2. London & South-Western Railway – for commercial use, Nine Elms to Southampton, 77 miles
3. London & South-Western Railway – for commercial use, Southampton to Gosport, 21 miles
4. London & Dover (South Eastern Railway) - Tunbridge to Maidstone (single line), 15 miles
5. London & Croydon Railway (an *atmospheric* line), 9 miles
6. South Devon Railway – Exeter to Plymouth (in part an *atmospheric* line), 52 miles
7. London & Blackwall Railway (cable), 3 miles
8. Great Western Railway - London to Slough, 18 miles
9. Yarmouth & Norwich Railway (single line), 20 miles

Cooke also noted at this time circuits he had laid between April 1843 and December 1845 alongside parts of the Manchester & Leeds Railway, that company's Oldham branch, the Edinburgh & Glasgow Railway, the Dalkey branch (an *atmospheric* line) of the Dublin & Kingstown Railway in Ireland, the Northampton to Peterborough branch (single line) and the relaying of the very first line between Euston Square and Camden of the London & Birmingham (soon to become the London & North-Western) Railway. There were then about 250 miles of Cooke & Wheatstone's telegraph, granted on local licences of the patentees to the relevant railway company controlling the route. None were contiguous.

Cooke recorded that he had provided thirty-six patent telegraph instruments in this time.

The London & Croydon Railway which worked from the shared terminus at London Bridge 10 miles south to Croydon in Surrey, added a third track to the 7½ miles of its line from New Cross to Croydon for a "fast" service worked on the atmospheric principle. It opened partly on January 19, 1846 and completely on February 27, 1846 with 39 trains a day over the single railway track reaching up to 75 mph.

The stationary air pumping houses at Forest Hill, Norwood and Croydon were connected from the outset by Cooke & Wheatstone's two-needle electric telegraph to control the stopping and starting of the silent-running eight- and nine-carriage trains. The instruments operated successfully, without any complaint.

The Croydon's parallel third atmospheric line was closed on May 3, 1847 due to continued problems with maintenance of the pneumatic tube and converted to locomotive traction. The Croydon was later absorbed by the London, Brighton & South Coast Railway.

A further 300 miles of telegraph were planned to connect London, Birmingham, Liverpool, Manchester and Holyhead, the ferry port for Dublin, Ireland, alongside of the tracks of the newly amalgamated London & North-Western Railway and its allies.

As his part of their agreement Wheatstone had successfully negotiated concessions abroad, introducing their electric telegraph into France in 1842, Germany in 1843 and Belgium in 1845, all with circuits built alongside of railways.

The Railway Connection

On the South Devon Railway in the far west of the country, Cooke & Wheatstone, in the autumn of 1844, contracted to install the telegraph on its whole fifty-two mile length at £160 per mile, linking the passenger stations. This line, too, did not use locomotive engines but had fixed line-side 'atmospheric' or air pumps for traction. However by January 1848 atmospheric working was used on just twenty miles; the eight pump-engine houses initially, and to the detriment of atmospheric operation, did not have direct access to the telegraph, which was located in the ticket offices.

During January 1846 the Eastern Counties Railway commissioned Cooke to install the telegraph over its 186 miles of track and 55 stations. By mid-year 180 miles of telegraph line were completed, worked by sixty instruments. For a great many years this was the most intense use of the electric telegraph by a railway company, with more lines and instruments per mile of rail than any other. As well as for signalling it was used extensively for public messaging. This level of innovation is remarkable in that the Eastern Counties Railway was ridden with financial scandal from its beginning; teetering on bankruptcy for half-a-century.

The chairman of the Eastern Counties line was the legendary "Railway King", George Hudson. As will be revealed later, Hudson's advocacy of the telegraph in the railways he controlled was found to be self-serving and corrupt.

The contract for building the original Eastern Counties Railway line, and latterly many of its subsidiaries and branches, was let to Morton Peto. In 1846 he was already a great builder and was shortly to become one of the largest contractors for public works in Britain. By 1850 one-third of all the rails in England had been constructed by Peto, a figure of controversy in his financial affairs. However he was to be the saviour of the electric telegraph in the hard times to come, and was to be active in its development for many years, having first noticed its innovation when building the London & Blackwall Railway in 1838.

In July 1846 the telegraph on the Eastern Counties connected London with Norwich and Yarmouth, with Ipswich in the east of the country, and most of the railway's intermediate stations. It also had a circuit from Ely to Peterborough which opened a connection to Birmingham and Rugby, along the Peterborough branch of the London & North-Western Railway, anticipating the new telegraph to Liverpool. The wire on its branch to Blackwall allowed public messages to and from there for the first time; the London & Blackwall Railway Company's old circuit was still "for the use of the Company alone." It was the intention of the Eastern Counties' board to place the electric telegraph on all of its important branches.

The instruments on the Eastern Counties were worked by its station-masters except where business necessitated a dedicated clerk.

During September 1845 Cooke announced the extension of the telegraph over the entire system of the South Eastern Railway. For the first time the works over the 124 miles of its main line from London to Dover and all of its branches were undertaken by an independent contractor commissioned by the railway company, W T Henley, not by Cooke, and completed in July 1846. This was Cooke's last major contract as sole manager of the Cooke & Wheatstone patents. To continue with the expansion of telegraphy a large capital was needed.

As can be seen, *all* of the small number of lines of telegraph the partners' organised were alongside of railways, where the rights of way between centres of population were already under single ownership.

Of these lines, the long city-to-city circuit alongside of the London & South-Western Railway was the most vital, demonstrating to the public the importance of the electric telegraph. Of the others, most used the telegraph for traffic control, either for single line working or because they did not use locomotive engines at all and required signals to stop and start stationary engines. As noted, the Blackwall railway was worked by cable and the Croydon, South Devon and Dalkey lines used the so-called *atmospheric* system, the trains being drawn by a piston in a vacuum tube between the rails with large line-side air pumps (a process that George Stephenson acidly dubbed "a rope of air").

Table 1

Growth of the Railways 1800 -1850
Knight's Cyclopaedia 1851

Year	*Acts of Parliament*	*Miles Authorised*	*Miles Open*
By 1840	299	3,000	1,100
1841	19	14	
1842	22	67	
1843	24	91	
1844	48	797	
1845	120	2,888	
1846	270	4,790	
1847	184	1,668	
1848	83	300	
1849	85	c50	
1850	30	c50	
Total	*1,140*	*13,700*	*6,621*

Each line of railway required an authorising Act of the British Parliament, not just in establishing the concern but for every branch and alteration.

There had been a Little Mania for railway building in 1836 as well as the great speculative Mania throughout 1845 and 1846, which required the debating of 574 Acts of Parliament to create new railway companies.

Such public access to the electric telegraph as existed between 1841 and 1844 was confined to offices within a very limited number of railway stations, with no interconnecting or long-distance traffic or common tariff. Public use of the telegraph was, in fact, scarcely considered in that period.

The intimate connection between railway companies and the electric telegraph was established almost immediately the Cooke & Wheatstone patent was granted and continued for the next thirty years. The railway connection was for the most part invisible to the public and, perhaps surprisingly, also to the government. The owners of the telegraph line, whether Cooke & Wheatstone or their corporate successors, through this co-operation had the immense advantage of having to deal with one landholder, the railway company.

Not that this connection was straightforward: for by 1867 there were to be 476 different railway companies in the three kingdoms (the maximum achieved in Britain and Ireland), each company having been debated and authorised by Parliament, owning 14,247 miles of rails; frequently merging and floating-off subsidiaries.

The competitors to Cooke & Wheatstone that appeared once their patents expired had to find other ways to connect populations.

Unlike in the United States or in wilder parts of Europe there were no major cross-country telegraph lines. The telegraph in Britain was to follow the rails, the roads and, eventually, the canals to connect cities. Also unlike in the United States there were few 'point-to-point' telegraphic concerns – in Britain the overwhelming majority of the several enterprises that were soon to be created to develop domestic telegraphy were, or at least intended to be, 'national' in coverage.

Lines Abroad

On May 25, 1845 Cooke & Wheatstone opened the first electric telegraph line in the Netherlands along the initial nineteen kilometre section of the *Hollandsche IJzeren Spoorwegmaatschappij* (Holland Iron Railway Company) between Amsterdam and Haarlem. The two-wire overhead circuit was to use Wheatstone's dial telegraph, rather than the needle apparatus. It was operated in cooperation with Eduard Wenckebach, an Amsterdam instrument maker. On December 19, 1847 Wenckebach obtained a second concession, for a line between Amsterdam and Den Helder, but chose to use his own instruments. He was to become director of the Dutch government's *Rijkstelegraaf* in 1852.

The following is a description of the first Dutch telegraph circuit written by S F B Morse in his usual sour style on September 22, 1845, just after being rejected by the capitalists of London:

"Went to see the Telegraph which is established here between Amsterdam and Haarlem. The Amsterdam terminus is at the railway-depot, and used for the purposes of the road only. It has been established six weeks. It communicates a distance of only ten miles English. The system is Wheatstone's ratchet-wheel instrument, slightly modified from the instrument shown me at the Southampton terminus in London. A dial-plate, with the letters marked upon the outer edge, is turned to the desired point for each letter, and then stopped a moment to be recognized. After each word a period is shown, and after each message a cross +. I inquired how many letters could be shown in a minute; the answer was fifteen ordinarily, but they could give twenty-four in a minute. A single wire is used in this case; it is said to be iron. A battery of six cups was shown me, which required replenishing every few days. The cost, the conductor told me, was about twenty pounds sterling per mile. The posts are about three inches diameter, and not more than eight or nine feet high; they are planted along the railroad, not so high as the tops of the cars. The telegraph is not used at present for general purposes, but the Government has been petitioned to grant them the privilege, and it is expected to be granted. It is used exclusively for the service of the railroad. The wire is covered with silk, and of iron; so said the superintendent. It is larger than mine about No. 12."

Morse went on "The conductor told me that Mr Wheatstone was engaged upon an instrument which would *print* the letters, and that it would be ready in about two weeks. From what I could learn it might possibly print as fast as it now shows a letter; that is, ordinarily, about fifteen letters per minute, while mine ordinarily prints forty-five, and can print eighty..." In 1845 the American telegraph *scratched* dots and dashes on a paper tape, requiring transcription; Wheatstone's new receiver *printed* the roman alphabet in ink!

The Cooke & Wheatstone two-needle system was the initial public telegraph in Belgium. A patent, based on the partners' first English claims, had been obtained on October 28, 1840 with the assistance of Wheatstone's academic friend Adolphe Quetelet, the director of *l'Observatoire Royale* in Brussels. The partners, with Quetelet's assistance, eventually obtained a twenty-one year concession of the Belgian government on December 23, 1845 to erect and work a line of electric telegraph alongside of the government's Brussels to Antwerp railway. This was to be completed by their successors in the following year.

2.] THE ELECTRIC TELEGRAPH COMPANY

The Lords of Lightning

On September 3, 1845 a syndicate led by the Ricardo family of City merchants projected a joint-stock company to purchase all the patents Cooke and Wheatstone had obtained to date and to provide capital for their more effective working, particularly to gain an income from public messages through a national network of telegraph lines. This created *The Electric Telegraph Company* – the first joint-stock concern in the world intended to unite a country with a network of electric communications. It had a short life of just over twenty-five years. In that time it united electrically not just the entire country but also, with its corporate allies, reached the extremes of empire.

The first Board of Directors of the Electric Telegraph Company comprised John Lewis Ricardo, the chairman, Samson Ricardo, brother and business partner of J L Ricardo, William Fothergill Cooke, George Parker Bidder and Richard Till. These five were also the largest shareholders in the company, and were to stay in post for over ten years.

Lords of lightning we, by land or wave
The mystic agent serves us as our slave

Cooke had agreed, prior to the establishment of the Company, to finance the expansion of the telegraph by assigning the majority of his patent rights to J L Ricardo and G P Bidder. This assignment valued Ricardo's share at £60,000 and Bidder's at £55,000, in addition to Cooke's minority at £45,000. The three partners transferred all their rights in the patents to the Company by an indenture or contract dated August 5, 1846.

Regarding the directors; the firm of J & S Ricardo & Company of 11 Angel Court, Bank, were originally merchants in the Spanish trade, but in the 1840s and 1850s had become deeply engaged in financial and political affairs; investing in foreign stocks and railways. Richard Till, a lawyer, of Guildhall Buildings, City, had been Secretary of the London & Birmingham Railway and was to have a similar role in many of the railway concerns that G P Bidder had influence in.

Whilst W F Cooke had become a skilled user of the public press, the Company released very little information over and above its very modest legal requirements. After 1849 it resisted all enquiries by outsiders as to its business; such information as became available was through government returns (which it completed only sporadically), from its competitors and from its associates. The Company proved to be a remarkably secretive concern. So much so that when the government took over in 1868 the board of directors, apparently, ordered the destruction of all of its historic documents, records and files. This accounts in some way for this work.

Table 2

The Value of Cooke & Wheatstone's Business
According to W F Cooke in 1855

The business acquired by the Electric Telegraph Company consisted of twelve domestic and foreign patents, Cooke's telegraph contracting business, the existing contracts and the materials on hand for future works.

Paid by the Company		150,000
Less unrealised contract		8,600
	£	*141,400*
To Wheatstone		30,000
To Lancaster for Irish rights		5,217
To Materials and for other rights		10,117
To Cooke		
In Cash immediately		2,566
In Cash by future profits		48,000
In 1,820 shares each of £100, at £25 paid		45,500
	£	*141,400*

As can be seen Cooke received £50,000 and Wheatstone £30,000 in cash. Cooke's additional 1,820 shares could not be sold for several years and he was obligated to the Company to pay the balance of calls, £75 per share.

Wheatstone was paid £20,000 in commutation of his royalty rights and £10,000 for his share in the Scottish, Irish and Belgian patents.

The new Company adopted as its motto the curious Latin sentiment *Ne tentes, aut perfice* – which very loosely translates as "succeed or do not try". Indeed it tried, tried hard for twenty years; it succeeded and was well rewarded for that success.

Just at the moment of the Company's creation in September 1845 S F B Morse arrived in London from America, exactly as he had done in June 1838 on hearing of the success of Cooke & Wheatstone's first telegraph line. He was, näively, allowed to inspect the Paddington line and the long line to Portsmouth. Typically, he then approached one of the Electric's speculative competitors offering to sell them his apparatus. Also in that September Morse contrived to examine the line worked with Wheatstone's dial telegraph between Haarlem and Amsterdam in the Netherlands before going on to Paris to view the government circuits there. As in 1838 Morse recorded in his notes all the advances he had found in Europe regarding the far superior electro-magnets, the new overhead iron wires and the new ceramic insulators. Speeding back to New York by steamer, Morse cynically incorporated them all with Alfred Vail's ingenious if clumsy apparatus into a patent for what was to become the well-known *American telegraph* in April 1846 in his own name.

The Electric Telegraph Company was registered under the new Joint Stock Companies Registration and Regulation Act of 1844 on September 2, 1845. This may be said to be the date of its foundation. To enable it to negotiate with public authorities and to obtain wayleaves over private property it required powers from Parliament through Statutory Incorporation, by legislation, as with the railways.

The Electric Telegraph Company Bill was to pass through Parliamentary scrutiny with remarkably little difficulty. Despite the novelty of its objectives hardly anything was reported in the press on its progress. Its petition for the Bill was submitted on February 16, 1846 to Parliamentary Sub-Committee No 5 (many sub-committees were needed in that year to process the mass of railway legislation), and passed standing-orders. It had a second reading before the full House of Commons on March 2, 1846. Given the unusual nature of its proposed business a report was required, this was received on May 8, and the third and final reading of the Bill was heard in the Commons on May 13, 1846, and passed. It was signed by the Queen as the Electric Telegraph Company Act, 1846, on June 19, 1846.

Despite what has been said subsequently there was little opposition to the Bill in Parliament, none of which received publicity in the press at the time. This was unlike many of the railway bills that were fiercely contested throughout their passage, many of which also failed to meet Parliament's standing orders on organisation and legal form.

In accordance with its new Act, the first General Meeting of the proprietors of the Electric Telegraph Company was held at 345 Strand, London, at 4 o'clock on Tuesday, July 7, 1846.

The Electric Telegraph Company Act of 1846 authorised the considerable joint-stock capital of £600,000 in £100 shares (on which only one-quarter, £25 per share, was to be paid-up immediately) to buy out the patent rights of both Cooke and Wheatstone, to finance their exploitation and the construction of telegraph lines across the country, with, among other legal powers, the right to lay wire over public property, especially railways.

According to Robert Grimston, the Company's last chairman, at this time and for many years after there were just eight shareholders!

Jeffrey Kieve, author of 'The Electric Telegraph - A Social History', records that in 1846 the eight were:

G P Bidder	1,540 shares	£38,500
W F Cooke	1,160 shares	£29,000
J L Ricardo	728 shares	£18,200
Samson Ricardo	616 shares	£15,400

Thomas Boulton	224 shares	£5,600
Benjamin Hawes	100 shares	£2,500
Albert Ricardo	56 shares	£1,400
Frederick Ricardo	56 shares	£1,400
Total	4,480 shares	£112,000

Apart from the Ricardo family, Cooke and Bidder were Benjamin Hawes, Member of Parliament in the Liberal interest much interested in science and technology, the son of a London soap-boiler and brother-in-law to I K Brunel, and Thomas Boulton, a City stock-broker who underwrote the initial public offering.

Other early shareholders were Richard Till, a railway promoting associate of G P Bidder and the contractor Morton Peto, as well as Alexander Bain, the telegraph inventor, who possessed 150 shares, £3,750 paid-up value for around eighteen months from July 1847.

It is notable that the Company chose not to advertise its shares for sale in the press, as did virtually all of the other joint-stock promotions of this period. Shares were initially sold privately through the projectors, Ricardo and Bidder, or allocated as part of business transactions, as in the purchase of patents and other rights.

The Electric Telegraph Company's Act of Parliament had several clauses that set a precedent for working electric communication; its circuits had to be open for the sending and receiving messages by all persons alike, without favour or precedence, subject to a prior right of use for the service of the government, and subject to such charges and regulations as the Company might make. However, when challenged in the Courts for giving preference to messages for 'The Times' newspaper over those for the 'Morning Herald' in 1850 the Company rejoined successfully that 'The Times' paid more for securing the preference.

It had powers to purchase patents, not just those of Cooke and Wheatstone, which would otherwise have been illegal under the ancient Acts for preventing monopolies in trade. Unusually the Act allowed the Company to apply to the government to have the duration of its patents extended over the usual fourteen years. The Courts later rejected the Company's application to extend these monopoly rights.

The Act also indemnified the Company against the negligence and carelessness of its officers and employees in the transmission and receipt of public messages. This indemnity against the results of errors in messaging was periodically challenged in the Courts; to no avail. The Electric company and its competitors were careful in ensuring that all messages were sent on forms that spelt out their legal protection, and that they all offered insurance against loss – at extra cost.

Powers were given to protect the works from vandalism: "that if any person shall wilfully remove, destroy or damage any electric telegraph, or any wire, standard or apparatus, or other part of such telegraph shall be guilty of a misdemeanour." The exercise of powers of detention extended not just to the police but to company officials and employees, to railway company employees and to any passer-by called upon to assist these individuals. The legal interpretation of 'misdemeanour' led in January 1854 to three men being jailed for six months with hard-labour for cutting the wires at Wigan in Lancashire.

Table 3

The Telegraph and the Railways in 1846
Miles of Telegraph Line in Operation
Compiled by Henry Tuck for
The Railway Shareholder's Manual 1847

Company	*Miles*
South Eastern Railway	124
Great Western Railway	18
London & South Western Railway	94
Midland Railway	251
Eastern Counties Railway	169
York & North Midland Railway	106
Norfolk Railway	58
York & Newcastle Railway	103
London & Croydon Railway	10*
London & North Western Railway (Wolverton to Peterborough)	54*
London & Blackwall Railway	4*
Sheffield & Manchester Railway	3*
Preston & Wyre Railway	20*
South Devon Railway	15*
Eastern Union Railway	16*
North British Railway	2*
TOTAL	1,048

* The telegraph used for railway signalling only

The year 1846 was the first year of operation of the Electric Telegraph Company: only eight of the sixteen railway companies contracted offered public telegraphy and these in isolated local networks. There were as yet no circuits from London to the cities in the north or west of Britain, only to the south and east.

From its commencement it intended to be a national enterprise, connecting the major cities and towns of the country by electric telegraph. After absorbing the original line to Southampton, the first long circuit it constructed was north alongside of the London & North-Western Railway, which came to an agreement with the Company in the autumn of 1846, from London to the major manufacturing town of Birmingham, which was completed in mid-1847. This line was continued north to reach the industrial city of Manchester on November 14, 1847.

As with the partnership the Company's initial income was to be derived from granting licences for use of the patents and from erecting lines; however *in addition* it anticipated substantial revenues from working public telegraphs, sending and receiving messages nationwide. That was an anticipation only slowly fulfilled.

The "Railway of Thought"
The financial journalist, John Herapath observed on July 1, 1846 that "the electric telegraph... has been not

inappropriately termed 'the railway of thought'." He was right on several levels, not least in the initial connection between the spectacular growth of the iron way in Britain in the 1840s and the electro-magnetic nervous system that gradually paralleled it, allowing the transmission of ideas as much as of people and merchandise.

The Electric Telegraph Company took over the short, 19 mile isolated circuit between Paddington and Slough on the Great Western Railway - displacing Thomas Home, Cooke & Wheatstone's enthusiastic young agent. The line was not to be extended to Bristol for several years, but the Company retained the stations at Paddington in London and at Slough as an "exhibition" where the instruments were explained to visitors between 9 o'clock and 5 o'clock daily; including games of chess and draughts played by telegraph between the two points. Whilst the line was isolated from its network Charles Wheatstone, Frederick Bakewell and others were allowed by the Company to use its closed circuits for electrical experiments and to demonstrate new instruments. Theodore de Chesnel was appointed licensee and manager in Thomas Home's place. The "exhibition" was still open in 1849. De Chesnel became the Company's District Superintendent for the north-east of England and Scotland in 1853.

Another breakthrough had been announced on January 19, 1846 at the general meeting of the proprietors of the Midland Railway Company in Derby. The chairman, George Hudson, said that, after a "useful" trial on their long tunnel at Claycross, the whole 250 miles of the company's network would be provided with the telegraph. This was the Electric company's first large contract for works.

Hudson was to be influential in having the telegraph installed on most of the railways with which he was involved: the Eastern Counties, the York & North Midland, the York & Newcastle, as well as the Midland. It became clear in the scandals that broke about Hudson in the late 1840s that he had benefited personally from the relationship with the telegraph company, to the considerable disadvantage of railway shareholders.

The latter half of year 1846 was, however, a busy one, additional telegraph lines were rapidly being created: the long circuit alongside of the rails between Rugby and Leeds, 122 miles, was opened on July 1 by wayleave of the Midland Counties and North Midland Railways, as was that between Gateshead and Darlington on July 17, on the Newcastle & Darlington Junction Railway. On August 20 the Hull & Selby Railway agreed to lay the telegraph between its two terminal towns and on its branch to Bridlington.

The annual reports in July and August of the York & North Midland Railway noted that they had spent £10,000 to install the telegraph; that of the Midland Railway, £18,161 9s, and the Norwich & Brandon, £2,000 for similar purposes. Against these substantial sums, the London & Blackwall Railway had spent just £13 16s on repairs to its venerable system of four years longevity.

Whilst the midlands and the north-east of England quickly embraced the electric telegraph it was to be over a year before their systems were connected with the capital. Until then the circuits from the north stopped at Rugby, 76 miles from London.

On September 1, 1846 the South Eastern Railway opened every telegraph station on its lines from London to Dover, Folkestone, Ramsgate and Margate to public messages for the first time. It had spent by January 31, 1846 £17,820 on creating its own system, with a further £4,567 in the subsequent six months, independent of the Electric Telegraph Company.

On October 24, 1846, it was announced that a Central station would be opened at the "Company's depot" in the Strand, connected by underground cables to the railway termini in London. The first such connection was to be to the long line on the London & South Western Railway. In anticipation of this, a week later the Eastern Counties Railway revealed that it was to connect its telegraph circuit at the Shoreditch terminus in the City of London to both the Royal Exchange and Lloyd's insurance market, so allowing electric connection with Liverpool by a roundabout link. In a belated reaction to this the London & North-Western Railway announced on December 5 that it had agreed to connect London with Liverpool and Manchester by telegraph, and also Liverpool with Manchester. It, too, promised an additional underground wire from Euston Square to the Royal Exchange in the City. The electric line was then complete from Euston Square to Watford. It was to cost the railway £140 per mile to erect. Progress on this crucial link with the north was slow.

There was a degree of wishful thinking by the railways over their proposed City extensions; it was left to the Company to "network" the capital.

Public messages received at the new Electric Telegraph Office in the Strand in London were carried to the circuit instruments at the railway terminals by porter until the autumn of 1847 when wires were led from them to the central hub. It was only then that all of the lines, new and old, could connect electrically.

The first six months also saw several incidents that opened the eyes of the public to the value of the electric telegraph. These included a visit of His Highness Ibrahim Pasha, the legendary regent to his elderly father, the Viceroy of Egypt, to the London & South-Western Railway's telegraph office at Nine Elms on June 16, 1846, whilst on a state tour of Britain. His Highness stayed an hour and sent questions by telegraph to Gosport and Portsmouth which were instantly answered. A solicitor in Southampton was enabled to send testimony by telegraph to his client's advocate, Mr Serjeant Smith, before one of the Commissioners of Bankruptcy in London in May 16, 1846. Mr Smith noted that he had posed questions and had been answered in seventeen minutes. The suspension of payments by the Leeds Commercial Bank was reported in Birmingham by telegraph, just fifteen minutes after it closed its doors at twelve noon on August 10, 1846, saving banks there embarrassment and money.

On August 21, 1846 the horse racing results from the York meeting were reported by electric telegraph for the first time in 'The Times' newspaper. The message had to be carried to London from Rugby by train as there was no telegraph yet south of that station on the London & North Western Railway. The race meeting at Doncaster was similarly reported on September 18.

A correspondent in the 'Railway Journal' of August 22, 1846, wrote, "I cannot help here noticing a very useful contrivance on the [Birmingham &] Derby Junction Railway by the engineer, Mr W H Barlow, of testing the velocity of trains. He has placed the electro-telegraph poles at the distance of 352 feet apart, by which one may get the velocity in miles per hour by doubling the number of posts passed by in a minute". Barlow was assisted in this and his other experiments by the Company's local superintendent, R S Culley.

On a criminal level, the electric telegraph apparatus at New Cross railway station in the Old Kent Road was stolen on August 18, 1846. The newspapers indicated, on the other side of the coin, that the police had immediately adopted the telegraph to intercept fleeing miscreants, as well as more mundane evaders of fares on the railways. Vigilant parents were also reported in that year as ordering the interception of eloping couples before any further sinful transgressions occurred.

Coinciding with all this publicity Mr J M Maddox, sole lessee and manager of the Princess's Theatre, 73 Oxford Street, London, advertised his new production of "Love's Telegraph", starring the famous players, Madame Vestris and Charles Mathews, in July. [See the Appendix m for more details]

Premises

On its foundation in 1846 the Electric Telegraph Company had no operational model to follow. Its initial inclination was to have a large office central to the whole of London. In accord with this, by the summer of that year it had, in W F Cooke's name, leased a substantial house at 345 Strand – just vacated by the Candidate Life Assurance Company, which had previously been the home of the 'Courier' evening newspaper and of Hodsoll & Stirling's bank. This was the first *Electric Telegraph Office*. It was three windows broad, of four floors, and was located on the north side of the street, midway between Wellington Street and Catherine Street, almost opposite the new Waterloo Bridge. Cooke planned to connect 345 Strand to the lines emanating out from the railway termini, hence to the rest of the country. For the next three years this was to be W F Cooke's London residence, his principal or country home being at Elliott Hill, Blackheath.

For the first general meeting of the proprietors held at 345 Strand and initially advertised on June 20, 1846, John Kymer, Jnr, was appointed the company secretary *pro.tem*. Kymer, then age 35, having been styled in 1841 merely as a "clerk", whose father had failed successively as a broker, sugar refiner and coal-owner, the latter in 1845, did not last long in the position, or in business. He was back living with his retired parent in 1851 in Hampshire.

At the same time in the summer of 1846 the Company took a lease of a cooper's (barrel-maker's) yard at 22 Church Row, Limehouse, adjacent to the London & Blackwall Railway and the Thames river. This was to be its *Electric Telegraph Depot* for heavy stores, wire, poles and ironwork. It was initially under the superintendence of Philip Woodrow, but by the end of the year he had been replaced by Isaac Hitchett. The Depot was narrowly saved from destruction by fire on October 29, 1846 when the adjacent, very large cooperage of James Wilson Gordon & Company in Church Row was burnt down; the staff of the Blackwall Railway having quickly summoned the insurance companies' fire engines - one would like to believe, by telegraph...

As well as W F Cooke's rooms, 345 Strand accommodated the company secretary's office, the engineer's office, the directors' meeting or board room and a "shop" with a large plate-glass window for the telegraph office, with public and private doorways. There was also a model room to demonstrate the many instruments that then existed for telegraphy; including an acoustic or bell telegraph devised by Wheatstone, inventions by its own engineers and by other patentees, as well as instruments that printed both code and letters of the alphabet. Until 1847 there was little real public business as W F Cooke was concentrating on the negotiation of wayleaves and the construction of lines along the railways.

In July 1847, the Strand office was open to the public, admission being by ticket. Here there were displayed Cooke & Wheatstone's two-needle telegraph with drop handles and drawings of Bain's new chemical telegraph using punched tape, intended for "long messages and public news." Also on show was Bain's electric clock, an electric passenger counter for omnibuses and an electric door monitor to register traffic, among other instruments. Schemes afoot included a "fire telegraph" to connect the fire engine stations of London. On sale at 6d was the first edition of 'The Handbook to the Electric Telegraph', with fifteen engravings, which was to go through several reprints into the 1850s. Of greater importance was the promise of a new Central Telegraph Station, then under construction in the City of London, to be connected to all of the railway telegraph lines.

The Company's press coverage in 1847 anticipated individuals engaging in "conversations" on its premises, rather than, as it was to transpire, having all messages delivered to recipients. A "turn-round" time of three or four minutes was then thought possible for a "conversation" being held between people in its London and Manchester offices.

It also made clear that it was going to transmit public and commercial news from London to subscription rooms in the provinces, optimistically within five minutes of the news arriving in the capital!

That singular and ingenus elecktricle inwention

'Punch, or the London Charivari,'
June 13, 1846

Jeames de la Pluche, former footman, former railway speculator, now landlord of the 'Wheel of Fortune' public house, Mayfair, and his wife, Mary Hann, have managed to leave their 'blessid boy', Jeames Angelo de la Pluche, 6 months, on a shelf at the railway station at Gloucester

'My boy! my little boy!' says poor choking Mary Hann, when we got there. 'A parcel in a blue cloak?' says the man. 'Nobody claimed him here so we sent him back by the mail. An Irish nurse here gave him some supper, and he's at Paddington by this time, Yes,' says he, looking at the clock, 'he's been there these ten minutes.'

But seeing my poor wife's distracted hisstarricle state, this good naterd man says, 'I think, my dear, there's a way to ease your mind. We'll know in five minutes how he is.'

'Sir,' says she, 'don't make sport of me.'

'No, my dear, we'll TELEGRAPH him.'

And he began hopparating that singular and ingenus elecktricle inwention, which aniliates time, and carries intelligence in the twinkling of a peg-post.

'I'll ask, says he, 'for child marked GW273.'

Back comes the telegraph with the sign, 'All right.'

'Ask what he's doing, sir,' says my wife, quite amazed. Back comes the answer in a Jiffy - 'C.R.Y.I.N.G.'

This caused all the bystanders to laugh excep my pore Mary Hann, who pull'd a very sad face.

The good-naterd feller presently said, 'he'd have another trile;' and what d'ye think was the answer? I'm blest if it wasn't - 'P.A.P.'

He was eating pap! There's for you - there's a rogue for you - there's a March of Intaleck! Mary Hann smiled now for the fust time. 'He'll sleep now,' says she. And she sat down with a full hart.

From 'Jeames's Diary, or Sudden Wealth',
by William Makepeace Thackeray

On July 28, 1847 fifty-nine places were in telegraphic connection with London or "will be opened by the commencement of the year": Ramsgate, Margate, Deal, Dover, Folkestone, Canterbury, Maidstone, Tunbridge, Gosport, Southampton, Winchester, Dorchester, Bristol, Gloucester, Cheltenham, Peterborough, Yarmouth, Huntingdon, Hertford, Northampton, Coventry, Birmingham, Wolverhampton, Stafford, Chester, Liverpool, Manchester, Leicester, Derby, Nottingham, Lincoln, Chesterfield, Hull, Sheffield, Bradford, Wisbeach, Lowestoft, Cambridge, Chelmsford, Ipswich, Rotherham, Barnsley, Wakefield, Leeds, Halifax, Rochdale, York, Darlington, Newcastle, Berwick, Edinburgh, Glasgow, Scarborough, Bridlington, Stamford, Norwich, St Ives, Ware and Colchester. The station order is that given by the Company, apparently following railway lines. Gaps then existing in circuits as they were being built were covered by relaying messages by train to the next available telegraph.

By the end of 1847 the Company opened a fine S*ubscription News-room* opposite of its West End office, upstairs at 142 Strand, "a spacious and unusually superior first-floor, in the most central part of the Strand, consisting of four rooms (one of which was 24 feet by 20 feet), lighted with gas and having a fine entrance Hall". The premises had been built in 1838 as the 'New Turk's Head Coffee House & Hotel'. The building had a broad shop front at ground level, occupied by John Chapman, an impecunious publisher, with two wide doors at either side, and of five storeys. It was a full storey higher than the rest of the houses. In 1848 a separate *Clock Department* was also based at 142 Strand. It exhibited there electric 'master' clocks to Bain's patent, for sale to the public at £16 16s, with extra 'companion' dials, connected electrically, at £10 10s each.

The Strand, the main thoroughfare in the retail and residential West End, between the City, the heart of the financial and commercial district and Westminster, the centre of government, was called by Benjamin Disraeli at the time 'the first street in Europe'.

The Company also intended to manufacture instruments to Cooke & Wheatstone's patents, as well as Bain's electric clocks. The *Instrument Department* was located in two temporary workshops at 25½ Bouverie Street, Fleet Street, London, under the management of Nathaniel John Holmes, and functioned from 1846 until October 1849. To produce the clocks it used for a period Bain's original Electric Clock Manufactory in Edinburgh, Scotland.

On May 29, 1847, the Electric opened a public exhibition at the Royal Polytechnic Institution, 309 Regent Street, London, featuring its electric clocks, needle telegraph, printing and writing apparatus and alarms. The display ran for six months, entry was 1s 0d.

With the sole exception of the recently completed circuits on the South Eastern company (London to Dover, the seaport for France), an exception that was to have considerable consequences, the railway companies agreed to transfer their rights and leases with Cooke & Wheatstone to the new concern. Although the Company immediately advertised the lease of rights to third parties none were granted for public telegraphy.

The year turned out not a good one to launch a new concern. It was promoted in the middle of the great twelve-month *Railway Mania* in Britain that took hundreds of millions out of the economy for a massive burst of speculative investment, most of it found on credit. Like the house of cards falling, this was to be followed by a money panic in the City of London as common commercial credit dried-up; then by a food panic as the corn import trade was affected by the failure of credit and by the Europe-wide destruction of the potato crop through disease. All this was compounded by revolutionary unrest in France, Belgium and the German states in 1848, damaging continental trade. To cap it all the United States mounted an unprovoked invasion of Mexico disrupting Atlantic commerce with both countries. The five years between 1845 and 1850 were to be some of the most difficult for trade and business in the century, and it was to be so for the new Electric Telegraph Company.

In Britain the Chartist movement of 1838, that sought reforms to suffrage and the introduction of the ballot in elections, was revived during the Revolutionary Year of 1848 but, to the horror of Parliament, taken over by extremists that advocated military rebellion.

Large numbers of disgruntled individuals were marshalled in protest meetings during the Spring of 1848 and the government of the day felt the need to monitor and control their movement. To this end the Home Secretary, responsible for public order, applied the clause in the Electric Telegraph Company's Act that empowered the government to take over its network. On April 9, 1848 the entire telegraph system was closed to public traffic, only individuals authorised by the Home Secretary were allowed access. These proved to be the Lord Mayors and Chiefs of Police in the several towns where the Chartists were well organised. For one week the Mayors despatched daily intelligence and situation reports by electric telegraph to the Home Office. Sites where the Chartists might gather *en masse*, Clapham, Hampton, Harrow, Kingston, Watford and Wolverhampton, had new circuits added to allow for immediate reports to be sent. Although some demonstrations resulted in violence, order prevailed and control of the telegraph reverted to the Company after just one week. The Home Secretary was charged £500 for its use.

Chartism, is has been said, "flourished in hard times and faded in prosperity". Its original reformist aims of 1838 were, in any event, incorporated into law during the 1870s by peaceful political process.

In addition to these financial and international problems the Company faced challenges to its telegraph patent monopoly at the end of 1846. The first was an instrument devised by John Nott in Ireland and seized upon by Douglas Pitt Gamble, a preserver of food in cans for the navy, as a promotional vehicle. The second was that of George Little, who was backed by Alfred Brett, a wine and spirit merchant. Both were pursued through the courts by the Company, neither succeeded in displacing the Cooke & Wheatstone master patent or in acquiring capital.

But there was a slow recovery. The strength of the British economy was such that it survived the Railway Mania, the money and the food panics with relative ease; although the reliance in Ireland on the potato crop was devastating to its population and that island's economy. The emergence of Louis Napoleon in 1848 and the subsequent creation of the Second Empire in France in 1852 stabilised the rest of Europe and restored economic harmony. The American war on Mexico was as short as it was brutal and its immediate effects on trade were equally brief. This stabilisation was assisted by the economic impact of immense new gold imports into Europe from California and Australia.

The Channel Cable of 1847

It was announced on June 11, 1846 that the pioneer long line built for the Admiralty from London to Portsmouth was to be extended from the Royal Clarence Dockyard across the harbour to the Port Admiral's House on Watering Island, *underwater*! The engineer Charles Samuel West had a mile of submarine cable made in London; it had a single copper core insulated with india-rubber and protected by an outer covering of iron wire. On July 22 one half of this unique cable was experimentally submerged between HMS *Pique* and HMS *Blake* using their small boats, under the supervision of William John Hay, the Royal Navy's "chymist" or senior scientific officer. Using a portable galvanic detector of Hay's devising and five small Smee silver-zinc cells a perfect circuit was obtained. The boats then laid the whole cable between the dockyard and the Admiral's house in a quarter of an hour on November 28, 1846. It was still in successful operation during the 1860s.

Based on this success Charles West and his partner, Captain W J Taylor, obtained on January 9, 1847 permission from the Admiralty to lay telegraph cables from England to France and from Holyhead to Dublin. They followed this, with the support of the famous novelist Charles Dickens and the engineer Joseph Paxton, by obtaining authority from Paris to land a cable in France on April 9 in that year.

Even before they were in possession of all of these permissions West and Taylor approached the Electric Telegraph Company in December 1846 with an offer to construct and to lease them a four-core cable insulated with india-rubber, an intermediate cover of cotton cloth impregnated with shellac, protected with plaited iron wire, to extend from Dover in England to Calais in France. The offer was based on an annual lease of 15% on the value of the cable, £6,000, for twenty-one years. The Company would work the cable to the Calais shore, where the French *télégraphe aérien* would take the messages onward to Paris. West and the Company eventually came to agreement on October 7, 1847.

The Electric in agreeing these terms had to negotiate a wayleave of the South Eastern Railway who, of all the existing Cooke & Wheatstone licensees, had refused to surrender their line side circuits to the Company. The negotiations with the railway were prolonged; it looked at an alternative underground circuit and then at an overhead circuit along the London, Brighton & South Coast Railway to Folkestone. The telegraph company had over-extended its capital and prevaricated; another concern stepped in and acquired a monopoly concession of the French government. The opportunity to use tried and tested technology to create the first long underwater telegraph cable was lost.

Charles West, ever nerveless, approached the Imperial government in Paris on December 5, 1858 with a request to renew his permission to land telegraph cables in France. He was politely rejected.

Table 4

The Telegraph and the Railways in 1847
Miles of Telegraph Line in Operation
Compiled by *The Civil Engineer & Architect's Journal*
January 1848

1839 - Great Western		
	London to Slough	19 miles
1842 - London & Blackwall		5
1844 - Yarmouth & Norwich		20
1845 - London & South-Western		99
1845 - Eastern Counties		
	London to Colchester	51
	London to Cambridge	88
	Hertford branch	7
	Ely & Peterborough branch	29
	Thames Junction branch	3
1845 - South Eastern		
	London to Dover	88
	Ramsgate branch	30
	Margate branch	4
	Maidstone branch	10
1846	Tunbridge Wells branch	6
	Bricklayers' Arms branch	6
1847	Deal branch	9
1845 - Norfolk Railway		
	Norfolk to Brandon	38
1847	Lowestoft branch	10
	Dereham branch	13
1846 - Midland Counties		
	Rugby to Derby	49
	Birmingham to Derby	41
	Derby to Normanton	73
	Nottingham to Lincoln	41
	Sheffield branch	5
1846 - York & North Midland		23
	York to Scarborough branch	43
1846 - Hull & Selby		40
1846 - York & Newcastle		84
	Durham branch	2
	Sunderland branch	5
	Shields branch	8
	Richmond branch	9
1845 - Sheffield & Manchester		
	Summit Tunnel	2
1846 - South Devon		20
1845 - London, Brighton & South Coast		
	London to Croydon	8
1846 - Preston & Wyre		
	Preston to Fleetwood	20
1846 - Eastern Union		17
1846 - London & North-Western Railway		
	Wolverton to Peterborough	57
1847 - Midland		
	Syston to Peterborough	40
1847 - Leeds & Bradford		15
1847 - Manchester & Leeds		61
1847 - York & North Midland		
	Hull to Burlington	27
1847 – York, Newcastle & Berwick		60
1847 - South Devon extension		27
1847 - London & North-Western		
	London to Rugby	82 ½
	Rugby to Newton	111 ¾
	Liverpool to Manchester	31 ½
	Crewe to Chester	30 ¾
1847 - Southampton & Dorchester		60
1847 - Midland		
	Bristol to Birmingham	90 ¼
1847 - Edinburgh & Glasgow		46
TOTAL		1,765

Prior to 1845 less than 45 miles of electric telegraph had been constructed, in 1845, 500 miles were laid; in 1846, 600 miles and in 1847, 1,000 miles.

Survival

The Electric Telegraph Company's first five years were ones of negotiation and construction; making deals for access rights or wayleaves, building overhead lines, training and employing clerks, and opening stations, as well as promoting the new medium to the public. A great deal of money was expended in a short time; but revenues grew slowly. Only in 1849 when the skeleton of the national network was completed could the telegraph be said to be secure as a business.

By 1850 there was a new energy and a new confidence about that Britain in particular benefited from. It was from this year that the electric telegraph grew in manifold degrees.

W F Cooke was elected to the first board of directors of the Electric Telegraph Company and remained with it until the end. In the earliest years of the Company he was effectively the managing director and implemented its initial burst of negotiations and line-laying. But once it was perceived that the costs of this expansion were getting out-of-hand the board attempted to rein-in Cooke's enthusiasm; he resigned in a fit of pique in November 1849. However he had returned to the direction, but in a less involved role, by 1850.

The partnership between Cook and Wheatstone had always been fraught and so it is no surprise to record that Wheatstone continued his life at King's College, London, and played no part in its management. Although he was frequently consulted by the Company in its early years Wheatstone had no contractual arrangement. He was in litigation with Alexander Bain over the patent for the electric clock, with whom the Company had already come to an arrangement and made a director; Wheatstone felt that his own employment in such circumstances would be prejudicial.

Much more was to be heard of the professor and his electrical innovations in the next twenty years. It was through his continued input, inspiration and co-operation with others that the Company maintained a technical superiority, not just in Britain but worldwide.

The Company's Patents

The Cooke & Wheatstone patents applicable in Britain acquired by the Company, there were six in all, both joint and individual, not only covered the principle of the electric telegraph in the initial master patent (although in that they claimed "improvements" and not "invention") but also a large number of technical innovations. Their telegraph patents subsequent to 1838 included a range of double and single needle instruments, dial instruments, printing instruments, circuit 'bridges', the 'detector' for determining circuit breakage, overhead poles in wood and metal, overhead insulators, underground wires, lead sheathing and just about everything else required to create a comprehensive telegraphic system. By and large Wheatstone originated the 'electrical' elements, instruments and such like. W F Cooke devised the 'technical' elements, the methods for the making of the line and rationalised Wheatstone's apparatus into a commercial reality.

As well as the patents of Cooke and Wheatstone the Electric Telegraph Company, between 1846 and 1850, acquired an expensive suite of other telegraphic and electrical patents, pre-existing and new, that served to protect its commercial interests – that is, preventing others using them in alternate circuits. The 'relay' or 'repeater' of Edward Davy of 1838 essential for extending the length of the electrical circuit, the chemical telegraph of Alexander Bain of 1848 which 'wrote' a mark on treated paper, as well as several improved insulators for its poles, were purchased and used in its circuits, and oddities such as Charles Massi's "percolating battery" of 1847, which it did not even utilise.

By April 1848 the Company, in addition to Cooke & Wheatstone's two-needle apparatus, had installed the Bain writer on separate electrical circuits between London and Birmingham (112 miles) and Liverpool and Manchester (32 miles), and a direct Bain circuit was just about to be opened from London to Liverpool (226 miles). The Bain chemical writer was the British equivalent of the American telegraph, using a key to record marks on a distant moving strip of paper, and was used by the Company for volume traffic. These instruments used "Bain Code" of dots and dashes, which meant that its clerks had to learn three codes, double-needle, single-needle and Bain.

Among the other patents acquired from Alexander Bain was that for his *Electric Clock*, which the Company intended to manufacture and used at most of its principal stations for time-keeping and as a publicity tool. The spread of these remarkable timepieces was unfortunately limited by the disinterest of the Electric company in their manufacture and marketing after 1849. Bain later bought back the clock patent.

The Company's *Clock Department*, under John Kymer, was located at 142 Strand, where it had showrooms, with workshops, formerly Alexander Bain's, at 11 Hanover Street, Edinburgh. In 1848 manufacture was transferred to William Reid, the telegraph engineer, at 25 University Street, London.

Cooke & Wheatstone's patents applied fully only in England and Wales. Different patents applied in the two other kingdoms, Scotland and Ireland. This allowed the Edinburgh & Glasgow Railway (which was soon to become the North British Railway) to install Alexander Bain's instruments on Cooke & Wheatstone's line in 1845. It used Bain's so-called "I & V telegraph", a simple single-needle device. The Company acquired the wayleave along with Bain's other rights in 1846, immediately replacing his apparatus with Cooke & Wheatstone *two-needle* instruments.

In 1847 the Company sued the proprietors of and eventually acquired the rights to Nott & Gamble's widely-publicized telegraph, simply to suppress it; and bought Little's telegraph patent in 1850 with the same negative intent. It had also acquired Henry Highton's 'gold-leaf' telegraph and Henry Mapple's electric alarm in 1846 as part of its policy of excluding others from its market.

On the isolated circuits alongside of the South Devon Railway the Company installed W H Hatcher's patent double-index dial telegraph specifically for train control in 1847. Hatcher was the Company's first engineer and chief manager.

The Company's first *underground telegraph* circuit in London was laid late in 1847 beneath street footpaths to connect the Strand offices with the South-Western Railway's overhead wires at Nine Elms station.

It sought and obtained formal permission of the City Commissioners of Sewers to open up the footpaths and lay down underground wires on March 16, 1847, including a conduit to Lothbury in the City of London. In the same week the government instructed the Company to extend the wires from the Strand office to the Admiralty building in Whitehall, so that there would be direct communication with the naval dockyard at Portsmouth, from there rather than from Nine Elms.

The newspapers reported its laying during the first week of November 1847. It ran from the terminus of the London & South-Western Railway at Nine Elms, along the Wandsworth Road, across to Vauxhall Gardens, Kennington Lane, Kennington Road, Oakley Street, Waterloo Road, under the western foot path of Waterloo Bridge, up Wellington Street to the Company's principal station at 345 Strand. It was laid eighteen inches deep in three-inch diameter cast-iron pipes, coated inside and out with hot pitch. The pipes contained two half-inch diameter "leaden tubes", also tarred on the outside, each containing four copper wires covered with cotton and waterproofed with india-rubber. The leaden tubes, as originally patented by W F Cooke, were made in lengths of 100 and 250 yards; as each was joined together the eight circuits were tested with a battery and a "detector" or portable galvanometer.

The 'United Service Gazette' published a long illustrated article on the improved Admiralty telegraph on November 9, 1847. It mentioned that "The Admiralty instruments, which are four in number - one at Whitehall, another, in case of accident, at 345 Strand, a third at the Nine Elms terminus of the South-Western Railway, and the fourth at the Clarence Yard, Gosport, ranging over a distance of ninety-nine miles, is (sic) worked... by a 'generator' of twenty four pairs." The Admiralty two-needle telegraphs used a simple numeric code based on eight elements (0 to 5 and two symbols) rather than six (alpha-numeric composites and one symbol) that later became the rule. The piece noted that "The wire of the Admiralty telegraph, between London and Nine Elms, is buried in a tube, and it was only on Tuesday last that by aid of the detector a fault was discovered in the wire near the Victoria Theatre, and at once repaired."

A set of nine underground wires was also completed on November 19, 1847 in Liverpool from the Lime Street station of the London & North Western Railway to a new city centre office at Exchange Buildings. They, too, were laid in an iron tube; a set of branch circuits leading off to the docks for future use.

The 'Morning Advertiser' in London reported the development of the Electric Telegraph Company in Manchester. By August 12, 1847 they had taken temporary occupation of the Committee Room at the Exchange on the Ducie Street side, intending to move to permanent first floor offices with a 100 foot long subscription room in the Exchange on the Exchange Street side. J P Cox was then appointed "agent and superintendent" for Manchester. Use of the telegraph was to be confined to subscribers. On that day there was a single double-needle instrument in use, with a trough or battery of twenty-four plate cells beneath its table.

The report noted that the telegraph was then open only between the Exchange and the Victoria railway station of the Manchester & Leeds Railway. There were eighteen copper wires covered with cotton and coated with pitch or tar, enclosed in two lead sleeves and contained in iron "gas pipes" laid beneath the curb stones of the foot paths from the Victoria station by Hunt's Bank, across Cateaton Street, along Victoria Street, across Market Place to the Exchange Building. Only two wires were being used on August 12.

The opening of the telegraph throughout the Manchester & Leeds Railway was anticipated before September 3, 1847; it already being complete from the Victoria station to Rochdale, 11 miles distant, the main delay being construction of the circuits through the Summit Tunnel, before reaching Normanton, 51 miles, where it joined the North Midland Railway to reach Leeds. For this seven galvanised iron wires were being suspended overhead. Once this line was complete connection would be immediately made along the Midland Counties Railway from Normanton to Derby and to Rugby on the London & Birmingham Railway, and from Normanton to York and Newcastle-upon-Tyne by way of the York & North Midland Railway, which lines already had the telegraph installed and working. Work then in progress included a connection from Hunt's Bank along the Liverpool & Manchester Railway to Liverpool, expected within a week.

Rugby continued to be the southern terminal for "live" messages for a couple more months. They were, until the line was completed, forwarded by train to London.

The Manchester telegraph office already had on display a Bain electric clock.

The immensely important long line from the capital to Liverpool and Manchester along the London & North Western Railway, as the combined Grand Junction and London & Birmingham companies had now become, was finally completed on November 13, 1847. The separate railway-based telegraph systems in the midlands, north-east, east, south east and south west of England were, at last, connected through the London hub. The Electric Telegraph Company now possessed a national network - the first in the world.

In August 1847 the 'Kentish Herald' newspaper reported that "The Electric Telegraph Company are now making arrangements to communicate the true time, as observed daily at the Royal Observatory at Greenwich to every station on the various lines of railway where the Company has a telegraph station, and, of course, to all large towns throughout the kingdom. It is now the daily practice at Greenwich, at 1 pm, to indicate the true time by dropping a ball from the upper part of the Observatory, which being telegraphed to the Admiralty, and signalled to the shipping on the Thames, enables ships' chronometers to be adjusted. The Telegraph Company intend that the ball, immediately on being detached at the top of its fall, should strike a spring, which, connected with the various lines of electric wires of the Company, will instantly strike a bell at every station. This it is not only possible and practicable, but what in all probability, will be a matter of daily experience ere very long – that before the ball at the Greenwich Observatory shall have reached the ground of its fall, the electric bell at Manchester will have struck and been set ringing; so that we shall know it is 1 pm at Greenwich before the ball announcing that fact has finished falling a few feet."

Actually it was not until 1851 that the Company succeeded transmitting the exact time from Greenwich to its stations, although it was sending a simple time signal to keep uniform its own clocks daily from 1846.

As has already been said, with adequate capital assured the next four years saw a remarkable growth in connections and coverage, though not a comparable growth in dividends. The Company continued to use Wheatstone's two-needle telegraph, Cooke's overhead suspension system with its earthenware "barrel" insulators in all of its city-to-city circuits, and long-distance rights-of-way negotiated with the railway companies.

Overseas, the Electric Telegraph Company acquired of Cooke & Wheatstone their rights in Belgium for the 30 mile overhead four-wire line between the cities of Brussels, Mechelen and Antwerp alongside of the railway and opened the circuit on September 9, 1846 in their own name. It had telegraph offices in the centres of Brussels and Antwerp as well as at the railway stations along the route, all equipped with the two-needle apparatus. The message rate was one franc (equal to 10d) for twenty words. Traffic, as in England was low, confined to mercantile messages between the Brussels and Antwerp *bourses*. The Company was requested to construct a second line in 1847 to unite Brussels and Quiévrain, where the French telegraphs would connect, but declined to do so as it believed business would not sustain it. The concession was surrendered to the Belgian government on September 1, 1850 and the circuit incorporated into a state telegraph monopoly.

Two years of immense effort saw the construction of 2,000 miles of line connecting sixty major cities by November 1847: London, Manchester, Glasgow, Liverpool, Edinburgh, Leeds, Sheffield, Birmingham, Bristol, Newcastle, Hull, Wolverhampton, Wakefield, Derby, Leicester, Norwich, Nottingham, Portsmouth, Northampton, Bradford, Coventry, Dover, Canterbury, Halifax, Rochdale, Maidstone, Southampton, Gloucester, Cheltenham, Yarmouth, Cambridge, Colchester, Ipswich, York, Darlington, Margate, Stafford, Barnsley, Hertford, Ramsgate, Deal, Folkestone, Rotherham, Tunbridge, Winchester, Dorchester, Peterborough, Huntingdon, Chesterfield, Wisbeach, Lowestoft, Chelmsford, Berwick, Scarborough, Bridlington, Stamford and St Ives. Another thirty county towns were also provided; "all the chief seaports and seats of manufacture, and several watering places" were in circuit.

The Electric Telegraph Company's *national* public service was launched on September 1, 1847, although for this it was dependent on its still incomplete line from London to Rugby. The first advertisement listing its available stations and services, once this long awaited circuit was finished, appeared in 'The Times' on November 27, 1847.

Mr Maddox at the Princess's Theatre fortuitously announced a revival of the previous season's hit play, "Love's Telegraph", for the autumn of 1847.

Making News

The transmission of the Queen's Speech at the opening of Parliament to the country by telegraph became an annual event from 1846. The 'Shipping Gazette' of May 20, 1848, in distant Sydney, New South Wales, picked up a report from London:

"On Tuesday, (November 30, 1847) the electric telegraph was brought into active operation on a grand scale, for the purpose of transmitting the Queen's speech to the various large towns and cities throughout England and Scotland. An early copy of the Queen's speech specially granted for the purpose, was expressed from Westminster to the central station in the Strand, and at Euston-square, both of which places it reached by about a quarter past one. The manipulators at these stations, having touched the wires communicating with every telegraphic station throughout the kingdom, thereby sounding a bell at each, and giving the note of preparation, commenced throwing off in a continuous stream along the wires, successive sentences of the speech. This operation occupied from a quarter past one to a quarter to three, on the principal lines of telegraph, but considerably less than this - owing to the greater proficiency of the manipulators - on the Eastern Counties and South Western. It was completed to Southampton, where a steamer was in readiness to express the speech to the continent, in about an hour."

"During the two hours the speech was transmitted over 1,300 miles, to 60 central towns or stations, where one or more manipulators were occupied in deciphering the transmitted symbols. Immediately on its arrival at Liverpool, Birmingham, Rotherham, Wolverhampton, Leeds, Wakefield, Halifax, Hull, Rochdale, Gosport, Southampton, Dorchester, Gloucester, Leicester, Manchester, Nottingham, Derby, Lincoln, Sheffield, York, Newcastle, Norwich, Edinburgh, and Glasgow, the speech was printed and generally distributed, and the local papers published special editions."

"It was telegraphed at the rate of 65 letters in a minute, or at the rate of 430 words in an hour; several of the long words, such as 'embarrassments,' 'infringements' and 'manufacturing' taking longer time, no abbreviations being used, so that the 730 words (the exact number contained in the speech) were, including pauses and repetitions, disposed of in 120 minutes, or two hours. Owing to the old (Bain) telegraph between Edinburgh and Glasgow having just been taken down, so as to allow of the substitution of the new one, the intelligence had to be transmitted from Edinburgh to Glasgow by train, though by this medium the speech would reach Glasgow at four, or within two hours after its delivery in London."

"The last Queen's speech, being but half the length of the present one, was transmitted is half the time, reaching Norwich, 120 miles, in less than an hour."

During the previous year, in July 1846, the newspapers recorded the medical profession's first, and quite memorable, encounter with the electric telegraph: "a celebrated London physician was in communication with a Norwich physician, and through the agency of the electric wires, actually prescribing for a patient whose life was in danger". This took place over the lines on the Eastern Counties Railway and was to be just the start of a medical fascination with telegraphy, to the extent twenty years later of having private wires between doctors' residences and their hospitals.

In April 1848 the Electric Telegraph Company took a revolutionary decision and organised the first "agency" to collect and disseminate news by electrical means. This it called the "Intelligence Department", distributing information from London and overseas to subscribing newspapers, news-rooms and individuals in the provinces. Using its circuits at night when public traffic was negligible it became one of its most profitable operations, and one that was to be deeply resented by the envious press of the period. The Company also collected unofficial despatches from steamers arriving at Dover, Folkestone, Southampton and Hull, reporting the revolutions that were shaking many countries in Europe during that Spring and distributed them to the newspapers. In April 1848 it also circulated a "State of the Country" bulletin listing short comments from its provincial offices on any unrest in Britain.

There was a minor insurrection in the south of Ireland during the spring of 1848, in pale imitation of events on the Continent. Whilst it quickly fizzled out, the Electric Telegraph Company was subject to severe criticism for the apparently inflammatory and exaggerated nature of the initial news reports it gave of the violence, forwarded by sea from Dublin to Liverpool. It became clear that it had been fed false information both by the partisans of the insurrection and by one of its news distributing competitors in Liverpool. The latter, Willmer & Smith, further claimed that the Company's directors used the exaggerated news from Ireland to speculate in the Stock Market. Willmer & Smith were successfully sued for criminal libel by the Company, with the support of the government. Willmer & Smith owned part of a telegraph patent.

The 'Times' noted later the extreme nature of Wilmer & Smith's original message "that the [railway] station at Thurles had been burnt, and the rails had been torn up for miles, that the whole country behind was in total insurrection, and that some of the troops had gone over to the rebels. Within the day it was proved to be a hoax." The word "hoax" here being an understatement.

When the handful of insurrectionaries were placed on trial in Clonmel in Tipperary in front of a Special Commission in the autumn of 1848 the government in London instructed the Company to arrange despatches of its proceedings at least twice a day. John Pope Cox, its senior superintendant, was sent from the Manchester office to oversee the couriering of the despatches to the nearest telegraph on the English mainland.

The newspapers from the summer of 1848 *daily* carried articles subtitled "By Electric Telegraph", especially relayed from ports communicating with foreign parts.

On April 11, 1849 an evening banquet was held in Wakefield, Yorkshire, to honour the popular radical politician Richard Cobden. The event was of such political importance, with much speech-giving, that 'The Times' newspaper made special arrangements to cover it with the Electric Telegraph Company. The banquet finished just before 12 midnight, "the whole process of reporting, transcribing, telegraphing, re-transcribing, typesetting and printing, was accomplished in less than four hours after the words were spoken". Three columns of solid type, out of six on the broadsheet page, covered the event in the paper's April 12 edition which was on the streets at 3 am that day.

The results of the great horse racing meetings were being reported by telegraph; from Newcastle on June 23, 1848, from Doncaster on September 7, and even from the headquarters of thoroughbred racing at Newmarket on October 11 of that year. A "horse express" was employed in the latter event to carry the results from the winning post one-and-a-half miles to the electric telegraph at the railway station.

It was not all positive, the Birmingham Stock Exchange recorded on May 9, 1849, that "on receipt of the London Prices by telegraph at midday a depression amounting to a panic occurred with respect to some descriptions of stock". Shares in several locally-based railways were wiped out, at least temporarily. The news-making power of the telegraph was slowly becoming recognised.

Despite, or because of, the previous year's little insurrection, the Queen and Prince Albert made a state tour of Ireland in the late summer of 1849 visiting Dublin and Belfast. They returned by way of Scotland. On September 28, 1849, Her Majesty left for Osborne on the Isle of Wight, leaving Balmoral at 8 o'clock. The progress of the royal pair were noted along the Scottish Central Railway, the Edinburgh & Glasgow, the North British, on to the lines in the north east and the Birmingham & Derby, Birmingham & Gloucester, and Great Western railways, changing at Basingstoke to a five carriage train on the London & South-Western to arrive at the Royal Clarence Dockyard, Portsmouth, where the steam yacht *Fairy* carried the Queen and the Prince Consort to Osborne on September 29. All this is known because the course of the royal party was followed almost hourly in reports by telegraph in the London morning and evening newspapers. Expectations of the new medium were so high that the journalists complained that there was no telegraph yet on the Great Western Railway to report the royal train!

A National Network

On April 23, 1849, J Lewis Ricardo, the Electric company's chairman, was able to report that its telegraphs in the United Kingdom encompassed 150 towns from Glasgow in Scotland to Dorchester in south-west England, from Yarmouth on the east coast to Liverpool on the west coast. Its central office and five branch offices in London employed sixty people; each of its country offices employed from two to ten clerks, excluding messengers. There were, he said, 2,060 miles of line composed of 9,800 miles of iron wire and 61,800 poles. In London and other cities resin-insulated copper wires were laid 'invisibly' within iron pipes under the streets. The cost of a twenty-word message over its longest circuit, the 520 miles between London and Glasgow, was 14s 0d. On the heavily-used circuit between London and Liverpool a twenty-word message cost 8s 6d (i.e. 168d and 102d, at a time when the cost of delivering a Post Office letter was 1d). The Company had a minimum charge of 2s 6d. Its employees he categorised as officials, clerks, mechanics, battery-men and messengers.

Ricardo finished with an eloquent justification of the Company's oft-criticised tariff; revealing, too, its view on the custom it expected, primarily mercantile:

"The telegraphic system is designed for important and urgent messages, and could I violate the secrecy which I feel bound strictly to observe, I could show that not one despatch in a hundred has been forwarded which has not been worth many times the amount paid for it by the sender.

"A commercial house in Liverpool will scarcely grudge 8s 6d for a communication by which a necessary payment may be made, an important order given, or a profitable operation facilitated in London; and the message from Glasgow, which traverses a distance of 520 miles in an instant, to summon a son from the metropolis to the bedside of a dying parent is scarcely to be judged overpaid at a charge of 14s - considerably less that ½ d per mile.

"A long and expensive journey is prevented, or a necessary one hastened - a bill accepted or protested - a purchase effected or countermanded - an important witness is summoned - the arrival or loss of a ship is announced - an insurance is effected - advice is asked, or orders given - in fact, an endless variety of important announcements, questions, and replies pass daily through our numerous receiving houses, and, I can honestly aver, have for the most part effected, and have been acknowledged to have effected, an economy and convenience far beyond the 1d per mile of our tariff.

"An express message sent by porters or by cab from the city to the west end of town - say from this office to the House of Commons, a distance of four miles, will cost 2s 6d, and if the same message can be sent from Manchester to Liverpool, a distance of 30 miles, for the same sum, and in a shorter time, it cannot surely be deemed an extravagant demand."

It is illustrative of the Company's difficulties to follow how the longest circuit between London and Glasgow in Scotland was achieved. This necessitated alliances with *seven* separate railway companies, zigzagging across the length of the country. It followed the rails of the London & Birmingham company towards the *north-west* between those two cities, hence to the *north-east* by the Birmingham & Derby, by the North Midland from Derby to Leeds, by the York & North Midland from Leeds to York, by the York, Newcastle & Berwick to the border town of Berwick-on-Tweed, then due *north* into Scotland by the North British Railway from Berwick to Edinburgh and before going due *west* by the Edinburgh & Glasgow Railway.

During Friday, December 15, 1848 a violent storm crossed central Scotland from west to east. When it reached Edinburgh "a large portion of the poles and wires of the Electric Telegraph Company were brought down at the viaduct over the Almond, which occasioned the interruption of communication by telegraph to Glasgow". The overhead circuits were to prove particularly vulnerable to the weather, especially wind and snow, for a great many years to come.

The much shorter direct route north-west to Scotland was by way of the London & Birmingham and Grand Junction lines (consolidated then as the London & North-Western Railway), the North Union (running from the Grand Junction to Lancaster), the Lancaster & Carlisle and the Caledonian Railway from Carlisle to Glasgow; just four companies! But the Caledonian resisted the Electric's advances; its west coast wires never got beyond Carlisle.

It was the Electric Telegraph Company's enduring relationship with the London & North-Western Railway, the so-called *Euston Empire*, the largest railway company in terms of capital in the world for most of the nineteenth century, and the most profitable, which guaranteed its success. The railway company, a brutally effective concern, controlled from its head offices behind the huge roman arch it erected at Euston Square in London, almost from its creation, the routes from London to Birmingham, Liverpool and Manchester, and, through its allies, the main routes to Glasgow and Edinburgh in Scotland, and to Holyhead, the port for Ireland. As well as providing the telegraph's most profitable wayleaves the railway's tough, anti-competitive management style was to be imitated by the Electric company during its middle years.

However the connection with Euston Square was not as simple as it might seem; in 1846 and 1847 the machiavellian railway company had employed Edward Highton to develop new, patent-evading apparatus. It installed his instruments experimentally on its long single-track branch between Northampton and Peterborough, and on its Liverpool & Manchester, Leeds & Dewsbury and Manchester & Huddersfield subsidiaries, but it went no further with Highton or his theories. Once Cooke & Wheatstone's master patent expired in 1851 Highton was to go on to create the first competitor to the Electric company. The North-Western had also allowed John Nott to install his dial telegraph on its short branch between Northampton and Blisworth. But by 1850 the Might behind Euston Square had become the Electric's staunchest associate.

As an example of the earliest arrangements with the railways, the Company's contract with the York & North Midland Railway was reported as costing the railway £24,634 for 159 miles of line by 1848. The arrangement was rather loose; the lines had been erected at the railway's cost, except for two wires over its system set aside for the Electric's use. It was first posed that the lines would be worked at the telegraph company's expense and that the revenues would be divided once they got above a certain sum. There was no formal agreement on this as it was said to depend on the telegraphic arrangements made with the railways with which the Y&NM connected. The telegraphs at the smaller stations in 1848 were worked by the railway's clerks, at the larger by the telegraph company's clerks; the latter working the railway's messages without charge. The net result of this vagueness was confusion regarding the money received for commercial messages at the two sorts of station: some was paid to the railway's account, some to the Electric Telegraph Company's account and some was simply kept by the clerks. The railway's shareholders expressed indignation in 1848 at their Board's handling of the matter.

Shareholder anger was justified. A little later the peculiar state of the telegraph on the York & North Midland Railway was clarified. On October 27, 1849 it was established that of their 195¾ miles of railway line, 98¼ miles had been furnished with the telegraph at the cost of £24,634; and that the railway was committed to a total expenditure of £35,000 to complete the work; but "no account had yet been rendered by the Electric Telegraph Company of expenses or revenues." This was because the contract had been made personally in the name of the railway's chairman, George Hudson, acting as an intermediary, who billed the railway for that arbitrary sum. The true cost of their telegraph before Hudson's "cut" was kept from the shareholders.

In July 1849 it was revealed in 'Herepath's Railway Journal' that Hudson had been a substantial shareholder in the Electric Telegraph Company. To cover their embarrassment the remaining proprietors redeemed his shares with a £500 premium.

A more ordered, and more typical, arrangement was that with the Midland Railway, with a large mileage centred on Derby. This concern worked its own public telegraphs until December 4, 1847 when operation was transferred to the Electric Telegraph Company. The costs of maintenance after that were to be charged two-thirds to the railway, one-third to the telegraph company; and the receipts from commercial messages were to be divided one-quarter to the railway and three-quarters to the telegraph company, railway messages being free of charge. The telegraph company would find the clerks for their commercial stations and the railway company clerks for all other places it required.

The Board of Directors of the Midland Railway Company in August 1849 justified this arrangement not as a source of profit but as a means of preventing accidents. It also noted then that when worked by the railway the electric telegraph "was frequently getting out of order", but now they were worked by the Electric Telegraph Company, and "had all their own messages conveyed for nothing and half the proceeds from private individuals who made use of it."

The East Anglian Railways committed £4,000 to install the telegraph on their 67 miles of line on February 17, 1848, "because it would save more than that amount in the working plant... from the facility to forward carriages and trucks to where they were wanted... instead of keeping stock in hand..."

Public messages were in any case few; the Electric's income in the first quarter of 1848 was just £160, in the second £200, in the third £320, and in the final quarter, £400. Intelligence in bulk, 'news', was the principal traffic in the first five years, supplied to the public press, local news-rooms, stock markets, produce markets and commercial rooms.

Wyndham Harding, a statistician, recorded the limited technical performance of the Company's circuits in August 1848:

"The rapidity of communication with which a message is practically transmitted, appears from the following facts, kindly furnished to me by Mr Hatcher, the manager of the central establishment of the Electric Telegraph Company in Lothbury."

"The average number of words in the messages from London to the North are 198 [daily]. The average rate of spelling by the telegraph is 55 letters, or 10 words per minute. Average time, therefore, of transmitting each message, 20 minutes. The Queen's speech of 750 words, thus occupied in the transmission, 1 hour 15 minutes."

By November 1848 the Company had opened subscription news-rooms in Edinburgh, Manchester, Liverpool, Leeds, Glasgow, Hull and Newcastle, as well as London, "for mercantile and professional interests". News, market intelligence, parliamentary reports and weather reports were made available to individual subscribers paying 21s a year for entry. In addition to the latest news subscribers were accommodated with the comforts of leather sofas and coffee. By 1849 the subscription had doubled to 42s, permitting entry to all of the Company's news-rooms.

Subscription Tickets to the news-rooms were issued annually; curiously dated from Christmas Day. They were lithographed on white card, the colour of the ink changing each year to prevent misuse. They had the Company seal in wax on their face, along with the subscriber's name and the secretary's signature.

Regarding *private* intelligence, businesses could have the bankrupts' list, corn market, share market, Tattersall's (the off-course horse-racing gambling market) betting list, dissolution of partnerships, Bank of England or provincial bank returns, cattle or hay market prices, corn or sugar advances sent to them at individual rates from 2s 6d to 7s 6d a message, less if contracted for more than six months. Racing intelligence, shipping news, political intelligence, judgements of law cases, and notices of trial could also be forwarded by arrangement, on annual subscription.

There was great consolidation of resources in 1848; the original plan of having a single large station in the centre of London had proved a mistake. The premises in the Strand were let go and a house taken in the City, at 64 Moorgate Street, for the Company's administration, and a huge public office planned for its principle source of business - the financial and mercantile district of the City of London. The Company also disposed of the clock workshops in Edinburgh and moved its instrument factory in Bouverie Street to the depot and wharf at Church Row, Limehouse, during 1848. The instrument shop in Limehouse was retained until 1851, making and repairing electrical apparatus.

Founders' Court

After two years of existence the Company was able to complete an impressive, 'statement' head office with a prestige public hall in the City of London "within a few minutes walk of the Bank of England, Stock Exchange, Royal Exchange, Lloyd's (for shipping), the joint-stock and private banks, assurance offices, in the heart of business, and not far from the Corn Exchange, Commercial Rooms, Coal Exchange, and the seat of the Manchester warehouses and colonial produce warehouses." It was a building intended to portray its maturity in public perceptions. It was designed by Henry Arthur Hunt, of 8 York Road, Lambeth, a surveyor and architect much employed by Morton Peto, the railway contractor and soon-to-be director of the Company. The builders were Thomas Piper & Son, of 173 Bishopsgate

Street Without, City, who had made many public buildings in London.

So January 1, 1848 saw the opening of the company's *Central Telegraph Station* at Founders' Court in Lothbury opposite the Bank of England in the City of London, at which time it had 1,524 miles of line in use or under construction. Although tucked away up a narrow court-yard this was an imposing building, containing a large colonnaded public hall lit by a great central sky-light around which were two open galleries each divided into six instrument compartments. Having no conventional windows it was lit by gas, day-and-night, and had a basement warm air heating apparatus.

On January 8, 1848 is was announced that "The principal central station of the Electric Telegraph Company in Moorgate Street was opened to the public on Saturday, to all parts of England, except Devonshire. A vast number of messages were despatched to all quarters."

The 'Illustrated London News' described the grand new premises in its issue of January 22, 1848:

"The Central Station of the Electric Telegraph Company, at the end of Founders' Court, in Lothbury, is one of the best of the recent architectural adornments of the city of London. It exterior, though necessarily limited in width, is very bold in character and picturesque in detail; whilst the interior is remarkably elegant in arrangement and profuse in ornament. Many of our readers are thoroughly conversant with the narrow passage called Founders' Court, in Lothbury, in the rear of the Bank of England; but to those who are not called by business or pleasure, or both, into that region of gold, the centre of commercial London, it is necessary to mention that Founders' Court is not above thirteen feet wide, and therefore the architectures enrichments of the front of the Central Telegraph Station are of very simple character. A boldly-designed doorway – the keystone ornamented with a head, nicely sculptured – springing from rusticated work; above it a balcony, supported by trusses, having wreaths of flowers pendant upon them; two enriched Ionic pilasters, supporting an entablature, simply ornamented, but in excellent style, and carrying an arched pediment – and, in the space between them, a clock, on a plinth, having sunken panels, and supported at the sides by inverted trusses, - are the leading points of the architectural arrangements, and produce a very satisfactory effect. Above the clock, and depending at its sides, are fruits and flowers, in high relief, exceedingly well done. In a panel, at the upper part of the building, are the words 'Central Telegraph Station.'

"A flight of six steps leads to the interior of the edifice; and on entering the Hall the visitor is struck by its novel and beautiful effect. The space of ground occupied by the entire building (exclusive of subscribers' rooms) is about 70 feet by 38; and great praise is due to the architect for the skilful mode in which he has arranged his plans, so as to give a capacious Hall for the general business to be transacted in, and yet allow of space for the utmost freedom of access to the different rooms in which the electric correspondence is carried on. The greatest length of the building is from east to west, the shortest from north to south; and in plan the Hall, which is in the centre of the building, is nearly a square, being about 42 feet from east to west, and in the other direction extending the whole depth of the building, within the walls – that is 32 feet.

"At the east and west ends a screen of two stories crosses the hall, in the manner shown in our Engraving, the first storey being supported by columns of the Doric order, painted in imitation of porphyry, resting on plinths, in imitation gold-veined marble, carrying the proper entablature and frieze; and the upper storey by columns of the Corinthian order, the shafts painted in imitation of sienna marble, their capitals and bases of white. These stories form capacious galleries, having communication with the apartments in which are the Electric Telegraph Machines; and, to connect the two ends of the building, galleries, of nearly the width of the first intercolumniation from the wall, run along the northern and southern sides. These galleries are supported by trusses springing from the frieze of their respective stories. The trusses to the upper storey are very highly enriched, and of beautiful design; those to the lower of plainer though elegant outline. The blank walls, running from east to west, have pilasters corresponding in order to the pillars of the screens and painted like them; and, in the intercolumniations, are arches springing from small pilasters attached to the larger ones. On the south side s the entrance from Lothbury, and the door projects somewhat into the Hall, to allow room for the porter, while the gallery before-mentioned follows the projection as shown in our view. Immediately opposite the Lothbury entrance is a small doorway leading into the Subscribers' Rooms, and above the doorway is a dial clock. A continuous rail, of light and elegant design, runs along the lower galleries, and is also introduced in the spaces between the columns at either end, and from it spring branches for gas-lights. A railing of plain by close pattern also bounds the upper galleries.

"The glazed windows behind the counter separate and office, called the "translating office," from the body of the Hall. In this office all messages are transferred or translated into the abbreviated code arranged by the Company; but it is to be observed, that all such message as descriptions of persons suspected of dishonesty are not translated, but sent in full; only the lists of prices in corn, share, and other markets are so abbreviated.

"These windows separate from the body of the Hall offices for clerks, in communication with those employed at the machines above; and who have to receive messages through the sliding panes before noticed, and transmit them to their fellow clerks above stairs, by the aid of 'lifts,' or small trays working up and down, by means of cords, in square tubes. There is a 'lift' and a bell in connexion with every desk. The motive power to these lifts is given by the clerk at the desk above, who, on his alarum being touched, turns a winch, and elevates the tray in an instant. As there are separate 'lifts' to each desk, so, of course, there are separate tubes for each to work in. On the first storey the apartments, in which are the machines, are not nearly so lofty as the Corinthian pillars would seem at first sight to indicate them to be; in fact. This storey is divided into two, by a floor, which does not project so far forward as the series of archways, which both ornament the walls and allow ingress to the machine-room; and therefore a plain railing is carried along to make all secure. In our View, the second flooring, and the hand-rail, is shown in the archways behind the Corinthian columns.

"The roof of the Hall is very effective in its character, and as all the light the Hall receives is from this source, a large portion of it is glazed. In plan, the roof is crossed, transversely and longitudinally, by four large beams, so arranged as to leave a square space of about 27 feet wide in the centre, the other portions of the roof are ceiled with deeply moulded and ornamented panels, divided from each other by beams, having on their soffits enrichment of the Etruscan fret pattern. The square space before mentioned is not vacant, but is covered at the sides, and sub-divided into twenty-five deeply sunken panels, (each glazed with rough plate glass,) by beams crossing each other. The under sides of the beams are very richly decorated with a double *guillorbe* pattern running along them; at the intersections, are pendant ornaments. The sides of the panels are also embellished with minute ornament, and the whole of the details are beautifully worked out. The ceilings, to the lower galleries, have rich flowers in the centres of the panels.

"In the machine galleries the wires are carried along the ceilings from the respective machines to the battery chambers and the test box; the battery wires running east and west, and the 'house wires' to [the] test box, north and south. The desks and machines, which are of Cooke and Wheatstone's Patent, are all of polished mahogany, and are very beautifully fitted up; and there are eighteen desks, thus affording accommodation for thirty-six machines, in the six apartments devoted to them. All the wires are numbered at the desks, to correspond from batteries to machines, and from machines to the test box, that the electric circuit may be complete.

"The west side of the building is devoted to transaction of the business connected with the cities and towns on the North-Western lines, and also to the Great Western; whilst the eastern side is for the service of the Eastern, South-Eastern, and South-Western lines, and the Admiralty.

"Supposing a message is required to be sent to Liverpool, the sender goes to the counter on the west side and hands the message, written out, to one of the clerks there, who takes the money, and gives a receipt for it. The written paper is then passed to the translating office, where it is duly transferred into the code arranged by the Company. This done, the clerk touches the alarum, and puts the message on the 'lift' for Liverpool, which is immediately drawn up by the clerk at the machine, who instantly sets to work, and, in a few seconds, the message reaches its destination!

"Having said thus much about the structure erected for the purposes of the Company, we will descend into the basement of the building, and describe the apparatus by which communication is carried on, and for which there are large vaults well-lighted up with gas.

"The wires from the several railway termini are brought through iron pipes, laid down under the pavements of the streets; and, meeting in Founders' Court, are brought through the south wall of the basement of the station ...; and, descending into a long box, called the 'test box', are fastened into the back of the box. At the bottom of the test box run a corresponding number of wires, called the 'house wires', and these go to the machines in the galleries. Connection is maintained between the line and house wires by small wire running perpendicularly from one to the other. The 'house' wires are numbered from 1 to 81 consecutively, and the others according to the respective stations whence they come. Thus, the North-Western Railway Station, in Euston Square, has twenty-seven wires in connection with it; the North-Eastern and Eastern Counties, nine; the South-Eastern, nine; the South-Western, nine; and there are nine in connection with the Admiralty; besides eighteen in spare tubes, for any future period. The Great Western has no separate communication with the Central Station, as the telegraph lines only go as far as Slough; therefore, all messages are sent via the North-Western as far as the Kensington branch railway, then along that to the Great Western to Paddington, whence they proceed to Slough. All communications with Bristol are sent to Birmingham, and thence by Birmingham and Bristol line of telegraph.

"The reason why so many wires are laid from the Central Station to the railway termini is lest any of the wires become defective, when the connection can be carried on by other wires, as the expense of taking up the pavement would be enormous for so slight a cause. The test box is usually kept closed by shutters, and machines are kept handy to test and of the wires which may be signalled as weak.

"... one side of the Battery Chamber... is for the service of the North-Western line. ... the wires from the several machines enter the room, and are carried to the respective batteries. [There is] ...but one series of batteries on each shelf; but, in reality, they are arranged in pairs or nearly so; and some shelves contain five, others six and seven, batteries each. Should a battery become weakened by evaporation, the wires are instantly carried to other batteries. The batteries are the old-fashioned ones on Wollaston's principle, and contain 23 pairs of plates each, with intervening spaces being filled with sand, moistened with acid diluted with about 16 parts of water.

"The Subscribers' Room is a very handsome apartment, having a roof of similar open character to that of the Hall, though not of such extent, and the glass filling the panels is engraved on a dull ground. The enrichments are of different design, but very excellent style and execution. When complete, with its tables, chairs and other furniture, this room will have an exceedingly piquant character.

"There are offices for the Engineer and Superintendant in rooms above the machine rooms, on a level with the roof.

"The gas lights are on Faraday's principle of ventilation. The several clocks in the building are all Bain's electric clocks, as is the illuminated dial in the front of the building.

"The building is thoroughly warmed by hot air, but the ventilation of it is by no means on a good system, as the machine rooms and upper galleries are excessively hot and unpleasant.

"The whole arrangements relating to the batteries, wires and general working business of the Company are entrusted to Mr N Holmes; and it needs but a brief glance at the completeness with which everything is ordered, and the perfect system which reigns through every part of the building, to show how successful his arrangements are, and how worthy the highest possible praise.

"We must here observe that this Station of the Company is not publically opened yet, as the whole arrangements are not quiet complete; and that, though messages are sent through it, they are merely done so for the accommodation of the public.

"The building is from the designs of Mr H A Hunt, of Parliament Street, and, as we have before said, does infinite credit to his taste and skill; and we need but mention the name of Mr J Thomas of Lambeth, to whose care all the modelling and decorative enrichments were entrusted, and whose great facility of invention has been so conspicuously displayed in the New Palace of Westminster, to show that in *detail* the work is a felicitous as in *general* arrangement. The builders were Messrs Piper."

"The wires from the several railway termini having been carefully covered with cotton and insulating material, are enclosed in a leaden or other tube, all the interstices between which and the wires, are filled with some non-conducting substance. Thus protected, the wires are safe from the action of damp; but to secure the soft leaden tube from injury by pressure, when laid underground, it is enveloped in some insulating matter, and passed through pipes of iron, buried at a safe distance beneath the surface of the earth."

These wires were carried from the Central Station under Founders' Court alley and the streets to the four railway termini, to the Strand and to the Admiralty – at the railway the line wires emerged to become iron wires suspended from wooden poles.

The house and line wires were connected together at the so-called *test-box* in the basement through two rows of metallic pegs and moveable brass loops, enabling switching to be made between the sixty-six circuits. The current from each cell was about one volt.

As the anonymous journalist noted, the Central Telegraph Station then possessed thirty-six double-needle instruments in its upper galleries for all its circuits; each instrument had designated lines to serve. A simpler single-needle instrument was being introduced at this time on rural lines. In the attics of Founders' Court was a Bain chemical telegraph, the first so-called *fast* or *automatic* apparatus, for sending and recording bulk messages such as news, the main traffic in 1848-50, at high speed. This device was used on the busiest circuits to Liverpool and Manchester, and between the Founders' Court and the Strand offices in London.

A separate tour conducted by Nathaniel Holmes, the station manager, for the 'Athenaeum' magazine in the same year added the following information:

"Each apartment is provided with an electrical clock shewing true London railway time - which, as our readers know, is observed throughout the departments."

"On a level with the rooms in which the wires are received are several long and narrow chambers devoted to the batteries. Of these there are 108 - each battery consisting of 24 plates. Sand, moistened by sulphuric acid and water, is used as the exciting medium. The batteries thus charged are found to remain above a month in good working order."

"We were surprised on making inquiry to find that the charges are much more moderate than we were led to expect from statements in the public prints - which set forth that the transmission of a message cost £5. How exaggerated this is, will be seen by the following charges, taken from the books of the company: - For a message not exceeding twenty words - to Berwick 12s 0d; Birmingham 6s 6d; Bristol 13s 0d; Edinburgh 13s 0d; Gosport 6s 6d; Liverpool 8s 6d; Manchester 8s 6d; Glasgow 14s 0d; Southampton 5s 6d; Yarmouth 7s 0d. When it is borne in mind that the company have laid down 2,500 miles of wire, and have upwards of 1,000 men in their employ, it cannot be said that the above scale of charges is exorbitant. There are at present 57 clerks employed in the department of transmitting and receiving messages - independently of those occupied in printing communications for the newspapers. This department is exceedingly interesting. It is carried on in a long room communicating with the west gallery."

This department used the chemical telegraph which printed symbols: "The alphabet used is as follows:- A . - B . - . C ... D ..- E - and so on; finis being always represented by a long dash ----. Hieroglyphical as all this may appear, the characters are read with the greatest ease by the parties concerned in the operation. It is carried on with wonderful celerity - 1,000 letters being printed each minute at stations two hundred or more miles apart."

"We shall attempt to describe the process... A slip of paper about a quarter of an inch broad is punched with holes at distances corresponding to the dash lines shown above - these holes being the letters. Two cylinders - one, for example, in London, the other at Manchester - are connected in the usual manner by electricity. Supposing it be desired by a party in London to print a message at Manchester - the slip of paper is placed over the cylinder in London, and pressed upon it by means of a spring which plays in the middle. Thus, when those portions of the paper which present no holes appear, the contact is broken; where the holes are presented, contact is made; - and accordingly, the current of electricity will be conveyed or broken to the cylinder at Manchester precisely in the same ratio as it is received from the cylinder in London. Over the cylinder in Manchester is wound a sheet of paper dipped in a solution of prussiate of potash and sulphuric acid; which enables it to receive - and record by dark green lines - the strokes of electricity given out by making and breaking contact with the cylinder at London. There are various ingenious mechanical arrangements connected with the process: which is the invention of Mr Bain."

There were originally thirty-four galvanic batteries each either thirty-two inches or twenty inches long by five inches wide. The largest battery contained twenty-four Cruikshank cells; the smaller twelve cells. From four to six 'twenty-fours' were needed for the longest circuit from London to Edinburgh. By 1854 the number had grown to 300 much improved Daniell batteries, which offered a constant current, in a mix of sixes, twelves and twenty-fours.

One legacy of the Company's arrangements at Founders' Court with its open public hall and surrounding open apparatus spaces on the superior floors was that instrument rooms in large offices were always known as *Telegraph Galleries*.

The complex electrical arrangements in the Central Telegraph Station were created in 1847 and 1848 by the station manager, Nathaniel John Holmes, who also managed the Company's workshops, and of whom much more later...

The secretary's and accountant's offices of the Electric Telegraph Company were located from 1848 at 64 Moorgate Street; a very modest, plain mercantile house, part of a long block in a new City thoroughfare made up of offices and shops. It connected at the back with the Founders' Court public premises from its west side. The offices also provided the private entrance for subscribers to the City news-room. The Company retained this house for its management, accounting and engineering offices until 1859.

For some years from June 10, 1848, John Cuff, a hotel owner and wine merchant, occupied the ground floor of 64 Moorgate Street with his "Electric Telegraph Hall" refreshment and dining rooms, "Soups and joints always in readiness. Private room for dinner parties."

Lothbury 1850

In 1895, Frederick Ebenezer Baines, a clerk with the Electric Telegraph Company between 1848 and 1855, gave his somewhat unreliable recollections of the workings of the new Central Telegraph Station at Lothbury around the year 1850:

"The Electric Telegraph Company, in the middle of the forties, had built for themselves as a central telegraph station an elegant suite of offices in Founders' Court. The plan was that of public hall, open to the roof, sundry offices, and a boardroom beyond. Right and left of the public hall were three or four galleries, one over the other, for operative and administrative purposes. Only the eastern set were ever used for telegraphic work; the western set were occupied by the secretarial officers, or were left empty, so small was the beginning of a great thing."

"These galleries, one over the other, have given the name for nearly half a century to telegraph instrument rooms generally."

"The lowest gallery at Lothbury was styled the 'code-room'. In this room, arbitrary signals were supposed to be translated into the vernacular, but the idea of codes as a means of economising the use of wires was never adopted, except to a very limited extent, by the Electric Telegraph Company."

"Here is the old [instrument] gallery at Lothbury as it was in the beginning. A room perhaps 12 or 14 feet wide and 30 feet long, well lighted and with plenty of ventilation. In it are ten or a dozen persons. Two high benches jut out at right angles from the windows, the instruments upon them thus getting a good side light. On one is fixed a double-needle instrument working to Rugby and Derby, and to Normanton in Yorkshire. Behind it operates a printing wire to Manchester on the principle of Bain's chemical process. Opposite, on the other bench, a double-needle to Birmingham, Manchester and Liverpool. Behind it, a double-needle to the Admiralty, rarely used - never in my recollection - out of sight, out of mind, at both ends of the circuit."

"The observant reader will have seen that two pairs of needle-wires and a wire for the so-called printing - in all, five wires - before 1850, sufficed to meet the telegraphic requirements with London of the whole of the North of England and Scotland."

"Besides the four instruments mentioned, there were on a long table opposite the windows, and with the light falling full upon them, a double-needle circuit to Norwich, one to No 448, Strand (the only branch-office of the company in London), another to Southampton, and perhaps a fourth, fifth, and sixth to Waterloo, Paddington and Shoreditch. Such was the modest head telegraph-office of the country when our gracious Sovereign Lady Queen Victoria had been about ten years on her throne."

"In the gallery below the instrument room was set up the Intelligence Department. Over that branch of the service there ruled from 1846 to the close of the Telegraph Company's career in 1870 as kindly autocrat, Mr C V Boys. His must have been an arduous post. It was certainly a responsible one. To compose the 'morning express' (a summary of news for the provinces) before 7 am, to write an evening version at six o'clock, was well-nigh equal to the composition of two original discourses per diem. Then, between whiles, to keep his mind going, London produce, and coal and corn markets, the arrivals of cotton in the Mersey and of shipping in the Thames, were always to the fore; and in the evening, four times a week, six months out of twelve, an outline of the debates of Parliament had to be provided. However, he did it all, and did it well, for a quarter of a century."

"There were two great events each week-day, and two greater still twice a year, to quicken our pulses. At noon and four o'clock the mid-day and closing prices of the London Stock Exchange were sent, under the title of 'Funds.' To these reports all else gave way. No matter how many costly messages, prepaid at an average of 10 shillings or 12 shillings each, were waiting to go off, 'Funds' took priority of all."

"Twice a year we had the Queen's Speech, at the opening and closing of the Session [of Parliament]. That was the 'Derby' of [the Central Station]. The witchery has worn off now. But in double-needle days each station was agog to beat the others."

"'Look out for Queen's Speech' came from London, and in the country offices all was hushed excitement. The needles were newly-magnetized, pencils by the dozen newly sharpened, pad upon pad of blacks and flimsies prepared, and the best readers, the swiftest writers, told off for duty. Then came..: 'My Lords and Gentlemen...'"

Five minutes for all distances
During 1848 the Electric Telegraph Company reported that it had telegraphs completed alongside of the following railways:

- South Eastern Railway
- London & South-Western Railway
- Hull & Selby Railway
- Darlington & York Railway
- North Midland Railway
- Birmingham & Derby Railway
- Eastern Counties (and North-Eastern) Railway
- Eastern Union Railway
- Norfolk & Brandon Railway
- Wolverton to Peterborough and Stamford railway (of the London & North-Western)
- South Devon Railway
- Great Western Railway
- In progress on the London & North-Western Railway main lines

The South Eastern, South-Western, South Devon and Great Western arrangements were made by W F Cooke before 1846. It should be noted that with those exceptions the railway lines above were engineered by either Robert Stephenson or his business partner G P Bidder. Only parts of the various railway lines were wired at this time. Incidentally, alone amongst them, the South Eastern Railway worked its own *public* telegraphs in connection with the Electric company's circuits.

Lines in the north-east of England, an area of important mines and industry, were just being negotiated during 1848. That left very large areas to the west and north-west that had no prospect of telegraphy even in 1850, and so open to competition. With the exception of Plymouth, Exeter, Bath, Oxford, Chatham, Preston and Brighton, all towns over one hundred thousand in population were in circuit. The first four were all on the lines of the Great Western Railway and its associates.

Developing its first underground circuits of 1847 in London to connect all of its long-lines, a network of small, 3-inch diameter socket-ended cast-iron pipes for lead-sheathed, tar-insulated copper wires was laid by the Company in 1848 from Founders' Court, Lothbury, under the street footpaths. These led to a new telegraph station in the General Post Office in St Martin's-le-Grand and to the Company's new office at 448 Strand; to the London Bridge station of the South Eastern Railway; to the new Waterloo Bridge station of the London & South-Western railway which replaced its old terminal at Nine Elms; and under Hyde Park to Paddington, terminus of the Great Western Railway. A cheaper earthenware pipe was laid beneath the Park. In 1848 connection from Founders' Court to the vital, profit-generating circuits to Birmingham and the north of England was made through its subterranean Paddington cable, then by overhead wires along the Great Western Railway and the short West London Railway at Kensal Green on the western outskirts of the metropolis to join the rails of the London & North-Western Railway at Willesden Junction.

Freeman Roe, a well-known and large-scale plumbing engineer used to laying iron piping, of 69 Strand, contracted to lay all the subterranean cables in London.

The telegraph office at the immense premises of the General Post Office in London was installed at official request to give the department notice of the arrivals and departures of foreign and colonial mail on ships at the ports of Dover, Southampton, Liverpool and Falmouth, and to give orders to post-masters and other postal officials throughout the country. It was also open for public message business.

Expanding the underground network further in 1849 the Company laid another 3-inch pipe from Lothbury under the footpaths to the Shoreditch station of the Eastern Counties Railway for the city of Norwich and agricultural East Anglia. This, apparently, contained the first telegraph cable insulated with the newly-discovered resin *gutta-percha*. Later in the same year the underground iron conduits and resin-insulated wires were extended to the Euston Square terminus station of the London & North-Western Railway, and in 1850 to the temporary Kings Cross station at Maiden Lane of the newly-opened Great Northern Railway. This latter connection was eventually to give a new, shorter route to the north-east of England, although the railway was violently opposed by the North-Western company.

Another direct point-to-point two-needle circuit was added to its busiest lines between London, Birmingham and Manchester, completed in January 1849, in addition to its existing one and its Bain line.

The Electric's first "submarine" circuit was laid in early 1849 when it extended its line at Kingston-upon-Hull in the north of England. An india-rubber insulated cable, manufactured by the short-lived firm of Billings & Company for the pioneering cable engineer Charles

West, was laid through one of the docks, twenty feet beneath the water, connecting their new town office with the original circuit on the Hull & Selby Railway.

The Company found india-rubber short-lived as an insulator for its underground circuits. C V Walker, telegraph superintendant of the South Eastern Railway, had consulted the Company's W H Hatcher in regard to providing insulation for damp even wet locations and was recommended to J & T Forster, india-rubber and gutta-percha manufacturers, in the autumn of 1847. In response Thomas Forster proposed gutta-percha insulation and produced samples of covered wire for Walker, which he tested thoroughly underground for over a year and underwater in Folkestone Harbour for three months during 1847 and 1848. The railway adopted the cables for its long tunnels and for lines exposed to the dampest conditions. Forster patented his process and immediately sold the rights to the Electric Telegraph Company, who were to use his gutta-percha insulated copper wires on underground circuits in London, Glasgow and Newcastle from November 1848.

On January 9, 1849, the South Eastern Railway Company laid two miles of the Company's patent insulated cable into the waters of the English Channel from Folkestone as an experiment, with a definite view to a permanent electrical link to France. Messages were successfully sent from a steamer offshore to London Bridge, 73 miles under water and by the side of the rails. W H Hatcher, the Company's engineer, was there to observe.

The Company also sold the "Electric Telegraph Company's Wire", with a gutta-percha insulated thin copper core, to electrical and medical instrument–makers through its independent agent, George Trimbey, of 39 Queen Street, Cheapside, in the early 1850s.

J & T Forster's wire-covering process owned by the Company was not precise enough for reliable insulation and was quickly rendered obsolete by the patent of Charles Hancock worked by the Gutta-Percha Company whose cable cores were eventually to bind the continents of the world together.

On June 1, 1849 the Company, in an attempt to introduce the telegraph to the larger Irish railway companies, opened a short demonstration line with two-needle instruments in Dublin. This extended a mile or so from the Kingsbridge terminus to the suburb of Inchicore on the Great Southern & Western Railway. The financial situation was such that none could afford its licences. It was to be almost ten years before the Company achieved even a limited presence in Ireland.

As with the general economy, it was a difficult period for the Electric Telegraph Company between 1848 and 1850. It was making large investments in lines and property; it expanded quickly in London, too quickly. With receipts of just £100 per week it had to borrow money in the short-term from the railway contractor, Morton Peto, to complete its largest construction work, the Central Telegraph Station, as well as generally cutting costs and letting-go many of its newly-trained clerk-operators and mechanics during March 1848, said in the press to total 150 individuals, including its secretary and other senior officials and engineers, 5% of its workforce.

The Electric was compelled by its financial circumstances to reduce the number of its sub-contractors in 1848. William Reid, one of Wheatstone's instrument makers and an investor in the Company, had a maintenance contract for all of its lines. This was terminated and Reid sued for compensation. He was offered a compromise payment and accepted. Reid went on to become one of the largest telegraph contractors in the country, but he expressed ill-feeling over this 'betrayal' for the rest of his life.

The Company was, unsurprisingly, very quiet in the public press in 1848 and 1849. It released hardly any information and ran no advertising in London.

However, Joseph Soul, Secretary of the Orphan Working School of Haverstock Hill in London, informed the public press in November 1848 that his charity had placed six boys with the Electric Telegraph Company as learners and messengers. The School lodged a premium with the Company for each youth and monitored their treatment and progress until they reached age 21. These placements were initiated by the Electric's chairman, Lewis Ricardo.

Kieve's analysis of the Electric's shareholders' register notes that in 1849 Morton Peto held 175 shares (£4,375 paid) and the other great railway builder, Thomas Brassey 333 shares (£8,325). Robert Stephenson then possessed 175 shares. Joseph Paxton, the architect and engineer, also took an interest in that year. Peto became a director in December 1849. The shareholder population has risen in three years from eight to twenty-three.

By 1849 the Company possessed six public offices in London: - the Central Telegraph Station at Founders' Court, Lothbury; 14 Seymour Street, Euston Square (adjacent to the London & North-Western railway terminus); in the Eastern Counties' terminus, Shoreditch; in the South-Western terminus, Waterloo Bridge; in the Great Western terminus, Paddington, and at the Great Western's West End ticket office, 448 Strand. The company had by then disposed of both of its former premises in the Strand.

Its other principal offices were:

Birmingham	73 Canal Street
Cambridge	Railway Station
Colchester	Railway Station
Derby	Railway Station
Edinburgh	68 Princes Street
Glasgow	Exchange Square
Gloucester	Railway Station
Hull	Bowling Alley lane
Leeds	Commercial Buildings
Lincoln	Railway Station
Liverpool	Exchange Buildings
Manchester	The Arcade
Newcastle	Exchange
Norwich	Railway Station

Nottingham	Railway Station
Rugby	Railway Station
Sheffield	Railway Station
Southampton	Railway Station
Stamford	Railway Station
Yarmouth	Railway Station
York	Railway Station

According to the Company in 1849 "public messages could be transmitted in a few minutes, and answers obtained, to and from the following [208] places":

Acklington, Alne, Alnwick, Ambergate, Apperby, Ardleigh, Ashchurch, Attleborough, Audley End, Aycliffe, Ayton, Barking Road, Barnsley, Beeston, Belford, Belmont, Belper, Bentley, Berwick-on-Tweed, Beverley, Birmingham, Bishopstoke, Blackwall, Bradford, Braintree, Brandon, Brentwood, Bridlington, Brick Lane, Brockley Whins, Brockenhurst, Bromsgrove, Brough, Broxbourne, Burton-on-Trent, Calverley, Cambridge, Castleford, Chelmsford, Cheltenham, Chesterford, Chesterfield, Chittisham, Church Fenton, Clay Cross, Cockburnspath, Colchester, Colwick, Countess Thorpe, Cowton, Crewe, Croft, Darlington, Derby, Dereham, Dorchester, Duffield, Droitwich, Dunbar, Durham, Eastrea, Eckington, Edinburgh, Edmonton, Elsenham, Ely, Fence Houses, Ferry Hill, Flaxton, Gateshead, Glasgow, Gloucester, Gosport, Granton, Grantshouse, Haddington, Halifax, Harecastle, Hurling, Road, Harlow, Helpstone, Hertford, Hessle, Hull, Ilford, Ingatestone, Ipswich, Kegworth, Keighley, Kildwick, Kelveden, Kirkstall, Lakenheath, Leamside, Leeds, Leicester, Leith, Lesbury, Lincoln, Linlithgow, Linton, Liverpool, London, Longeaton, Longniddery, Longport, Long Stanton, Longton, Loughborough, Lowestoffe, Maldon, Malton, Manchester, Manea, Manningtree, March, Masbro', Melton, Mildenhall, Mile End, Milford, Morpeth, Newark, Newcastle, Newley, Newport, Normanton, Northallerton, Norton Bridge, Norwich, Nottingham, Oakinshaw, Oakington, Otterington, Peterborough, Ponders End, Poole, Portsmouth, Rillington, Raskelf, Resten, Richmond, Ringwood, Rochdale, Romford, Rotherham, Roydon, Royston, Rugby, Sawbridgeworth, Sawley, Scarborough, Selby, Sessay, Sheffield, Shelford, Shipley, Skipton, Slough, Southampton, South Shields, Spetchley, Stamford, Stanstead, Staveley, St Ives, Stoke on Trent, Stone, Stortford, Stratford, Stratford Road, Sunderland, Swinton, Syston, Tamworth, Thetford, Thirsk, Todmorden, Tottenham, Tranent, Trentham, Tring, Tweedmouth, Ullesthorpe, Uttoxeter, Wakefield, Waltham, Ware, Wareham, Washington, Waterbeach, Waterloo Station, Watford, Whitacre, Whittlesea, Whittlesford, Willington, Wimbourne, Winchburgh, Wingfield, Wisbeach, Witham, Wolverhampton, Wolverton, Woolwich, Worcester, Wymondham and York.

What is interesting about this list are those cities and towns yet to be put in circuit.

From May 1849 the Company loudly announced in the press that "the average time of transmission was five minutes for all distances". This was, of course, from station to station, and did not include delivery. It was, however, a great achievement, and more importantly, quite accurate.

The Electric tested Jacob Brett's patent type-printing instrument on its circuit along the Eastern Counties railway from Shoreditch in London to Norfolk in East Anglia during December 1849. In this the operator "plays on keys, each key being pressed down prints a capital letter on long, narrow strips of paper". The Company found the apparatus unreliable and took no further interest. However, the type-printer was to reappear three years later in the hands of a competitor.

The tipping point as far as the business was concerned had been reached, the Company had developed to such an extent that in 1850 it had a gross profit of £10,075 on revenues of £43,524.

In 1850 the Great Western Railway transferred the lease of the impressive corner site at 448 Strand, at Adelaide Street, in the area known as Charing Cross, designed by Royal architect, John Nash, to the telegraph company, which premises became its prestige West End office. It was notable for the two cupola-topped towers at the Charing Cross corner, known as the "pepper pots".

From January 27, 1850 a 24 hours a day service was commenced at the Charing Cross telegraph station. This had required additional wires in its underground cables to Lothbury.

It also took over one of the four stone lodges at the North-Western railway's terminus, firmly under the protection of the great arch at Euston Square.

On July 13, 1850 the Electric announced that its principal stations in London, at Founders' Court and in the Strand, would be open on Sundays. This was a little disingenuous as virtually all of its provincial offices, located at railway stations, were closed on the Sabbath. Also remaining closed were the telegraphs on the railways at Euston Square and Waterloo Bridge in London.

On August 14, 1850 the Company announced a 1s 0d for twenty words rate for messages between any of its seven stations in London; Lothbury, Euston Square, Shoreditch, Waterloo Bridge, Paddington, St Martin's-le-Grand, and 448 Strand.

The original long line of 1844 on the London & South-Western Railway was revealed on February 13, 1850, to be open for public traffic only between Waterloo Bridge in London and Southampton, not yet to any of the intermediate towns, such as Basingstoke.

Francis Whishaw, a civil engineer, and secretary of the prestigious Royal Society of Arts & Sciences in London from 1843 to 1845, and a manager for the Company between 1845 and 1848 wrote an account of the electric telegraph in November 1849 for the 'Artisan' magazine:

"The construction of the telegraphs, chiefly used in England, may be thus described: Along the sides of the various railways (for by this system it is wise to have the telegraph wires protected, as far as possible, by a constant supervision) wooden vertical posts of fir timber are ranged at convenient distances. Each post is furnished with an insulator of earthenware, through which the wires are drawn, to prevent their connexion with the wooden posts. The wires are of stout galvanized iron, which are carried from one end of the railway to the other, except in passing through tunnels, or under bridges. In such cases, the insulators are attached to the brickwork; and thus the wires are prevented from being in contact with the brickwork. Each post is furnished with a lightning conductor, and is also capped with a wooden roof, with dripping eaves to throw the rain water from the wires."

"At each end of the telegraphs, the line wire is connected with an earth battery, consisting of a large plate of zinc or copper, buried in the earth-the object of which is to avoid the necessity of a return wire, which in the first telegraphs in England was made use of."

"At the various stations, one or more of Cooke and Wheatstone's needle instruments are set up, being connected with the line wires and batteries by wires of smaller size, generally covered with silk or cotton, which is easily destroyed by the alterations of weather, and, therefore, is objectionable. Each telegraph on this plan has two wires. The batteries used are of the most simple form, consisting of a trough, divided into any number of cells, according to the power required. Alternate plates of zinc and copper are connected throughout the pile, which dip into sand, saturated with dilute sulphuric acid - the use of the sand being to prevent waste of the acid in the battery, when required to be sent from one station to another ready charged. The signals are given by means of the needles, placed in front of a dial, on which are written or engraved, the letters of the alphabet, being moved either to the right or to the left. Each needle in front of the dial is placed on the same axis as a magnetic needle behind the dial, which latter is suspended freely in a space, surrounded by a coil of wire, through which coil, when the current is transmitted either in one direction or the other, the needle is deflected either to the right hand or to the left, as may be desired; so that, by a certain number of movements of each needle, and by the combination of the movements of both, every letter of the alphabet, or any numeral, is given. As many as thirty letters, under ordinary circumstances, are thus transmitted in a minute; but by expert manipulators many more. Although the requisite movements are easily learned, yet it requires many weeks for a telegraphist to work the needle instrument sufficiently well to be entrusted with a communication of any value, whether for railway or commercial purposes; moreover, it is requisite that the two persons communicating with each other should be equally advanced in the required manipulations. Some of the boys employed by the Electric Telegraph Company, have acquired wonderful rapidity in the transmission of messages; while I have known many persons give up the occupation altogether, although having no other employment to resort to. In case of a telegraphist attending the needle instrument being suddenly disabled by illness or otherwise, great inconvenience must be experienced, by reason of no one being at hand to take his place; whereas by other instruments, as that of Siemen's, &c., which can be worked by man, woman, or child, at five minutes' notice, this inconvenience is done away with."

"The exposure of the wires to atmospheric influence, to storms of snow, as lately experienced on the South Eastern Railway, to the destructive effects of trains running off the way, and to the destruction of the wires by malicious persons (rewards for whose apprehension have frequently been offered), are all fatal objections to the present English system ever becoming universal."

"Moreover, the expense to railway companies and others is a sad drawback to the further extension of this system in Great Britain and Ireland - for the railways of which alone an extension of at least 2,000 miles is still required. The average charge for an electric telegraph, with two wires, as hitherto furnished to the various railway companies in England, may be stated at not less than £150 per mile; added to which an annual sum must be calculated on for keeping it in order, and reinstating, when necessary, the wooden posts, &c."

"The charge for transmission of communications by the Electric Telegraph Company's telegraphs in England is at the rate of one penny (1d) per mile for the first fifty miles, and one farthing (¼d) per mile for any distance beyond one hundred miles. The South Eastern Railway Company's charges for telegraphic communications are even higher than those of the Electric Telegraph Company. Thus twenty words, transmitted eighty-eight miles, is charged the large sum of 11s (132d); whereas the same length of communication for the distance of 100 miles is only charged 6s 3d (75d) by the Electric Telegraph Company."

The Company's retrenchment in the late 1840s, when it was borrowing money short-term to continue and was laying-off clerks, saw it abandon the manufacture of Bain's electric clocks. Bain bought the patents back and started his own clock business in 1852.

The Electric Telegraph Company went before the Judicial Committee of the Privy Council in London, then the highest legal authority in Britain, during 1851 in an unsuccessful attempt to extend the life of the initial Cooke & Wheatstone master patent that it owned and which was soon to expire. It did so on the grounds that there had not been adequate time to obtain a reasonable profit since it had acquired the rights. In the course of this process the books of the Company were made up and balanced from the introduction of the electric telegraph to 31st December, 1850:-

The receipts from railway companies for licences for the use of the company's patents were £122,285 13s 2d; the receipts from the erection of telegraphs for railways, £40,747 4s 2d, the receipts from maintenance and sundries, £7,301 13s 1d; totalling £170,334 10s 5d in income. From this were deducted charges, including law and parliamentary expenses, of £34,319 6s 7d leaving the sum of these capital entries at £136,015 3s 10d.

The Company charged their capital account with £33,603 10s 8d as the value of the thirty-four patents of all descriptions employed in their telegraphs. The book value of these patents was nominal as they had been bought with shares.

Regarding the working of its public telegraphs up to the end of December 1850; these earned, during the first five years, a total gross sum of £103,444 7s 11d with expenses amounting to £83,265 6s 11d showing a surplus of £20,179 1s 0d. Earnings only accumulated in the last three years of the period. This was the total net return upon a paid-up capital of £104,229 17s. 8d.

There had been no annual dividend paid on the Company's shares for the years 1846 and 1847, then for 1848 and 1849 it was just 2%; but after five years the corner had been turned for the business and two decades of real prosperity commenced.

In 1850 the Electric Telegraph Company declared that it possessed 2,225 miles of line, 13,906 miles of wire and 257 stations, constructed between June 1846 and May 29, 1850; carrying 64,734 messages. It then was using 482 two-needle and 86 single-needle instruments. Besides a dividend of 4 per cent on its paid-up capital of £300,000 in that year the company's shareholders, said to total just twenty-five individuals, received a handsome bonus of £15 per £100 share. The Company was to continue to award bonuses to its loyal proprietors, especially after the state imposed a dividend limit in 1863.

The Company's engineer, Edwin Clark, waxed lyrical at the celebration of the opening of Robert Stephenson's great Britannia Bridge for the Chester & Holyhead Railway across the Menai Straits, held at Bangor on August 27, 1851. In response to the toast "The Electric Telegraph Company" he declaimed:

"The electric telegraph is an appropriate toast. It is indeed the immediate child and offspring of railway enterprise, and another characteristic of the march of civilisation. While, on the one hand, our material wants are transmitted with the speed of a hurricane, a slender wire conveys our thoughts and our sympathies with a velocity equalled only by light itself – our doings this day might ere now have been recorded throughout the land; yea, even a simultaneous cheer might greet every toast from every city in the kingdom. Thus in our onward march time and space become more and more annihilated, and a goal is approached when even a few short years of life may rival an eternity. A just tribute of admiration has been paid to those enterprising men who have thus placed at your disposal such engines of social improvement. May the railway and the telegraph go hand-in-hand until the whole human race consists of one brotherhood, united in action as in mind!"

Liverpool had been connected by telegraph with Holyhead, the ferry port for Dublin in Ireland, by way of Chester, Conway and Bangor, since June 23, 1851, alongside of the new railway. The Electric company appointed W H Smith & Son, news agents and booksellers, 1 Eden Quay, Dublin, as its Agent to receive and forward Irish messages for England by steamer to Holyhead on July 22, 1851.

The ambitious news-agent William Henry Smith, who made his fortune from bookstalls on railway stations, appreciated the value of the electric telegraph. He became a large shareholder in the Company and was to join its Board of Directors. He also became a Member of Parliament.

The Patent Expires

When the Cooke & Wheatstone master patent expired, the Electric Telegraph Company in negotiations after 1851 had to amend its business model to create a mutual relationship with the railway connection. Henceforth each railway company granted a wayleave to the Company to lay wire alongside of its lines of rail for a nominal sum, or even free-of-charge, in return obtaining free use of parallel wires for its own use, that is, of course, other than for public messages, and to have those wires maintained.

It was stated in 1851 that the London & North-Western Railway had previously paid the Electric Telegraph Company £1,000 annually in licences and for its services in maintaining the wires. In addition its employees were instructed to allow the telegraph company access to its rails for repairing its circuits, even going so far as sending an extra engine, without charge, when there was not a regular train available; and they had to immediately report anything found to be out of order.

The new model allowed the Great Northern Railway to pay £5 a mile per year for its own long circuits, and £2 a mile for branches, on six months notice in May 1852. The Bristol & Exeter Railway was charged £6 per mile per annum for five years, with a £40 terminal commutation at the end of the contract. In the north-west, the Lancaster & Carlisle Railway paid the Electric £5 5s per mile a year after the newly-formed British Telegraph Company asked for £6. These charges were for wires for their own use.

The shareholders' meeting of February 13, 1851 revealed that the Electric possessed a total of 34 patents; the critical one being that of Cooke & Wheatstone obtained in 1836, the life of which they sought, unsuccessfully, to have extended.

In January 1851 the Company had £600,000 in capital subscribed for of which 50% was paid on 6,000 shares of £100. Going to Parliament once again for approval and authority in that year the original 6,000 shares were called-in and re-issued as two shares each of £25 all paid. Its borrowing power of £200,000 at that time was fixed at one third of the nominal capital with one half paid-up. These structural changes were intended to make the Company's stock more attractive to smaller investors as competitive concerns were just about to enter the London capital market.

Unlike its new competition, the Electric eschewed preference shares and other derivatives, and rarely, after its formative years, acquired bond debt.

On January 15, 1851, the Company opened a new line along the London, Brighton & South Coast Railway. It initially ran from the London Bridge terminus to Brighton station, but was extended shortly to the Royal York Hotel in the centre of the Channel resort.

When the Great Exhibition took place at the Crystal Palace in London's Hyde Park between May 1 and October 15, 1851 the Electric Telegraph Company was to demonstrate a system for communication with various parts of the exhibition building; exhibiting as well single-, double-needle and Bain instruments, batteries, bells, magneto-electric machines, methods of insulation, maps of telegraphs in operation, and maps showing the daily changes in the nation's weather. It arranged telegraph stations in the many galleries and at each of the entrances in connection with a main office at the south entrance, where a two-needle telegraph was in communication with all of the public offices in the country, and where it showed its instruments. The indoor circuits had a network of small single-needle telegraphs, used principally for summoning the carriages of visitors or for communicating information to the exhibition's adjacent police station, although capable of transmitting all manner of information.

On May 26, 1851 the Company announced its presence there in the press and revived its 1s 0d metropolitan message rate, valid then between the eight offices at the Great Exhibition Building, Hyde Park; Central Office, Founders' Court, Lothbury (behind the Bank); No 448 West Strand, Charing Cross; No 7 Lowndes Terrace, Knightsbridge (opposite Albert Gate); Entrance Lodge, Euston Railway Station; Waterloo Railway Station; Hall of the General Post Office, St Martin's-le-Grand; and Shoreditch Railway Station.

The Most Wonderful Thing

"We went to the Exhibition and had the electric telegraph show explained and demonstrated before us. It is the most wonderful thing and the boy who works it does so with the greatest of ease and rapidity. Messages were sent out to Manchester, Edinburgh, &c., and answers received in a few seconds – truly marvellous!"

Queen Victoria, Diary, July 9, 1851

The public circuit connected the Crystal Palace with the Company's Charing Cross telegraph office; a private wire was extended from there to the Office of the Commissioner of Police in Scotland Yard by special request, to handle "cases of disturbance or tumult requiring reinforcement of Police". A charge of £500 was made to the Police by the Company for use of the telegraph during the Great Exhibition.

The Electric Telegraph Company had a large display at the South Entrance of the Exhibition Building demonstrating the firm's investment in the industry. In pride of place were Cooke & Wheatstone's patent apparatus; the famous five-needle telegraph used at Euston Square in 1837, the first two-needle instrument, two common two-needle telegraphs, a single-needle telegraph, a portable single-needle telegraph and a detector or portable galvanometer. There were side stands showing eight different patterns of electro-magnetic alarm (bells) in several sizes; eight dial telegraphs ranging through the Wheatstone 1840 galvanic prototype to his latest magneto version, including his electric register or counting machine and Nott & Gamble's apparatus. There were three types of W H Hatcher's double-index dial telegraph receivers used on railways for train control; four type-printing telegraphs, by Wheatstone and by Barlow & Forster; two Bain chemical printers and tape punching accessories; two magneto-electric machines, one for bells and one for working the double-index dial; two induction machines for the double-index dial; and five galvanometers; as well as a set of pole insulators of four sorts.

The Queen was most impressed when she visited the Exhibition for the first time on July 9, one several visits she and her family made. The Company's display was the first Her Majesty called at, as it was by the entrance; the monarch was received democratically by Edwin Clark, the Company's engineer, and W H Hatcher, its former secretary, rather than by any of the directors, which suggests that the royal visit, like so many others, was impromptu. The Queen and Prince Albert had previously turned up unannounced at grim and grubby Wapping on July 26, 1843 to walk together through the newly-opened Thames Tunnel to Rotherhithe, but then there was just enough time to assemble some of the tunnel company's directors to "do the honours".

Ominously for the Company in the year that the patent expired there were fifteen other separate exhibits of telegraphic apparatus in the Great Exhibition; with W S Alexander, Thomas Allan, Frederick Bakewell, Alexander Bain, Jacob and John Watkins Brett, the British Electric Telegraph Company, George Edward Dering, Charles French, William Thomas Henley, Archibald McNair, Henry Mapple, William Reid, Charles Vincent Walker and Francis Whishaw in the British stands, and Siemens & Halske in the Prussian stands. Virtually all of these names are to reappear later in this work.

In 1851 the Company introduced for sale at its station at the Great Exhibition its *Franked Message Paper*, a prepaid message form on pink stock, which allowed twenty words to be sent to stations within a circuit of fifty miles for 1s 0d. It could be completed and handed in at any of its offices in London.

The Company provided the Royal Household at Buckingham Palace with a private circuit with two-needle instruments from Founders' Court in 1851; a confidential telegraph clerk was also recruited to accompany the Queen on her travels. The Commissioner of Police for the Metropolis of London, Sir Richard Mayne, immediately followed his sovereign's initiative with a private wire of his own: a confidential circuit from New Scotland Yard, Whitehall, to the Company's station at Charing Cross. A telegraph was installed at Osborne House on the Isle of Wight, the Queen's summer residence, in October 1852, necessitating a special submarine cable. It was to be an additional year before Parliament caught up with the Queen in electric communication.

The Company agreed terms with the Receiver of the Metropolitan Police, managing is financial affairs, leasing the line between the Commissioner's Office and

Charing Cross for £86 per annum for ten years, or £500 if taken for one year, commencing in May 1851.

In March 1852 the Receiver requested that the Company provide a cost for connecting Scotland Yard with its principle stations. However Commissioner Mayne declared in September 1852 that he had "no intention of recommending the proposal of the Company for a general communication to the Police Stations by the Telegraph and this single line of communication is of no use". It seems that the Commissioner had made little use of the Charing Cross circuit. The Company promptly disconnected it and demanded £500 for early termination of its agreement.

The relationship between the Company and Metropolitan Police subsequently appears cool. However message traffic between Scotland Yard and the county police, and probably between its police stations, on the public circuits continued, and Police Orders of August 12, 1852 advised that constables might use the telegraph to "send information of a fire" to the London Fire Engine Establishment, being careful not to do so for small fires or those outside of a radius of five or six miles from Scotland Yard. The costs were to be recovered from the insurance companies. Only in December 1859 was there a review of the need for telegraphic communication between some police station locations. This need was to be filled six years later by the Universal Private Telegraph Company.

Introducing his copying telegraph in 1851 Frederick Bakewell proposed that anyone might write a message on a 'page' of tinfoil with a common pen dipped in coloured varnish and send it to a telegraph station for transmission; a fair facsimile of the writing, or a drawing, being received at the distant station on electro-chemically sensitive paper. As well as avoiding the need for transcription, and intrusion of errors, by intervening clerks, it was capable of receiving "secret" messages on paper that could only be revealed chemically.

The Electric Telegraph Company had allowed Bakewell to use their short isolated line between Paddington and Slough to develop his first model of the copying telegraph in October 1848.

Bakewell's perfected apparatus, which used a small synchronous rotating drum and a longitudinally moving electrical 'feeler', was eventually worked experimentally on April 2, 1851 on the Company's newly-completed fifty-two mile circuit between Founders' Court and Brighton on the south coast of England, but it was not adopted for public use.

The copying telegraph was featured in a display at the Great Exhibition at the Crystal Palace. It was so well-received there that on October 20, 1851 Bakewell advertised in the 'Times' for support for a new telegraph company to work his apparatus, or "to introduce the system to existing lines". He modestly claimed that his machine would "supersede the Post Office" in the delivery of letters.

At the annual meeting of August 15, 1851, the directors reported that circuits on the Chester & Holyhead, London & Brighton, and Buckinghamshire Railway had opened in the previous six months. New works were in hand or were about to be commenced on the Great Western, Bristol & Exeter, Great Northern (over the whole system) and Manchester, Sheffield & Lincolnshire Railways, totalling 970 miles of new line. These were to be made under a new regime of rental rather than purchase by the railway; the Bristol & Exeter Railway, for example, paying £6 a mile.

The Company's capital account to June 30, 1851 had received £411,111 and expended £386,502. Revenue for the half-year was £25,529, expenditure £14,762.

A new era of competition was about open in 1851. With the finishing of the first competitive telegraph line in prospect, between Liverpool and Manchester, on January 1, 1852 the Company introduced a spoiling 1s 0d for twenty word rate from its two offices in Liverpool, at 33 Dale Street and Lime Street railway station, to its three offices in Manchester, at Ducie Buildings, Victoria railway station and London Road railway station.

Table 5

The Telegraph and the Railways in 1852

Miles of Telegraph Line in Operation

Compiled by C V Walker

Just before competitive concerns became fully operational the Electric Telegraph Company had these lines in circuit, according to an unofficial survey:

	Miles of Line	*Instruments*
Edinburgh & Glasgow Railway	80½	16
Edinburgh & Granton Railway	5½	8
North British Railway	66	14
York, Newcastle & Berwick Railway	193	48
York & North Midland Railway	164	23
Lancashire & Yorkshire Railway	96¾	31
Midland Railway	353¾	76
London & North-Western Railway	236½	37
South Devon Railway	4	2
Newmarket Railway	17	4
Eastern Union Railway	19½	10
London & South-Western Railway	169	20
Eastern Counties Railway	256½	88
Norfolk Railway	104¼	30
North Staffordshire Railway	121	22

South Staffordshire Railway	11¼	4
Northampton & Peterborough Railway	57½	12
London & Croydon Railway	8	4
Great Western Railway	19	2
Manchester & Sheffield Railway	16½	8
London & Blackwall Railway	3½	4
Various mineral railways	6¾	8
Streets of London	?	10
South Eastern Railway	182	77

This list totals 2,192 miles of line and 558 instruments and was taken from figures published in 1852 by Charles Walker, superintendent of telegraphs for the South Eastern Railway Company, running from London to Dover. This railway operated its own public telegraphs in circuit with the Electric company using Cooke & Wheatstone's two-needle system.

Relations between the Electric company and the Great Western Railway, at the time the second largest business concern in the country, were strained by its close co-operation with the London & North-Western Railway. Between 1845 and 1852 it had only the original circuit between London and Slough and a poorly maintained signal circuit on the long Box Tunnel. Connection to Bristol – the western terminal of the railway – had to be made very indirectly in a long geographical 'elbow' to the north by way of Birmingham and Gloucester alongside of the North-Western railway and the rails of its allies. The Great Western and the Electric companies belatedly came to terms during 1851 and a direct circuit finished between London and Bristol onward west from Slough on March 5, 1852.

This important agreement rapidly opened the whole West Country of England to the telegraph alongside of the Great Western's allied lines, the Bristol & Exeter Railway, the South Devon Railway (a Cooke & Wheatstone licensee), the South Wales Railway, and the Wilts, Somerset & Weymouth Railway. The new direct telegraph was opened to the public in Bristol on April 13, 1852 and Exeter during August 1852, where it connected with the old line on the South Devon, putting Plymouth in the far west in national circuit on August 14, 1852. On October 15, 1852 the Electric opened circuits for the Admiralty from Exeter to Plymouth, Devonport navy yard and Stonehouse, with a connection to the Port Admiral's house. The whole industrial coast of South Wales was connected by the year end of 1852.

Also on October 15, 1852, the amalgamation of the Electric and the Irish Submarine company, with rights for the Holyhead to Howth cable was approved.

Eight wires were erected from London to Swindon where the circuits divided, four following the main line to Bristol and Cornwall, all on poles on the south side of the rails, the remaining four diverging along the branch for Gloucester and South Wales.

To connect these new lines with Founders' Court a new underground cable was laid to Charing Cross, then down Whitehall and Birdcage Walk, past Buckingham Palace to Albert Gate on Knightsbridge, and under Kensington Park Gardens and Hyde Park, across the bridge over the Serpentine, to access Paddington railway station in November 1852. It replaced the existing two wire circuit with one of sixteen galvanised *brass* wires insulated with gutta-percha bound with webbing and covered in tar forming an "open rope". These were protected in the Company's common three-inch diameter socket-ended cast-iron pipe.

In addition to advances in the west, on the eastern side of the country, the Electric's new relationship with the Great Northern Railway resulted in a 160 mile long-line with six wires from London to Doncaster. It was constructed for the Company by William Reid, Cooke & Wheatstone's original telegraph engineer and contractor, and opened on March 10, 1852, providing an alternative telegraph route to Scotland to that alongside of the London & North-Western Railway.

The Edinburgh & Northern Railway between Burntisland and Tayport in Scotland, the Preston & Wyre between Preston and Fleetwood, the Liverpool, Crosby & Southport, both in Lancashire, the Eastern Union between Colchester and Ipswich, and the grandly-titled Manchester, Buxton, Matlock & Midlands that had a short line from Rowsley to Ambergate, all used telegraphs built under license or under lease from the Electric company in 1852 but not worked by it. These odd lines were either isolated from the rest of the national network geographically or because they were leased to other railway companies. In 1852 the system of the South Eastern Railway Company from London to Dover and to Reading, including the North Kent line between London Bridge and Rochester in Kent, as well as the Submarine Telegraph Company between Dover and Calais and Ostend, remained independent of the Company but worked Cooke & Wheatstone's apparatus.

The special circuits to the Crystal Palace in Hyde Park were put to good use after the Great Exhibition closed in late 1851. They were connected to a new station at 1 Parkside on Knightsbridge, opposite the Palace site, convenient for the elegant Grosvenor estate, Belgravia and Brompton, and for the betting market at Tattersall's; to a new subterranean cable under Hyde Park to Paddington; and to a private wire to the Chairman's house in Lowndes Square in 1852!

According to its competition the Electric Telegraph Company's connections were such that it was able to enlist the support of the Railway Clearing House in its parliamentary battles preventing or limiting the powers of other telegraphs during 1851 and 1852. The Clearing House, created on January 2, 1842, ostensibly had the role of balancing inter-company accounts in passenger and goods traffic. It became so essential to the companies' business that it was empowered by its own Act of Parliament in June 1850. It soon also became the representative body for all of the railway companies in Britain and Ireland. In September 1851 it appointed a "parliamentary agent to watch, at the expense of the associated companies, any bills other than railway bills, which may be brought into Parliament in order that no clause injurious to the interests of railway companies may be passed unnoticed." Thomas Coates, a solicitor, was appointed to the post; to be, in modern terms, their 'lobbyist', and his first reports were on the telegraph bills then in progress.

The Clearing House was formed at the instance of the London & North-Western Railway and had its premises on land leased from the railway company, adjacent to its station at Euston Square in London.

Even if short-lived, the Electric's influence through the Railway Clearing House in 1851 and 1852 was such that competitive telegraph companies were effectively excluded from all the railway routes into London, being confined to provincial lines.

The Passage of Time

From its creation the Electric company had installed handsome, long-cased electrically-driven Bain regulator clocks in all of its public offices, which, in 1846, on the initiative of Francis Whishaw, then managing the message department, were corrected to the minute daily by a time-signal from its head office.

Above the Royal Observatory at Greenwich was a "time ball", regulated by a precise solar clock, the descent of which had been used since 1833 by mariners on the river Thames leaving the Port of London to set their chronometers for ocean navigation.

During 1851 the Astronomer-Royal installed an electric chronometer to the design of Charles Shepherd, a clockmaker of 53 Leadenhall Street, City, at the Greenwich Observatory, at a cost of £70. This, too, was delicately adjusted as needed from readings off the solar clock. The electric chronometer was placed in circuit with four other clocks in the Observatory and, during July 1852, in co-operation with the South Eastern Railway, with another on display at the railway's terminal station at London Bridge, ten miles away, so that each beat simultaneously with each other. C V Walker, the railway company's telegraphic superintendent, took the first electric time signal from Greenwich at 4pm on August 5, 1852 at the London Bridge terminus and it was simultaneously received at its Dover station. The experiments continued daily over the next few weeks, one time signal being extended automatically to all the railway stations on the line at least once in each day.

The existing large public clock at London Bridge made by John Carter, chronometer maker to the Royal Navy, of 61 Cornhill, City and 207 Tooley Street, Southwark, next to the terminus, was adapted with an electric check to take the precise time signal.

It was intended that this "time circuit" be extended from London Bridge to the Electric Telegraph Company's station at Founders' Court in July 1852 where its beat would regulate the Company's Bain electric clocks and hence the daily time-signal to all of its offices.

The Electric Telegraph Company's "time works" also involved the laying of new underground circuits and the installation of a six-foot diameter *electric time-ball* constructed of red-painted zinc on a twenty-foot post on the roof of its prominent Strand premises at Charing Cross in the West End of London. A rod in the post connected with a piston in a cast-iron cylinder at the base which regulated its descent by air-pressure. It was released electrically through a dedicated circuit in concert with the original time-ball at Greenwich Observatory so that both dropped at exactly one o'clock each day, from August 28, 1852. The electric time-ball allowed the public in the Strand and its environs to set their clocks and watches with equal precision.

The press reported on August 3, 1854, that the time-ball at Charing Cross was struck by lightning just three minutes before one o'clock, when it was due to be released. The ball was already raised and fell back causing its winch handle to turn and strike the operating clerk. The clerk recovered sufficiently to re-raise the ball and release it at 1 o'clock.

The time signal from Shepherd's clock at Greenwich was used to adjust the electric regulator clock in the Strand office which controlled, on sub-circuits, the electric time ball on its roof and a very large gas-illuminated Bain electric clock with four dials on a tall cast-iron pillar on the pavement outside. In February 1855 another time circuit was introduced along the South Eastern railway from Greenwich for the Admiralty to work an electric time-ball at the Royal Navy Dockyard at Deal, on the Kent coast.

This had immediate effect on the specification of the proposed giant new clock to be installed in the tower above the Houses of Parliament. It was now to be regulated "on the principle recommended by Mr Wheatstone, at least as often as once in a minute, for the purpose of producing a magneto-electric current, which will regulate other clocks in the New Palace."

The clock's regulation, through the wires of the Electric Telegraph Company, were described by Edmund Beckett Denison in 'The Times' of August 11th, 1865: "I may as well correct a mistake, which I often have to correct privately about the great clock. In consequence of the ambiguous language of another report of the Astronomer Royal [George Airy], some people imagine that the clock is controlled by electric connection with Greenwich Observatory. It contains no machinery whatever for that purpose. It reports its own time to Greenwich by electrical connection, and the clockmaker who takes care of it receives Greenwich time by electricity, and sets the clock right whenever its error becomes sensible, which seldom has to be done more than once a month. Mr Airy's last report upon the rate was 'that it may be relied on (that is, the first blow of the hour) within less than one second a week;' which is seven times greater accuracy than was required in the original conditions."

The Royal Observatory eventually had telegraphic connections for transmitting time signals with the Electric company at its Greenwich station, with the Magnetic company through its Deptford office and with the London District company at their office in Greenwich town. These were used for time signals to all of their respective public stations and offices to set regulator clocks that passers-by might adjust their watches.

With this public success the Electric immediately added an electric time-ball to its main office in the great seaport of Liverpool in 1854; another was subsequently put up by John French, a chronometer maker, on the roof of his premises at 80 Cornhill in the centre of London, with a private time circuit from Founders' Court. In Liverpool there was also a very large municipal electrically-controlled clock with six faces on the Victoria Tower, said to be the largest existing in 1859, in circuit with the Liverpool Observatory. In Edinburgh by 1855 the city authorities had erected an electric time-ball on the Nelson Monument, Calton Hill, overlooking the city, controlled by their observatory. Shortly afterwards a wire was run from the Edinburgh Observatory to the great port of Glasgow to work an electric time-ball on the Sailors' Home overlooking the river Clyde.

The electro-pneumatic mechanism for the time-ball was designed by Edwin Clark, the Company's engineer, in 1850 and was manufactured by John Sandys, of 72 Upper Whitecross Street, London, one of its contractors for instruments. In 1863 it was quoting £110 for a time-ball, £25 for a regulator clock, and £40 a year for providing a time-signal. To this would be added the construction of the circuit and subsequent maintenance. By that year the time-ball mechanisms were made by Maudslay, Sons & Field, of Lambeth, an eminent firm of engineers.

An extremely precise transmitting instrument for the time signal, called the *Chronopher* (or *Chronofer*), was latterly devised by the Company's Samuel Alfred Varley, younger brother of C F Varley, in 1854 in Liverpool. The circuits were closed to traffic just before the hour and the time signal received from this device by ordinary needle telegraph instruments. The Chronopher was used to send Greenwich time to all of the Company's offices in the following year to adjust their regulator clocks so that the public might correct their watches from them.

In November 1867, the 'Gentleman's Magazine' described the workings of the Greenwich signals and the Chronopher: "One of these signals passes to the Electric & International Telegraph Company's offices in Moorgate Street, London, where there is placed a very beautiful piece of mechanism, planned by Mr C F Varley (sic), and called by him the "chronopher", the office of which is as follows : At a few seconds, only four or five, before the hour, it cuts off the connection between every speaking instrument in the establishment and the wires leading therefrom to the provinces and along the railway lines, and it "switches" all these wires on to the one wire along which the Greenwich signal is to come ; so that, at a few seconds to the hour Greenwich is what is technically termed "put through" to every station in the company's service, and to every office to which the company's wires are led. At the hour the Greenwich signal comes, and, without a moment's stoppage or any interruption, passes through the scores of wires that emanate from the office, and through every branch of the ramification into which, all over the country, these main lines diverge and spread. At two seconds after the hour the chronopher restores the connection between the wires and speaking instruments, and the ordinary business is resumed, having been interrupted only for the brief space of four or five seconds. As it is needless that this signal should be repeated very frequently, the above marvellous operation is performed only once a day, at 10am… It is by means of these signals that time-balls are dropped and time-guns fired, and provincial clockmakers are enabled to exhibit dials showing Greenwich time in their shop windows."

Starting in Liverpool in 1857 public clocks began to have an *electric check* installed which connected them to a single master timepiece that was regulated to one minute accuracy. The master clock at the Liverpool Exchange regulated commercial clocks in clockmakers and similar premises, and that at the Town Hall the public clocks, with electric circuits. This was a municipal initiative unconnected with but enabled by the timekeeping of the telegraph companies. Electric checks were soon adopted by the clockmakers of London and by the cities of Glasgow and Edinburgh.

So it came about that regional east-to-west time differences were abolished and London, or rather Greenwich, time became the national standard.

The Company began to transmit Greenwich time to the astronomical observatories at Cambridge and Edinburgh in Britain during 1854, then subsequently to the observatories at Brussels in Belgium and Paris. These latter signals were used to determine (by the standards of the period) the exact difference of longitude between the observatories.

On April 1, 1853 the Company opened its House of Commons Telegraph Office in the Lobby or Octagon Hall of the newly-rebuilt Parliament. It used two-needle instruments to send the reports of its Parliamentary shorthand-writers a half mile or so to its St James's Street office in the centre of the most prosperous part of London and to Founders' Court. At St James's Street half-hourly abstracts of proceedings were printed by its own compositor and press-man for circulation to the twelve largest gentlemen's clubs, Arthur's, the Athenaeum, the Carlton, the Reform, the Oxford & Cambridge, the Travellers', Brooke's, the United University, the Conservative, the Union, the United Service and White's, and to the salon of the Royal Italian Opera House in the Haymarket, and hourly to Boodle's and Prince's Clubs, by its three messengers. It became known as the "Club Telegraph"; the independent proprietress of this undertaking being Mrs Eliza Collet who received an annual payment of £10 per club, not to exceed £200 in all, for organising the service. It was continued by the Company until 1868, in which year Mrs Collet received £170.

It also served to "whip-in" Members of Parliament when a division vote was required.

Much longer, almost verbatim, abstracts of debates were telegraphed daily from Founders' Court to newspapers and subscribers in the provinces. The Octagon Hall office also gave Members of Parliament and the Lords Temporal and Spiritual access to the telegraph at the doors of their respective Chambers and, less popularly with the elected element, gave constituents immediate access to their representatives.

The Royal Italian Opera House was of sufficient public interest to have its own telegraph line. This was opened on May 18, 1853, coinciding with the introduction of a new "Metropolitan" tariff of 1s for twenty-words between the Company's London stations.

The Houses of Parliament caught up with technology quickly. The addition of the telegraph station in the Lobby was accompanied in April 1853 by a large electric clock over the principal entrance. At the same time the Electric Telegraph Company installed a general system for notifying members of a division vote by means of thirty electric bells wired throughout the Palace, all "set in motion" by an officer of the House at the Lobby door.

Circuits of Air

To overcome the difficulty of sudden surges of messages at branches, in 1853 the Electric company introduced a 200 yard long 1½ inch diameter subterranean pneumatic tube between its Central Station, where there were many clerk-operators, and the Stock Exchange in London, where its office was particularly confined. A small stationary steam engine drew containers of bulk messages from brokers and jobbers by atmospheric pressure. The engineer was the Company's Latimer Clark. It was so effective in collecting written messages in bulk that a slightly larger diameter 1,000 yard long vacuum tube was added in 1858 to the branch in Cornhill in London, and another from Lothbury down Fenchurch Street to the Mincing Lane office, serving the provisions trade, in June 1860.

In July 1860, Andrew Wynter, MD, wrote, in the magazine 'Once a Week,' a description of the air circuits:

"For some years the Electric & International Telegraph Company have employed this new power to expedite their own business. Thus their chief office at Lothbury has been for some time put in communication with the Stock Exchange and their stations at Cornhill and Mincing Lane, and written messages are sucked through tubes, thus avoiding the necessity of repeating each message."

"We witnessed the apparatus doing its ordinary work only the other day in the large telegraphic apartment of the company in... Moorgate Street. Five metal tubes, of from two to three inches in diameter, are seen trained against the wall, and coming to an abrupt termination opposite the seat of the attendant who ministers to them. In connection with their butt-ends other smaller pipes are soldered on at right angles; these lead down to an air-pump below, worked by a small steam-engine. There is another air-pump and engine, of course, at the other end of the pipe, and thus suction is established to and fro through its whole length. Whilst we are looking at the largest pipe we hear a whistle; this is to give notice that a despatch is about to be put into the tube at Mincing Lane, two-thirds of a mile distant. It will be necessary therefore to exhaust the air between the end we are watching and that point. A little trap-door - the mouth of the apparatus - is instantly shut, a cock is turned, the air-pump below begins to suck, and in a few seconds you hear a soft thud against the end of the tube - the little door is opened, and a cylinder of gutta-percha encased in flannel, about four inches long, which fits the tube, but loosely, is immediately ejected upon the counter; the cylinder is opened at one end, and there we find the despatch."

"At the station of the Company... it acts the part of messenger between the different parts of the establishment. The pipes wind about from room to room, sufficient curve being maintained in them for the passage of the little travelling cylinder which contains the message, and small packages, and written communications."

As provincial message traffic also grew, on June 22, 1864 pneumatic tubes were opened in Liverpool between the Company's main office in Castle Street 300 yards to its branch in Water Street and another 1,000 yards to the Exchange. As improved by the Company's Latimer Clark and C F Varley the new Liverpool air tube was 'double-acting', working message carriers both ways. There was a one-horsepower steam engine in the Castle Street basement working two air pumps, along with a vacuum cylinder and a compressed air cylinder, both ten feet long by four feet in diameter. The system worked 20 inches of vacuum or 11 pounds per square inch pressure on the 1½ inch diameter lead tubes in 2 inch iron pipes, drawing or propelling message carriers to-and-fro at an estimated forty miles-per-hour. The instrument clerks at the tube ends used electric bells to signal the men at the pneumatic valves and pumps.

In the following year, 1865, Birmingham and Manchester had message-carrying air tubes. The Company, the Board reported, had then spent £4,400 on these 'air circuits'. The London air circuits were also extended.

The two pneumatic tubes in Manchester connected the new main telegraph station in York Street with branches in Ducie Buildings at the city's Royal Exchange (510 yards) and in Mosley Street (320 yards) on December 6, 1864. An additional 17 yard tube was added to connect the counter at York Street with the instrument gallery. There were 1½ inch diameter iron tubes, a 13 hp steam pump at York Street, with a vacuum cylinder to draw the message carriers and a pressure cylinder to return them. As in Liverpool they were controlled by a system of electric bells.

In the city of Birmingham, a 1½ inch diameter, 140 yard pneumatic tube was laid between the Company's office at the Exchange and the telegraph at the New Street railway station through which the long lines to London, Liverpool and Manchester passed. It was worked by a small 3hp steam engine.

By 1870 the Company's new *General Offices* at Telegraph Street in London was at the heart of a much enlarged network of seven air circuits: to Fenchurch Street, 980 yards; Leadenhall Street, 670 yards; Gresham House, 588 yards; Cornhill, 490 yards; Old Broad Street, for the British Indian Submarine Telegraph Company, 370 yards; the Stock Exchange, 324 yards and Founders' Court, 223 yards. The first two tubes were to a new large 2¼ inch diameter, the remainder to the original 1½ inch size. The internal circuits within the General Offices then consisted of five tubes: to the Anglo-American Telegraph Company's instruments, 62 yards; to the Indo-European Telegraph Company's instruments, 57 yards; to the Engineer's office, 50 yards; to the new South Instrument Gallery, 50 yards (all 2¼ inches in diameter and installed in the previous eighteen months); and to the Intelligence Department, 44 yards (1½ inches diameter). The basement steam engine had to be replaced with a much larger 20hp version to cope with demand for air and vacuum. The air was also used for other purposes in the building.

These pneumatic telegraphs, carrying paper messages in bulk from office counters to instrument galleries, were the first of hundreds of miles laid in Europe and in America.

Direction

As well as capitalists and investors such as the brothers, J Lewis Ricardo and Samson Ricardo, the Company very quickly attracted an array of technical and management talent to its direction; Robert Stephenson, engineer of the London & Birmingham Railway, the London & North-Western Railway and of that company's many iron relatives, was to sit on the board, joining his business partner, the so-called 'calculating boy', George Parker Bidder. Bidder was a mathematical prodigy who became engineer of the London & Blackwall, South Eastern and many other railways in England and India; he was the largest shareholder in 1846 and for many years subsequently, remaining a director from its founding until its end in 1869. Bidder also had his law-agent, Richard Till, as a director. Till stayed with the Board until the mid 1860s.

In September 1853 the Board comprised J Lewis Ricardo, chairman, G P Bidder, W F Cooke, Thomas Crutchley, Lord Alfred Paget, S M Peto, W H Smith, Richard Till, and Colonel Wylde CB.

During the early 1850s the railway contractor and financier Morton Peto was the most important new board member. Peto had privately lent a substantial sum of money to rescue the Company in 1849, and was soon to guarantee the finances of the Great Exhibition of 1851, such were his means. But by 1866 he was ruined.

By the 1860s the largest shareholder was Joseph Whitworth, the steel-master of Manchester, whose interests ranged from precision machine tools through steel manufacture to armaments. He held £70,000 of stock in 1860 and was also a director of and large shareholder in the London & North-Western Railway.

The ruthless General Manager of the London & North-Western Railway Company, then by far the largest public corporation in the world, Mark Huish, became deputy chairman in 1860 and stayed until his death early in 1867. He was replaced in that role by Frederick N Micklethwait, a director of the Great Western Railway. Previously Lord Alfred Paget, also a director of the North-Western railway, had became a director in 1853, and Thomas Brassey, the greatest contractor for building railways and other public works in Britain, Europe and America, and yet another a director of the North-Western, joined the board in 1858. Both stayed until the end in 1869.

W H Smith, the newspaper, magazine and book distributor, and Member of Parliament for Westminster, also was on the Company's board in the 1850s. For a period about 1853 his bookstalls acted as agents for the Electric Telegraph Company, accepting message forms for passing to railway telegraph stations.

Robert Stephenson became a director of the Company on February 21, 1855, succeeding to the chairmanship of the Electric Telegraph Company in 1857, replacing J Lewis Ricardo. But sadly his tenure ended with his premature death in 1859. The lawyer Robert Grimston took the chair for the rest of the Company's existence.

In addition to the Board in London the Company maintained small committees of shareholders not necessarily directors, in Manchester, Liverpool, Bristol, Glasgow, Edinburgh, Bradford & Leeds, Newcastle and Hull, the membership varying in numbers from seven to one. These local committees were a peculiarity of the domestic telegraph companies, serving primarily to encourage share participation and to monitor service provision at local level.

The Company's first Secretary, which in the nineteenth century was the senior salaried managerial position, equivalent to legal and business manager or chief executive officer, ignoring the interim appointment in 1846 of John Kymer, was William Henry Hatcher, an ambitious civil engineer interested in electrical apparatus. As well as being Secretary he was the firm's chief engineer and was also responsible, along with W F Cooke, for the construction of the first 1,700 miles of line that the Company built. Hatcher was replaced as Secretary by James Sealy Fourdrinier, a lawyer with engineering interests, one of the famous Huguenot émigré family of paper-makers, during March 1849. Fourdrinier, the Electric's longest serving manager, effectively oversaw the maturity of the Company in the 1850s; but he did not seem to be aware of the opportunities and threats the telegraph industry faced in the 1860s. On his retirement he was succeeded in January 1864 by Henry Weaver, who remained as the senior management figure until 1869. Weaver had been manager of the International Telegraph Company and Superintendent of the Electric's London District. Subsequently Weaver went on to be connected with the Indo-European Telegraph Company, and became Managing Director of the Anglo-American Telegraph Company.

In 1864 William Reid, the telegraph contractor, claimed that the "power behind the throne" at the Electric Telegraph Company in the period 1848 to 1859 was Douglas Pitt Gamble, Private Secretary to J Lewis Ricardo. Gamble obtained this post as part of the resolution of the legal suit over Nott & Gamble's telegraph and used his influence to have appointments made. These included the replacement of W H Hatcher by J S Fourdrinier in the role of Secretary. Fourdrinier, Reid claimed, had a poor reputation, being a weak negotiator, bullying of the clerks and a toady to the board. He was only there to 'keep the seat warm' for Gamble.

By 1863 the much enlarged and more professional board of directors had come to their own conclusion and tried to pay Fourdrinier off with a £300 a year pension but the shareholders, led by Reid, objected. A compromise was come to with a lump sum of £1,000 being paid.

Gamble successfully lobbied for his financial backer, Colonel William Wylde, to be appointed to the board of directors. That did not do him much good: in 1859 Gamble was summarily dismissed from his several positions in the Company for referring to the Board as "a set of old women".

A note is necessary on William Wylde, who was a director of the Electric Telegraph Company from 1848 until 1870. Wylde was an officer of the Royal Artillery, serving in Holland at the end of the French Wars. As an out-of-place half-pay major in the early 1830s he became an Assistant Poor Law Commissioner. Between 1836 and 1847 he was British military agent in Portugal during a civil war, cannily employing his two sons as secretaries. As his reward he became Equerry to Prince Albert in 1847, rising to be Groom of the Bedchamber in 1848. From this point on he became the archetypal ambitious courtier, marrying his only daughter off to a rich northern coal-owner. His army rank increased, achieving Major-General on June 20, 1854. In 1868 he became honorary Master-Gunner of the Royal Artillery. It may be said that he rose without trace.

Wylde did, however, use his royal connections to interest the Queen and Prince Albert in the telegraph.

J S Fourdrinier was latterly paid £750 per annum in salary. Henry Weaver received £1,000 a year on his appointment.

Thomas Colling Bennett was Accountant to the Company from the 1850s to the end. He latterly was also Secretary to the Channel Islands Telegraph Company and, when Henry Weaver left for the Indo-European company, became the Electric's last manager.

Between 1845 and 1848 W H Hatcher was assisted by Francis Whishaw, who in today's language may be said to have devised and developed the systems and processes used in the correspondence or message department. Whishaw, a prominent writer on technology, also undertook a large amount of public relations work, placing articles in the press and organising exhibitions for the Company.

The assistant secretary from around 1852 was William Barchard, who had previously been chief clerk in Liverpool. He returned to Lancashire and became a silk merchant. From the mid-1850s until 1870 the position was held by Henry Schütz-Wilson. He was employed by the Company to manage its 'foreign affairs'; travelling on its behalf through the German states and into Russia negotiating traffic rights. Schütz-Wilson was also a well-known Alpinist and writer.

William Henry Hatcher was the Company's engineer from 1846 until 1850, being for sometime in that period also the Secretary. He was responsible for construction of its first 2,000 miles of line. Little credit has been given him for this achievement, and his gradual elimination from the Company's management is mysterious.

The brothers, Edwin and Latimer Clark, the Electric company's engineers throughout the 1850s and 60s, had both been employees of Robert Stephenson's civil engineering firm before joining the Company. Whilst working on the great Britannia Bridge carrying the Chester & Holyhead Railway cross the Menai Straits from Wales to Anglesey from 1846 to 1850 Latimer Clark had a cannon ignited by an electric current each morning to awaken the labour force. Edwin Clark replaced W H Hatcher in August 1850. When he left to return to hydraulic and dock engineering in 1855 his younger brother was promoted from assistant engineer. Between them they managed the Company's major constructional works on land and sea, and were to have immense influence on domestic and underwater telegraphy.

Cromwell Fleetwood Varley, the Electric's most important electrician, initially for the London district in 1850 then for its entire network, in charge of all its apparatus and a major contributor to its technical base, was alone in having no other employer. He advised on many other major electrical projects and apparatus, including several of the Atlantic cables. His brother, Samuel Alfred Varley, also worked for the Company for a period.

Nathaniel John Holmes, the manager and electrician of the Founders' Court station, was let go in 1848. He, too, was subsequently to make several innovations in telegraphy, domestically and in submarine works. He was a close associate of Wheatstone.

In August 1854 the Electric Telegraph Company made the pioneering decision to form a department in London for young girls wanting to become telegraph clerks, under the management of a "matron". It was, they said, intended to afford a "wider and more intellectual scope for female employment." Mrs Maria Craig, a widow, was recruited to superintend and train the young ladies.

The Company's principal bankers were the formidable Glyn & Co., of 67 Lombard Street, who performed a similar function for the London & North Western, Great Western and many other railway companies. George Carr Glyn was for a long time chairman of the London & North Western Railway, though the bank was not represented on the Electric's board.

As can be seen the railway interest if not dominant was heavily represented in all aspects of the Electric Telegraph Company's capital and management. From beginning to end there was a strong cross-representation of both direction and shareholding between the railways and the Electric.

Systematic Expansion

At the start of 1852 the Electric Telegraph Company announced that it had its Central Station in London and 226 provincial stations, 70 of which had constant attendance, day-and-night. It was working 2,500 miles of line with another 800 miles "in process of suspension".

James Graves, when he joined the Company as a clerk on February 26, 1852, had this impression of his new employer:

"The Electric Telegraph Company's Office is in Lothbury behind the Bank of England. Although they have numerous other offices, this one is the chief of the metropolitan offices and in fact of all the stations in the Company. It is as it were the centre of the Company, here all orders, rules and regulations are issued, and all the accounts received examined and passed, to this place the whole of the stations forward at intervals of two or three days all the messages received by them together with an abstract of them all. The whole management of this Company's business is carried on here. It is in this place that all the lines of telegraph in the United Kingdom and from the Continent radiate into one common centre - hence the distinctive appellation of 'Central Station' is derived and given to the Lothbury Station. The building in itself is a very extensive one, it consists of a large hall open up to the skylight - this is approached by a narrow passage called Founder's Court, in front over the doorway may be seen the large clock worked by electricity. On attaining the interior of the hall immediately before you may be seen the Committee Room - on the left a flight of stairs - leading to different departments on the different floors, some devoted to examination of papers, messages, accounts and other to instrumental operations, forwarding and receiving the messages. Another department is occupied in making up 'Expresses' and supplying press intelligence, this is called the Intelligence Department."

"On the right of the entrance behind the counter (which extends round two sides of the hall) is situated the Code Room, the Superintendent's office and immediately over this is the Secretary's Office and other Departments, the highest of which is used for instrumental work. The messages on either side are raised from the Counter to the Instrument Room by means of a 'lift' which consists of a wooden square tube divided into two parts - a wheel and windlass handle placed at the top over which passes a rope furnished at each end with a square box – so that when one box is at the top the other is at the bottom and vice versa. A signal is given to draw up or put down the messages by means of a small bell and communication is held from top to bottom and vice versa by means of a gutta-percha speaking tube. The whole establishment is carried on by strict order and discipline and every different Department has its own description of employment. Under the building is a large cellar where the batteries, acid, etc, are kept. The broken instruments or those found defective are repaired on the premises."

The Company's paid-up capital at the end of 1852 was £512,000 with a reserve fund of £73,400. It had spent £416,693 on its telegraphs including patent rights, spending £13,100 in that year on renewals and maintenance. Receipts from messages in 1852 had been £40,087; costs on that account had been £26,232 allowing for a dividend of 6½ % and a sum placed to the reserved fund. The principal directors at this time were J L Ricardo, G P Bidder, R Till and S M Peto.

New telegraph lines in 1852 were recorded opened on the London, Brighton & South Coast, London, Brighton & Newhaven, Chester & Holyhead, Carnarvon, Lancashire & Cheshire Junction, Manchester, Sheffield & Lincolnshire, Bristol & Exeter, South Devon, Great Northern, Manchester & Huddersfield, Shrewsbury & Chester, Shrewsbury & Hereford, and South Wales Railways, additional circuits added from London to Birmingham, Rugby to Leamington, Paddington to Oxford, Southampton to Lymington and for the Admiralty. New direct circuits were also made between London and Liverpool and London and York, with a cable to the Isle of Wight. A line erected by "a competitor" on a branch of the London & North-Western Railway was also replaced by one of its own. This was the last time for many years that the Electric Telegraph Company provided the public with such an engineer's report.

"Additional Stations" in the Company's circuits were announced to the press on November 4, 1852 at Plymouth, Exeter, Taunton and Bridgewater in the West of England; Lancaster, Carlisle, Preston and Wigan in the North West of England; Shrewsbury, Wellington and Newcastle-under-Lyme in the West Midlands; North Shields, Great Grimsby, Gainsborough, Grantham and Boston in North and East of England; as well as in London at No 17, Great George Street, Westminster, opposite Parliament, and No 53, Waterloo Road, Southwark.

The same advertisement in November 1852 declared that books of discounted pre-paid "stamped message forms" were available at its stations.

In March 1853 the Electric Telegraph Company had 237 telegraph offices, 16 were open day and night, and 47 were open on Sundays.

To combat competition a one shilling for twenty word message rate was launched in August 1853 for all stations within fifty miles of London, specifically including Birmingham, Brighton, Cambridge, Coventry, Northampton, Oxford, Rugby and Windsor.

Between 1852 and 1853 the Company promoted several Bills in Parliament for powers that directly threatened its competition. In November 1852 it proposed a Bill to acquire the Submarine Telegraph Company. It also launched a Bill to enable a subsidiary, the International Telegraph Company, to work circuits in Britain along roads, railways and canals, as well as underwater cables to continental Europe. Then, in November 1853, it sought ambitious authority to work circuits in its own name not just in Great Britain, Ireland and in all Her Majesty's overseas dominions but also throughout Europe, Asia, Africa and America. These remarkably aggressive prospective legal powers were either rejected or abandoned.

Also during December 1853, imitating its competition that had adopted apparently weather-resistant subterranean circuits, the Electric Telegraph Company commenced laying long lines of six underground "express" wires insulated with gutta-percha resin from London to Manchester and Liverpool, and from Manchester to Leeds, in iron pipes alongside of the London & North-Western Railway.

Despite having its assistant engineer, Latimer Clark, rigorously test its new subterranean cables *underwater* at the Gutta-Percha Company's works in London in April 1852 it was surprised by the slow transmission of messages when compared with its overhead lines. The Company then had Michael Faraday and George Airy, two of the country's most eminent scientists, examine the new lines. Faraday electrically tested two 100 mile coils of 1/16 inch diameter copper wire insulated with gutta-percha to 3/16 of an inch, one set of coils suspended in the canal by its wharf and one set in the dry warehouse of the Gutta-Percha Company; noting considerable differences between the two. These experiments were later used in addressing retardation in submarine cables.

On Friday, January 20, 1854 Prof Faraday demonstrated his findings on submarine circuits to the evening meeting of the Royal Institution in London. The Electric Telegraph Company provided him with 450 pairs of galvanic plates and eight miles of gutta-percha insulated wire to facilitate the lecture.

On May 21, 1854 the Company's electricians, as an experiment, joined the six underground wires into one continuous copper circuit 1,100 miles in length, from its Strand office. They tried this immense line at first with a galvanometer and then, with moderate success, transmitted messages with a Bain chemical printing telegraph, their most sensitive instrument. This was the longest single circuit yet achieved.

As it turned out the gutta-percha insulator, whilst stable when immersed in sea and fresh water, eventually oxidised and crumbled when exposed to air. The Company in five years had to revert to its original overhead iron wires. It took until August 1864 to eliminate the last underground circuits on its London, Liverpool and Manchester trunk lines; the last piece being at Rugby.

In August 1854 the Company also had the fifteen miles of underground line connecting its eighteen stations in London, containing 350 miles of wire.

At this time, in either 1854 or 1855, the Electric established Stores as 17, York Street, York Road, Lambeth, on the river Thames, in the former premises of "Nickels' Gutta-Percha Company". Nickels had previously supplied gutta-percha insulated wires for telegraphs. John Muirhead was Superintendent of the Stores. It only maintained this warehousing for a few years; transferring its stores for instruments, wire, poles and cable for the rest of its existence to a yard on the London & North-Western Railway at 44 Gloucester Road, Camden Town, in north London, right opposite the northern end of the very first, experimental line of telegraph. Under Muirhead's management the Company built its own large Factory for batteries and instruments in 1858 around a courtyard at Gloucester Road. As well as developing the Company's Factory Muirhead devised many improvements in cell technology and other apparatus.

The Company opened a Bain printing circuit in January 1853 between Founders' Court in London and Southampton, alongside of its Cooke & Wheatstone two-needle circuit of 1844. There were then twenty-nine Bain printers in service, using separate circuits between the stations at Founders' Court, Charing Cross, Birmingham, Bristol, Edinburgh, Glasgow, Liverpool, Macclesfield, Manchester, Newcastle, Rugby, Southampton and York, usually installed in pairs at each office. The last lines using the Bain printer, with their single-wires, were opened shortly after to Bristol, Cardiff and Falmouth in England's West Country. They lasted in these large and busy offices until the 1860s.

To illustrate the growing complexity of managing telegraphic circuits, the separation between long and local lines, and also railway signalling; there were eighteen wires out from the Shoreditch terminus of the Eastern Counties Railway in London during 1852. Two wires comprised the long-line to Cambridge, Ely and Norwich; two wires covered the local stations between London and Brandon; two wires those to Broxbourne; two wires for the long-line to Colchester; two wires for the local stations to Chelmsford; and two wires to their London Goods' Office at Brick Lane. The other six wires were single lines working single-needle telegraphs and bells for railway signalling.

In another instance, at this time the southern area of the London & North-Western Railway between Euston Square in London and Normanton was separated by the telegraph company into three Divisions; from London to Birmingham, from Birmingham to Derby and from Derby to Normanton. The stations in the Divisions were in direct connection with each other but connected to the rest of the telegraph system through the "transmission" stations at London, Birmingham or Derby as was appropriate, where there were switches between circuits. The transmission stations also had direct, independent circuits or long-lines between themselves.

The Division between London and Birmingham carried seven wires in 1849. Two were for the very long line from London through Birmingham to Derby, Normanton, York and Newcastle for Scotland; two were for the intermediate long line to Birmingham, Manchester and Liverpool; two were for the local or Division line covering Euston Square, Camden Town, Tring, Wolverton, Rugby, Birmingham, on to Stafford and Crewe; and the odd single wire was for the Bain printing line from London to Manchester. The other lines worked the Cooke & Wheatstone two-needle instrument. By 1852 the London to Birmingham Division had increased from six to seven telegraph stations; at Euston Square, Camden Town, Tring, Wolverton, Rugby, Coventry and Birmingham.

The Divisions were aggregated into geographical Districts; the Company's main administrative unit.

Table 6

Statistics on the Telegraph in the United Kingdom in 1854 compiled by H A Murray

Electric Telegraph Company	
Miles of line	5,070
Miles of wire in cables	5,000
Miles of wire on poles	20,700
Magnetic Telegraph Company	
Miles of line	1,740
Miles of wire in cables	6,180
Miles of wire on poles	4,076
Submarine (& European) Telegraph Company	
Miles of line	400
Miles of wire in cables	2,740
Miles of wire on poles	–
British Telegraph Company	
Miles of line	1,000
Miles of wire in cables	2,755
Miles of wire on poles	3,218
Electric Telegraph Company of Ireland	
Miles of line	88
Miles of wire in cables	176
Miles of wire on poles	–
Total Miles of line, 1854	*8,298*
Total Miles of wire, 1854	*44,845*

Of these 534 miles of line were submarine, employing 1,100 miles of wire in underwater cables.

Murray quotes the cost of putting up a telegraph originally as £105 per mile for two wires and that experience now enabled it to be done for £50. The cost of laying down a submarine telegraph was stated to be about £230 per mile for six wires, and £110 for single wires.

Of the three principal companies, from 25,000 to 30,000 miles of wire were worked on Cook & Wheatstone's system; 10,000 on the magnetic system - without batteries; 3,000 on Bain's chemical principle and the remainder on Morse's plan.

The International Telegraph Company

An independent creation of the Electric company, the International Telegraph Company connected its English circuits to those of the European continent by an underwater cable from East Anglia to Holland. It had been granted a concession by the Ministry of the Interior of the Netherlands government on May 10, 1852. The initial 110 mile cable was completed on May 30, 1853; this opened its business not just to the North European states but also to Russia, the Balkans, Ottoman Turkey, the Levant, and eventually, in a little over ten years, to the vital British possession of India.

As it did not have circuits in Britain the International company was constituted under a Royal Charter rather than being debated through an expensive and time-consuming Act of Parliament. It had an independent capital of £150,000 in 7,500 shares each of £20.

The first public messages between Amsterdam in the Netherlands and London were transmitted on August 15, 1853, relayed through the International Telegraph Company's station at The Hague. There were already international circuits onward into Belgium dating from December 1, 1852, and into Prussia, opened on February 1, 1853. The Company announced access from all of its stations in Britain to Amsterdam, Antwerp, Berlin, Bremen, Breslau, Dantzic, Florence, Frankfort-am-Main, Hague, Hamburg, Hanover, Strassburg, Leghorn, Lübeck, Milan, Pressburg, Rotterdam, Trieste, Venice and Vienna. With current technology these messages could not be sent direct, point-to-point, but had to be "translated", or retransmitted, several times at intermediate stations.

The Moving Fire

From 'The Quarterly Review', July 1854

"Jammed in between lofty houses at the bottom of a narrow court in Lothbury, we see before us a stuccoed wall ornamented with an electric illuminated clock. Who would think that behind this narrow forehead lay the great brain – if we may so term it – of the nervous system of Great Britain; or that beneath that narrow pavement of the alley lies its spinal cord, composed of two hundred and twenty-four fibres, which transmits intelligence as imperceptibly as the 'medulla oblongata' does beneath the skin? Emerging from this narrow channel the 'efferent' wires branch off beneath the different footpaths ramify in certain plexuses within the metropolis, and then shoot out along the different lines of railways, until the shores of the island would seem to interpose a limit to their further progress. Not so, however, as is well-known, for beneath the seas, beneath the heaving waters, down many a fathom deep in the still waters, the moving fire takes its darksome way, until it emerges on some foreign shore, once more to commence afresh its rapid and useful career over the wide expanse of the Continent."

Quoted by Maria Rye
in 'The Rise & Progress of the Telegraphs', 1859

To aggressively compete with the Submarine Telegraph Company's cable from Dover to Calais, in December

1853 it sent continental messages via the Hague from all of its provincial stations in Britain at the same price as those from London.

The laying of the Company's first underwater cable from Orfordness to Scheveningen, manufactured by R S Newall & Company, the maker of the first successful submarine circuits, was superintended by Edwin Clark, the Company's engineer-in-chief. He was assisted by F C Webb as submarine electrician. Webb went on to be chief electrician to the Atlantic Telegraph Company, and contributed to the successful laying of the first intercontinental cable in 1866.

Three more identical cables were laid between England and Holland, on June 16 and 17, 1853; on September 8 and 9, 1853 and September 29 and 30, 1855. All were of light weight with single cores, and made by Newall.

Originally the International company had four underground circuits from Scheveningen to Den Haag where the Company had its own offices. But on September 1, 1855 the Hague office was closed and four new wires solely for international service were laid alongside the line of Holland Railway Company to rooms in the *Rijkstelegraafkantoor,* the main telegraph station, on Nes, in the oldest part of central Amsterdam. This moved in December 1856 to much larger new premises on Nieuwezijds Voorburgwal, by the Royal Palace at Dam.

On January 29, 1855 a convention had been signed between the *Rijkstelegraaf* in Holland and the German Austrian Telegraph Union for a direct circuit between Amsterdam and Hamburg, the major port in northern Europe. Experiments were made by the Company during September at its new office in Amsterdam with messages direct to Hamburg, Vienna and Dantzic, even to Königsberg in eastern Prussia.

Cooke & Wheatstone had made the first electric telegraph in the Netherlands between Amsterdam and Haarlem on the same Holland Railway in May 1845.

With the opening of its cables to Holland and the continental telegraph system in June 1853 the Electric adopted the "European Alphabet" for the Bain printers and single-needle instruments throughout its entire system. This was the continental version of the code or cipher used in America. The much more common two-needle instruments retained their own code.

In the following year it introduced Siemens & Halske's American printing telegraphs on its foreign circuits.

After three attempts, on September 4 and 5, 1854, the Electric finally completed the 65 mile single-core underwater circuit from Holyhead to Howth of the short-lived *Irish Sub-Marine Telegraph Company*, whose rights it had acquired in 1852, joining its circuits to Ireland by the most direct route, off its line on the Chester & Holyhead Railway, an ally of the London & North-Western company. The amount of traffic necessitated the construction of a second cable to Dublin on June 13 and 14, 1855. Both were manufactured by R S Newall.

The International Telegraph Company managed the construction of the Dublin as well as the Holland underwater circuits on behalf of the Electric company.

For several years the Electric's presence in Ireland was limited to just one office, at 4 College Green in Dublin. It only extended its lines to cover the principal towns of Belfast, Cork and Wexford in the mid-1860s; its communication to the island was limited to the capital until then.

Although other companies pioneered submarine telegraph cables to Europe and to Ireland the Electric was to dominate the English and Scottish domestic offshore cables. Its electrical and engineering staff used these small beginnings to develop an unmatched knowledge of the requirements for underwater telegraphy that eventually enabled the ultimate success of the intercontinental cables of the 1860s and 1870s. As noted, it resolutely re-laid the broken Holyhead to Howth cable. Before that it had already spanned the broad estuaries of the Forth and Tay rivers in Scotland on December 22 and 24, 1853 respectively, to access the far north of the country. For these it had acquired the 500 ton wood-hulled paddle steamer *Monarch* in 1853 and converted her to lay underwater cables; she was kept in service for the life of the Company.

To connect the major offshore islands the Electric projected between 1852 and 1869: (year completed)

The Isle of Wight Electric Telegraph Company (1852)
The Channel Islands Telegraph Company (1858)
The Isle of Man Electric Telegraph Company (1859)
The Scilly Islands Telegraph Company (1869)
The Orkney & Shetland Islands Telegraph Company (1870)

The first domestic public cable, and the second successful sub-sea circuit, was that of the *Isle of Wight Electric Telegraph Company* of 1852. This had thirty-two miles of land line and one-and-three-quarter miles of submarine cable (between Hurst Castle on the mainland and Sconce Point on the Island). In addition part of the line between Keyhaven to Hurst Castle on a long sand-spit was also laid as a submarine cable, as was the crossing of the river at Yarmouth. It was undertaken at government behest to provide the Royal Household at Osborne House in East Cowes with electric communication. The Company's original engineer was Charles West who pioneered the use of india-rubber insulation for electrical circuits; he was to be replaced by Latimer Clark, the Electric company's assistant engineer.

The Isle of Wight company's circuit ran from the city of Southampton to Brockenhurst on the long-extant overhead lines by the side of the South-Western Railway, and underground from Brockenhurst to Hurst Castle on the mainland and underground between Sconce Point and Cowes on the island alongside of the common roads. It was unique at the time in using india-rubber insulation for its circuits, subterranean and submarine, from Brockenhurst to Osborne. The underwater cable was uniquely armoured with *plaited* iron wire. The Isle of Wight Telegraph had stations at Southampton, Lymington, Yarmouth and Cowes, with a private branch to Osborne House, and opened throughout on October 14, 1852. It used five Cooke & Wheatstone instruments in its line. The short cable across the Solent proved vulnerable to ships' anchors and was broken within eighteen months; it had to be replaced four times by 1861, although the sections of the 1852 cable from Keyhaven to Hurst Castle and across the river Yar were still in good condition after ten years service. The Electric company absorbed the Company as soon as it opened its line, and was to lay a second, parallel cable to the Isle of Wight in 1867.

The *Channel Islands Telegraph Company* had a capital of £30,000 in £10 shares. The Electric contributed £4,200. Its board of directors, and chief shareholders, in June 1858 were Robert Grimston, chairman, D de Quetteville, W Tupper, L W Robins, D M Gordon, P Gosset and H Carrel. Grimston was chairman of the Electric company, Tupper and Gordon represented the manufacturers of the cable, who underwrote the enterprise. The government in London guaranteed the company an income from civil service and military messages of £1,800 per year, or as much as would bring its annual dividend to 6%, for 25 years, but only for when the cable was working.

Its circuit to England opened on September 7, 1858, connecting with Electric's circuit alongside of the London & South-Western Railway to Southampton, having cost £25,280. The 180-mile line from Southampton to Guernsey and Jersey via Alderney originally had three Siemens & Halske relays in its circuit but these were found unnecessary. In 1860 the Channel Islands company was working 93½ miles of submarine line from Weymouth in England to Portland, Alderney, Guernsey and Jersey, and 23 miles of underground cable in wooden troughs on the islands, with three stations, open from 8am until 8 pm daily, and had 13 employees dealing with 11,102 messages. It used the American telegraph, made by Siemens & Halske, in its circuits. The cable, the longest domestic underwater circuit, manufactured and laid by R S Newall & Company, sadly failed, after many repairs, in June 1861 after having £4,010 more spent on it.

The Channel Islands company, in 1860, charged 5s 8d for a twenty word message to and from the Electric's provincial stations in England, 5s 0d to London, 4s 0d to Southampton and 1s 0d between islands. Messages were sent to and answers received back from London in 1860 in forty minutes.

The Submarine Telegraph Company had Glass, Elliot & Company lay a competitive circuit between Pirou, Normandy, in France and Filquet Bay, Jersey in January 1859, routing messages via Paris, Calais and Dover to London. When the direct cable failed in 1861 this became the sole route, with a consequential 50% increase in charges. The rate became 7s 6d when the Submarine simplified its prices in 1862. The two telegraph companies had offices in the same building on Jersey.

The *Isle of Man Electric Telegraph Company*, of Douglas, IoM, was formed in 1859 "for telegraphing messages to all parts of the island and to England". It was an entirely local promotion and, as the island is not a part of Britain, the Company was a statutory incorporation by the Tynwald, the Manx Parliament, on August 10, 1860, with a modest capital of £5,500 in shares of £10. Only £4,800 was needed to be called-up for a 36 mile long cable, manufactured and constructed by Glass, Elliot & Company of Greenwich in August, 1859 from Point Cranstal, four miles north of Ramsey, IoM, to Saint Bees' Head in Cumberland, England, using the chartered steamer *Resolute*. The Company also erected twenty miles of land line south from Cranstal to Ramsey and Douglas, and four miles more north from Saint Bees' to the town of Whitehaven, the nearest mainland telegraph circuit. The Manx company had telegraph offices at Atholl Street, Douglas and East Quay, Ramsey. The Chairman was Samuel Harris; its Secretary and Manager was Pieter Johannes Duyshart, who earned £226 in yearly salary. Messages were transmitted from Douglas, the Manx capital and its largest town, direct to Manchester in northern England using the American telegraph on the Electric's circuits. The Company was bought by the British Post Office for £16,106 in 1872.

The *Scilly Islands Telegraph Company* was promoted by Messrs Ashurst, Morris & Company, of 8 Old Jewry, London, in June 1869 with the support of Augustus Smith, who leased the Scilly Islands from the Duchy of Cornwall, after the Post Office refused to support a cable from the islands to the Cornish mainland. Along with the Islanders, over 600 merchants and ship-owners had lobbied for a telegraph to communicate with a notoriously dangerous area for shipping. The cable was to be constructed to the patent of William Rowett, also one of the promoters, with a single, india-rubber insulated, core and a thick hemp rope outer covering, manufactured and laid by the contractors, R S Newall & Company. As well as a thirty-one mile circuit from Land's End, the westernmost tip of Cornwall to St Mary's, the principal town of the Scilly Islands, there were to be two additional lines to the lighthouses on the islands' rocky shore. The principal circuit was completed on September 25, 1869, the Company having offices in St Mary's and Penzance in Cornwall for messages, charging 2s 6d for a twenty word message between the two places. In the latter it connected with the Electric Telegraph Company. The extensions to the lighthouses were not built, leading to great losses of life where immediate reports of several shipwrecks were unable to be sent to the coast guard. The hemp-covered cable failed and in April 1870 the Islands company employed Nathaniel Holmes, electrician and engineer to the Great Northern Telegraph Company of Copenhagen, with its several North Sea cables, to under-run it from the Scilly shore to find the fault and have it repaired. This proved a temporary measure and on June 20, 1870 W T Henley, the telegraph cable manufacturer and contractor, replaced Rowett and Newall's defective work with a new cable, having the usual iron-wire armouring. His work lasted until the government appropriated the Company's assets on April 24, 1878.

Finally, the *Orkney & Shetland Islands Telegraph Company* was promoted by a local merchant and landowner, George H B Hay of Laxfirth on Shetland, in 1868. Once again Nathaniel John Holmes was employed as electrician and engineer. The Islands company had a capital of £20,000, obtaining a modest guarantee of interest from the local boroughs. It employed WT Henley and Reid Brothers of London to successfully lay a 260 mile series of land lines and single-core cables from the town of Wick and the coast station of Voe in Caithness in the far north of Scotland across the Pentland Firth, through Orkney to Boddam and across the straits on to Lerwick in the Shetland Islands, with a separate section to Balta Sound on Unst, the most northerly inhabited island, in April 1870. It charged a Special Rate of 2s 0d for twenty words to Lerwick and 3s 0d to Unst. The main land cable broke in 1874 and was replaced, and the Shetland cable duplicated, in December 1874. However the damaged cable was repairable and the Company then had "double" cables. The message rate soared to 6s 0d for twenty words to pay for the new works.

The earliest underwater cables, domestic and foreign, of the Electric company were distinguished by having a single, relatively large diameter copper conducting wire as the core. Where traffic necessitated it, two or more cables were laid.

The Company's own steamer, *Monarch*, laid the Tay, Firth, Isle of Wight, Holland and Ireland cables and was kept busy repairing these and the Channel Islands' circuits for two decades. Other companies owning submarine cables used chartered vessels.

Monarch was built in 1830 by Pearsons of Thorne, inland south-west of Hull, for William Batchelor Brownlow and William Hunt Pearson trading as the Hull Steam Packet Company. She had a wooden hull and side-lever engines driving paddle-wheels. *Monarch* was, according to 'Lloyd's List of Shipping' in 1850, 512 tons gross, 295 tons register, 156ft 3ins long overall, 19ft 9ins in breadth and 14ft 6ins depth of hold, with a crew of eighteen. The hull had been lengthened twice, in 1844 and 1849, and had been newly "felted and coppered" in the latter year. Her two-cylinder engines achieved 130nhp. She had been employed by Brownlow & Pearson on the Hull to Hamburg route from April 10, 1830 for 23 years until sold to the Electric Telegraph Company.

The vessel was acquired by the Company on May 14, 1853, re-registered in London as No 18,604, with flag identity MNLF, and fitted-out to lay and repair underwater cables, with cable brakes, buoys, anchors, sheaves and winches. *Monarch* was fitted with the first picking-up machine, and became the first vessel to grapple for a lost cable and successfully carry out a repair at sea. The original on-board electrical instrumentation consisted of a vertical galvanometer in gimbals and a single-needle instrument for speaking to shore. Her home port was Lowestoft.

It was the Company's assistant engineer Frederick Charles Webb who searched out the *Monarch*, when she still belonged to Brownlow & Pearson of Hull, and arranged for the equipping for her new role. He selected her as she had holds less interfered with by beams than anything of the size he had been able to find. The price was £6,200, paid to the owner Pearson in cash, much to the distress of T C Bennett, the Electric's accountant, who had to hand the money over in person on the dockside in Hull.

F C Webb gave an account of his four years working with the steamer in the 'Electrician' magazine in May 1884. "The old *Monarch*, if she could not go fast - about seven and a half knots was her fastest, if I recollect right - could creak to perfection (she was a wooden ship, and twenty-three years old when we bought her). She used to begin with a deep groan below the deepest growl of a Lablache, or a Formes, and then slur up to a note an octave higher than the highest note of a Patti." Webb had a musical bent and clearly knew the opera singers of the day.

Webb continued "During the four years I gradually organised the system of buoys, mushroom anchors, bridles, grapnels, &c, which, with the picking up gear and brake, caused the *Monarch* to be the first ship regularly equipped for cable repairing, and she may consequently be fairly considered the father ['the mother', surely?] of the fleet of repairing steamers".

For almost all of her cable-laying life *Monarch* was under the command of Captain James Blacklock, who in addition to his duties as master mariner became, in the late 1860s, the Company's Submarine Engineer. He was a Scotsman, from Kirkcudbright, born 1821, obtaining his steamship master's certificate in 1854. After handling *Monarch's* operations for sixteen years, in April 1870, Blacklock was appointed to replace Sir James Anderson as Marine Superintendent of the Anglo-American Telegraph Company, managing its maritime affairs. He died in 1883.

The 'Illustrated London News' reported that the initial Holland cable was loaded into *Monarch* in five coils, two in the main hold and three in the fore hold, coiled alternately in order to keep the ship trimmed during paying-out, and in oblongs to save room. The cable was paid-out over a sheave erected on shear-legs over each hold, carrying it high over the deck and allowing it to untwist and straighten. Rope was used to secure the coils together in the holds and cut out gradually as the cable ran out. Twelve men worked in the cable holds.

Monarch, with all of her specialised equipment, was occasionally chartered to the Submarine Telegraph and the Magnetic Telegraph companies in the 1850s to repair their underwater cables.

The Electric Telegraph Company engaged at this time in two other foreign ventures; but overland rather than undersea. One of its directors, the railway contractor Morton Peto, commissioned the Company to erect a line-side overhead telegraph on the *Norsk Hovedjernbane* or Norwegian Trunk Railway, fifty-six miles with seven stations between Christiania and Eidsvold on Lake Mojoven. This was the first railway and first telegraph in the newly independent Kingdom of Norway; one-half the capital was English, Lewis Ricardo was a director, and it was engineered by G P Bidder. It was completed by Peto, Brassey & Betts on September 1, 1854.

In March 1853 Peto also commissioned the Company to build a telegraph alongside the *Sydslesvigske Jernbaner*, the South Slesvig Railway, incorporated in England as the Flensburg, Husum & Tönning Railway Company; known also, grandly, in London as the "Royal Danish Railway". It was intended to connect the North Sea and the Baltic Sea, and Denmark with Prussia, joining the towns of Rendsburg, Schleswig, Flensburg, Tonning, Esbjerg and Husum. Peto, Brassey & Betts were again the contractors for building the sixty-nine miles of railway works, and G R Stephenson, brother of Robert, was the engineer. The first major component of the Royal Danish Railway, from Tonning to Flensburg, was opened during October 25 1854. It was part of Peto's scheme to integrate the resources of the Eastern Counties Railway Company, the Port of Lowestoft and the North-of-Europe Steam Packet Company, all of which he had financed.

On March 16, 1854 the Company announced that it had opened a connection with Denmark through its Holland cables, and that, among others, the towns of Elsinor, Copenhagen, Kersoer, Nyberg, Frederika, Rendsburg, Hamburg and Altona were in that circuit.

The Electric Telegraph Company was responsible for erecting the 125 miles of poles and iron wires and the interior circuitry on both Scandinavian lines; which used Cooke & Wheatstone's two-needle system.

John Henry Greener was the Electric Telegraph Company's engineer in Norway and Denmark between 1854 and 1855. In 1855 he returned to become the Company's Assistant Engineer, surveying potential extensions into Ireland. Greener had acquired his electrical skills with the telegraphs of the London & Blackwall Railway in 1843 before joining the Electric. He left the Company in 1860 to undertake many telegraphic projects in India and the Middle East.

From this period the Company maintained a consistent policy of isolating risk in regard to capital. It carefully financed external projects, that is, new and technically-hazardous underwater cables, through subsidiary companies. The capital it raised in its own name was devoted to domestic land-based business. Only when the new business was secure did the Electric absorb its capital and its risks. Eventually, jumping ahead in this chronology, it also created a 'sphere of influence' in Europe based upon its enormous foreign traffic, driven by the commerce of London, Liverpool, Manchester and Glasgow. It held out the promise of revenues, as well as lending its technical and management support, to ever longer lines created by a series of foreign allies towards its strategic destinations.

The Electric Telegraph Company was always aware of the contribution of its staff. On Monday, January 9, 1854 the directors sponsored a supper for the 135 clerks working in Founders' Court at Radley's Hotel, 10 & 11 Bridge Street, Blackfriars. There were then 310 clerks working in the metropolis and 940 in the provinces.

Later that year, on June 2, 1854, the King of Portugal and his son, the Duke of Oporto, paid a ceremonial visit to the Central Telegraph Station at Founders' Court, along with the offices of 'The Times' newspaper.

Table 7

The Electric Telegraph Company
Four Years of Growth

	Line	*Index*	Wire	*Index*
Jul 1851	1,965	*100*	7,900	*100*
Jan 1852	2,122	*108*	10,650	*135*
Jul 1852	2,502	*127*	12,500	*159*
Jan 1853	3,709	*188*	19,560	*247*
Jul 1853	4,008	*204*	20,800	*263*
Jan 1854	4,409	*224*	24,340	*308*
Jul 1854	4,652	*230*	25,233	*320*

The above in English statute miles

	Offices	*Index*	Staff	*Index*
Jul 1851	224	*100*	485	*100*
Jan 1852	224	*100*	485	*100*
Jul 1852	201	*90*	565	*116*
Jan 1853	207	*92*	695	*143*
Jul 1853	254	*113*	715	*147*
Jan 1854	338	*151*	954	*197*
Jul 1854	374	*161*	1,152	*236*

	Income	*Index*	Expense	*Index*
Jul 1851	25,529	*100*	15,370	*100*
Jan 1852	24,336	95	15,370	*100*
Jul 1852	27,437	*107*	17,259	*113*
Jan 1853	40,087	*157*	26,241	*171*
Jul 1853	47,265	*185*	34,000	*221*
Jan 1854	56,919	*223*	38,000	*247*
Jul 1854	61,215	*240*	45,091	*291*

The above in pounds (£) sterling

	Messages	*Index*
Jan 1850	29,245	*100*
Jul 1850	37,389	*128*
Jan 1851	47,259	*161*
Jul 1851	53,957	*181*
Jan 1852	87,150	*291*
Jul 1852	127,987	*437*
Jan 1853	138,060	*470*
Jul 1853	212,440	*726*
Jan 1854	235,867	*807*

Statistics from 'Der Telegraph als Verkehrsmittel', Dr Karl Knies, Freiburg, 1857

In 1851 Julius Reuter arrived in London from Aix-la-Chapelle intending to establish an agency for distributing foreign news to the journals of London. The parochial press in Fleet Street and the Strand rejected his services and he commenced business on October 14, 1851 collecting and distributing commercial intelligence from continental sources for private subscribers in the business community, and providing British news for his overseas connections. He also, as a side-line, managed the private overseas telegraphic traffic of merchants unused to the new medium. In September 1853 Reuter "agreed with the Electric Telegraph Company to transmit all his dispatches, and such other messages as he could collect or influence, for a commission on the company's charges" through its new cables to Holland. This arrangement was extended in January 1854 when the Company agreed to support the development of Reuter's foreign news business by allowing him to send and receive public intelligence with a preferential discount of 50% on the ordinary message rates. Despite this it took him four years to convince the London press to use his service.

The Company's lawyers, Burchell & Parson, lodged a curious application for a Royal Charter in the name of a new concern to be called "The Telegraph Company," on January 4, 1854. It had as its objective the formation of "one continuous or uniform system of telegraphic communication between Dublin, the north of Scotland, Osborne, Windsor and London, and between those places respectively and the other principal cities and towns in the United Kingdom". Nothing is known of this new concern, but it is reasonable to surmise that it was to be a vehicle to acquire and unite the capital of the new competitive firms, formed after the lapse of the Cooke & Wheatstone patents, with that of the Electric Telegraph Company. It was not proceeded with and the Company took instead to negotiating agreements to avoid unnecessary competition in the summer of 1855.

Table 8

The Electric Telegraph Company and the Railways in May 1854

Compiled by Dionysius Lardner

	Miles of Wire	*Instruments*
Bangor & Caernarvon Railway*	26 ¼	6
Birmingham, Shrewsbury & Stour Valley Railway*	226	19
Chester & Holyhead Railway*	336 ¼	15
Eastern Counties Railway	1,372	205
Eastern Union Railway	87 ¼	8
Exeter & Crediton Railway	82 ½	4
Furness Railway	3 ¼	2
Great Northern Railway	1,499	49
Great Western Railway†	1,952 ½	102
Lancashire & Yorkshire Railway	436	41
Lancaster & Preston and Lancaster & Carlisle*	188	9
London, Brighton & South Coast Railway	327	53
London & Blackwall Railway	20	4
London & North-Western Railway*	4,522	167
London & South-Western Railway	799 ¼	38
Manchester, Sheffield & Lincolnshire Railway	385	31
Maryport & Carlisle Railway	56	9
Midland Railway	2,451 ¾	114
Monmouthshire Railway*	64	14
North London Railway*	73	3
North Staffordshire Railway*	748 ¼	32
Oxford, Worcester & Wolverhampton Railway†	249	30
Shrewsbury & Birmingham Railway†	118	9
Shropshire Union Railway*	58 ½	3
Shrewsbury & Chester Railway†	182	9
Shrewsbury & Hereford Railway	104 ¼	16
Newport, Abergavenny & Hereford Railway†	82	3
Hereford, Ross & Gloucester Railway†	10	2
South Devon Railway†	432 ½	27
West Cornwall Railway †	50	7
South-Eastern Railway	970 ½	112
South Staffordshire Railway*	30	11
South Wales Railway†	691	49
Taff Vale Railway	63 ½	7
Vale of Neath Railway†	49	9
Whitehaven Junction Railway	24	4
York, Newcastle & Berwick Railway	1,532 ¾	64
York & North Midland Railway	521 ¼	40
Edinburgh, Perth & Dundee Railway	196	11
Edinburgh & Glasgow Railway	402 ¾	14
Dundee & Arbroath Railway	13	1
North British Railway	352 ½	12
Scottish Central Railway	4	0

London Offices
500 76

Of these instruments 1,250 were Cooke & Wheatstone double-needle, 177 Cooke & Wheatstone single-needle and 29 Bain printers. The Bain lines connected the major cities. The single-needle apparatus was then used primarily on rural branches and to control access to tunnels and single-line railways. There were no single-needle telegraphs as yet in use in London.

Worth noting is the concentration of wires in the north-east of England in 1854 due to the railways in the north-west being contracted to competitive companies. The lines marked with an asterisk * are those of the London & North-Western Railway and its allies; those with a dagger † are those of the Great Western Railway and its associated companies.

Mid Decade

On June 1, 1854 the Company introduced *Franked Message* stamps, relatively large adhesive labels (quite large enough to have abbreviated regulations on their face and to be signed by the sender) for twenty word messages, in three denominations, under 50 miles on pink paper (1s 0d), under 100 miles on blue (2s 6d) and over 100 miles on white (5s 0d) that could be stuck on to its ordinary message forms or even onto plain paper. Messages could be so pre-paid and left at or delivered by one's servant to one of its stations, speeding up the transaction. In January 1855 the wordage and mileage limits on these large label-like stamps were abandoned and more flexible monetary values adopted. In August 1855 the rate changed after "free" addresses were allowed and the Franks then were valued at 3d, 1s 0d, 1s 6d, 2s 0d, 3s 0d and 4s 0d, all on different coloured papers. These were used until 1861.

The Franked Message stamps were available from stationers in addition to the Company's offices, in London these were: W J Adams, 59 Fleet Street; J Airey, 53 Shoreditch; H Good, 60 Moorgate Street, A J Hall, 78 Old Broad Street; Vacher & Son, 29 Parliament Street; and Waterlow & Son, 49 Parliament Street, 24 Birchin Lane and 65-68 London Wall.

Many businesses about the country began to sell the Electric's message forms and stamps and became *telegraph agents*, forwarding messages to the nearest office on the lines between 1854 and 1856.

In the same month, June 1854, the Company opened an independent marine telegraph connecting Hurst Castle, where the Isle of Wight cable left England on the western entrance to the Solent, with the port of Southampton. It erected masts for flags at the Castle using Captain Marryat's *Code of Signals for the Merchant Service* to speak with inbound steamers that they might inform their owners and agents at the port of their cargo. One of its first uses was to give notice of the arrival of the visiting King of Portugal's fleet to Queen Victoria.

As it gradually expanded in domestic lines and its investment in overseas cables the paid-up and debt capital of the Electric Telegraph Company reached an impressive £512,000 in 1855. In that year it was authorised by Parliament to merge its capital with that of its subsidiary, the International Telegraph Company, which owned several cables to Europe through Holland, to create *The Electric & International Telegraph Company*, a remarkably cumbersome title. The Act of 1855 allowed it to use either the new or the original title for its business, which it did interchangeably. To the end, with the public, it was still 'the Electric'.

Just at this moment Britain, France, Sardinia and Turkey went to war with Russia. The conflict had a severe, if temporary, effect on the British economy particularly on iron, coal and foreign commerce. The telegraph benefited from some increased 'distress' traffic but not from the consequent fall in investment as capital was distracted.

In support of the war the Company trained a corps of soldiers in single-needle telegraphy and provided the army with a waggon-train carrying all the apparatus – instruments, batteries and underground cable – for a field telegraph, the first in the world. The twenty-four man corps and its equipment was landed in the Crimea during the frozen month of December 1854 and had connected all of the fighting units, supply bases and headquarters with electric telegraphy by March 1855.

In November 1854, as the hostilities commenced, the Electric Telegraph Company arranged that any *officer* engaged in the Russian campaign could send a message by the continental telegraph system to its station at The Hague and it would be forwarded to their relatives or friends in Britain without further charge.

A new Special Act of Parliament obtained by the Company in 1854 gave limited-liability protection to all of its shareholders, encouraging investment.

Maturity & Success

At home the greatest length of any one line in the Electric's system in 1855 was about 600 miles, from Aberdeen to Plymouth. Each two-needle telegraph circuit required at this time two wires (with earth returns); traffic on the busiest segments required multiple circuits; the line from London to Rugby had nine wires, from Newton Junction (where the London and the Manchester circuits combined) to Liverpool eleven wires, and from York to Newcastle ten wires. The odd single wires were the Bain lines working chemical printers.

It then possessed 27,711 miles of wire, with 404 stations and 2,458 Cooke & Wheatstone and Bain instruments. In 1855 it worked 717,404 messages.

In the year 1855 the Company negotiated away price competition in messaging.

The Chairmen of the Electric Telegraph Company and of the English & Irish Magnetic Telegraph Company signed an agreement on July 19, 1855 fixing their message rates to a national joint tariff. This unpublished collusion became effective on August 1, 1855.

The Electric's shareholders' meeting reported on August 2, 1855, that the British Telegraph Company also adopted the unified tariff. It remained operative until the end of the public companies in 1868.

From this time, 1855, the Company began to make more intense use of its circuits, doubling its capacity, if not its effectiveness, by gradually replacing its double-needle instruments using two-wires with the single-needle apparatus that used single wires. This also allowed it to install American electro-magnetic printers for high-density traffic on the same circuits, rather than have separate Bain chemical circuits as it had previously.

Table 9

Electric Telegraph Company

Staff at the principal stations 1854

From the 'North British Review', February 1855

	London	Liverpool	Manchester
Male clerks	141	34	41
Female clerks*	52	12	17
Messengers	83	19	16
Engineers	9	-	-
Total	*185*	*65*	*74*

Total by employment 1854

Clerks & Messengers	994
Female clerks	81
Engineers	139
Total staff	*1,214*

* Females were only employed in these three stations

C F Varley, the Company's electrician, was not content with the "on-off" key of the original American telegraph, and in 1854 introduced *current reversal* or *double current* operation. The line current was kept permanent for the duration of the message and the ingenious key or tapper was enabled to reverse the polarity of the circuit to indicate the dot or dash. This reduced retardation in the circuit (extending its viable length), simultaneously reducing the battery power and the number of relays required. Used originally for underwater and underground lines where retardation was a critical issue, it was applied to the Company's overhead domestic long-lines in Britain using the American telegraph. From 1854 no other land circuits were as efficient as those of the Electric Telegraph Company.

In the next year, 1855, Varley perfected his 'translating' apparatus for the American telegraph. This enabled, for the first time, consistent transmission of messages over the longest circuits from point-to-point by the introduction of sophisticated automatic relays. An example cited a message routed from Windsor Castle in southern England to Balmoral in northern Scotland. On being keyed in Windsor it was first 'translated' at York, then in Edinburgh, then finally in Aberdeen before the printer marked the tape, almost instantaneously, in Balmoral. The new 'translator' was installed at Amsterdam on the cables to Holland, converting the English electrical system to the simpler European circuits automatically, so enabling direct messaging between London and Frankfurt and Berlin.

The new word *telegram* was to gain popular countenance during 1856 and in subsequent years; although the expression was first noted approvingly by 'Jackson's Oxford Journal' on July 17, 1852. 'The Times' newspaper first used the word only on September 14, 1857 quoting messages relating to the mutiny of troops in India. Its popular acceptance was brought about primarily with the widespread appearance of the by-line "Reuter's Telegram" on many newspaper articles on foreign subjects from 1858.

In March 1856 the Queen's Speech on the opening of Parliament, totalling 701 words, was sent from Founders' Court to Amsterdam, using the American telegraph for the first time. It travelled a distance of 321 miles by overhead wire alongside the Eastern Counties Railway to Lowestoft, the International company's cable and its wire from the Hague, and was printed, in just 20½ minutes. The telegraph clerk in London was an eighteen-year-old girl who transmitted at a speed of nearly thirty-five words a minute. Two words had to be corrected by interchange of signals, all within the time specified.

With the formal end of the war with Russia, effected by the Treaty of Paris on March 30, 1856, the Company's continental connection through Holland and Prussia was speedily restored. By May 5, 1856 a new direct circuit had been opened between London and St Petersburg; at 1,700 miles it was the longest line of telegraph then in existence.

On April 23, 1856 the Company used the steam tug *Wilberforce* to lay a two-mile cable across the Humber river, between Hull and New Holland. This was to form part of a long line from Hull to Grimsby and Peterborough through to London to be opened by mid-May.

On October 8, 1856 W F Cooke hosted a dinner for the visiting "electrician" S F B Morse at the 'Albion' Tavern at 153, Aldersgate Street, in the City of London. Attending the event were Lord Charles Clinton, Sir James Carmichael, Charles Fox, General William Wylde CB, Dr William O'Shaughnessy, Rowland Hill, Cyrus Field, John Watkins Brett, Charles Tilston Bright, Edward Bright and Thomas Crampton; important and pioneering figures in engineering and telegraphy from Britain, America and the empire. But other than Cooke and Wylde, no one attended from the Electric Telegraph Company, such was their opinion of the American gentleman's pretentions.

Morse's visit was connected with the promotion of the Atlantic Telegraph Company and the first intercontinental cable, between Europe and America. The Electric took a cautious view of this immense project; none of its directors or its technical staff were involved in its projection, and its management had their own opinions on the viability of underwater circuits.

Coincidentally, the 'Albion' Tavern, run by John and Thomas Staples, "purveyors of turtle", was the venue for the semi-annual dinner held by the directors after the shareholders' meeting of the Electric company.

Kieve records the principle proprietors in 1856:

Thomas Brassey	£38,850
W F Cooke	£25,575
Thomas Critchley	£25,000
E R Langworthy	£28,575
J L Ricardo	£19,025
Albert Ricardo	£18,075
Robert Stephenson	£14,275

The paid-up capital stock had reached £707,600. There were 442 stockholders in 1856, up from 8 in 1846; 2½% of the proprietors held over 30% of the stock.

Critchley was a cotton merchant from Manchester, living adjacent to Lewis Ricardo in Lowndes Square, and a director with him of the North Staffordshire Railway. Langworthy was also a merchant from Manchester, and sometime Mayor of Salford.

The Electric Telegraph Company reported in January 1857 that it possessed 5,398 miles of line, 28,627 miles of wire requiring 136,000 poles, and 2,121 instruments with 653 bells. It advertised in 1857 that it has circuits along at least some of the lines of the following sixty-three railway companies: Aberdeen; Bangor & Carnarvon; Birkenhead, Lancashire & Cheshire Junction; Birmingham, Wolverhampton & Stour Valley; Bristol & Exeter; Buckinghamshire; Caledonian; Chester & Holyhead; Deeside; Dublin & Drogheda; Dundee & Arbroath; Eastern Counties; Eastern Union; Edinburgh & Glasgow; Edinburgh, Perth & Dundee; Forth & Clyde Junction; Furness; Great Northern; Great North of Scotland; Great Western; Hereford, Ross & Gloucester; Hull & Holderness; Lancashire & Yorkshire; Lancaster & Carlisle; Lancaster & Preston Junction; Lancaster & Skipton; Leeds & Bradford; London & Blackwall; London, Brighton & South Coast; London & North Western; London & South Western; London, Tilbury & Southend; Manchester, Sheffield & Lincolnshire; Maryport & Carlisle; Midland; Monmouthshire Railway & Canal; Newmarket; Newport, Abergavenny & Hereford; Norfolk; North British; North Devon; North London; North Staffordshire; North Union; North Western; Northern & Eastern; Oxford, Worcester & Wolverhampton; Perth & Dunkeld; Port Carlisle Dock & Railway; Scottish Central; Scottish Midland; Shrewsbury & Birmingham; Shrewsbury & Chester; Shrewsbury & Hertford; Shropshire Union; South Devon; South Eastern; South Staffordshire; South Wales; Taff Vale; Vale of Neath; Whitehaven & Furness Junction; and the West Cornwall. On the Caledonian and Dublin & Drogheda railways the circuits were limited to short branches. At that moment there were 243 separate domestic railway companies of varying sizes and states of organization.

With the consolidation of the competitive lines in January 1857 into the British & Irish Magnetic Telegraph Company, as the second wholly national network the Electric launched a widespread press advertising campaign in the new firm's northern heartland. It emphasised its much larger number of stations in Britain.

Electric Telegraphs
of the United Kingdom 1857
September 29, 1858

"The Electric & International Telegraph Company had at the close of last year, 5,637 miles of telegraph, which were provided with 29,498 miles of wire; the British & Irish Magnetic Company had 3,441 miles, with 15,688 miles of wire; and the South Eastern Railway Company 301 miles, with 1,296 miles of wire, making a total of 9,379 miles of telegraph, with 46,482 miles of wire. The number of stations open for the public were, on the Electric & International Telegraph Company's line 460, on the Magnetic 230, on the South Eastern company's 80; and the number of instruments employed were 2,938 in the Electric & International, 574 in the Magnetic and 141 in the South Eastern, making a total of 770 stations, and 3,653 instruments.

"The total number of messages transmitted during the year was 1,241,163, which were thus distributed: Electric & International company 844,668, British & Irish Magnetic company 356,186, South Eastern company 40,309. The number returned by the first named company does not include the business messages by the sixty-eight railway companies with whom the company has agreements, and by public offices, and which are estimated at three times the number sent by the general public. Neither are they included in the return the number of messages which were transmitted by the company to 142 provincial newspapers and 55 reading-rooms, which are daily supplied with the heads of the public news.

"In the case of the British & Irish Magnetic company no account is taken of about 250,000 messages which were transmitted jointly with that company and the Submarine Telegraph Company to and from the company and from various railway companies, newspapers and news-rooms.

"The total increase in the number of messages during the last three years upon the lines of the three companies above named has been from 1,017,529 in 1855, to 1,121,523 in 1856, to 1,241,163 in 1857 and the total mileage has increased from 43,720 miles in 1855 to 46,482 in 1857."

A widely published newspaper report based on returns to the Board of Trade

---

The chairman, Robert Stephenson, reported in 1859 that the first generation of its submarine cables was decaying and due to the shallow nature of the German Bight were vulnerable to anchor-damage. He noted that some lasted five years, others ten. The Electric had spent £140,000 on these continental and domestic cables, and would henceforth set aside £14,000 a year to enable their complete renewal over a ten year cycle. It had had a policy of sponsoring domestic cable companies, but still had to maintain and periodically re-lay its own foreign wires to Europe by way of Holland.

A new exceptionally heavy underwater cable with four cores was laid by the Company between September 19 and 21, 1858 from Dunwich at Orfordness to Zandvoort in Holland to replace its original four lightweight circuits, which had suffered repeatedly from ships' anchors. It was engineered by Latimer Clark and manufactured by Glass, Elliot & Company. The four old cables were then raised to recover the copper cores for scrap and reuse. Foreign traffic was of such importance that the Company had to lay another heavy four-core cable between Lowestoft, and Zandvoort in 1862; this too was made by Glass, Elliot. The change of landing place to Lowestoft was found necessary as Dunwich was a major roadstead for anchoring ships, which caused damage even to the new heavy shore end cable.

The first Zandvoort cable was enveloped in drama and incident, with accusations of industrial sabotage.

In the Guildhall Court in London, on February 20 and 21, 1861, Glass, Elliot, the makers of the Company's heavy cable between England and Holland of 1858, sued George Boswall, London agent of R S Newall, its chief competitor, for damages. Boswall was accused of engaging a man named Curtis to accompany the cable-laying expedition to drive a series of iron nails into the cable to destroy its insulation on submersion.

Curtis admitted his actions to the court, but Boswall's plot was only partially successful, just one of the four cores was penetrated. His damage cost the Company something like £4,000 to £5,000 in attempts to repair.

The courts awarded Glass Elliot £3,875 1s 10d in compensation for the sabotaged cable. But as it was Boswall alone who was sued by Glass Elliot he promptly declared himself bankrupt in December 1861 with debts of £150 and assets of £300. As the prosecution of Boswall was a civil and not a criminal matter Glass Elliot's award had no more value than any of his other trivial debts.

The 'Northern Daily Express', of Newcastle-upon-Tyne, in May 1862 obtained and printed correspondence between R S Newall in Gateshead and Boswall in London that showed that they had both directed the events of 1858, instructing Curtis and another of their employees, named as Craigie, a foreman rigger, to enter the works of Glass Elliot and to board their cable transports, "offering their services as sailors". The spying and sabotage was organised by one Stevens, Newall's warehouse manager at Blackwall, on the opposite bank of the Thames from Glass Elliot's wharf. All of this Newall denied in court - effectively, as the newspaper's article proved, perjuring himself.

Newall left the submarine cable business in 1860. The Atlantic cable of 1858, and several others that his firm had manufactured for the Mediterranean Sea and Indian Ocean, failed, at huge cost to their promoters.

The old single-core cables were not wasted. When the Company's two Dublin cables failed in 1859 they were replaced in 1861 by its ship *Monarch* laying a single circuit using Newall's salvaged material from 1854 and 1855. This, too, lasted four years...

The Prince of Wales visited the Central Station at Founders' Court on February 21, 1857, being shown around by the directors Thomas Critchley, Mark Philips and Richard Till. His Royal Highness, the newspapers noted, was particularly "attracted to the direct communication with Hamburg, Berlin, Vienna, &c."; possibly contemplating messages to and from his many royal relatives in the German states. The Prince was to join his Royal mother in having a private telegraph installed at his residence.

Due to the direction and nature of their business the clerks in the Foreign Gallery commonly were of German origin and spoke German among themselves. Their traffic in October 1857 reached out to Hamburg, Berlin, Vienna, Trieste, Stettin, St Petersburg, Moscow and even Kiev. On May 2, 1858 a direct circuit to Constantinople in Ottoman Turkey was opened for the first time. The response was in French as they then controlled the telegraphs there.

The Company ventured northwards in Britain with a new telegraph office and news-room in Inverness, at the eastern end of the Great Glen in the north of Scotland, on June 28, 1859. The citizens of Inverness had lobbied for the telegraph since November 1856 but had to wait for the opening of the Inverness & Aberdeen Railway, and the wayleave it offered the Electric company, to have access to foreign parts, such as England and the Continent. This was to be the farthest north that the Company's circuits reached for nearly ten years.

The Electric Telegraph Company had an authorised capital of £1,148,000 of which it had called-up £827,885 in 1859. The latter half of the 1850s had seen its greatest level of investment, so that in 1859 it had 32,499 miles of wire, 552 stations, of which 37 were in London, and carried 1,025,269 messages, employing 1,594 people.

Table 10

The Electric Telegraph Company
Growth 1850 – 59

	Miles of Wire	*Stations*	*Staff*	*Messages*
1850	7,046	257	-	64,734
1851	9,400	224	-	99,216
1852	15,737	207	-	211,137
1853	20,588	338	-	345,793
1854	23,570	420	1,281	572,216
1855	27,729	404	1,131	745,880
1856	28,875	423	1,114	812,223
1857	29,613	460	1,201	881,271
1858	31,144	519	1,305	870,143
1859	32,678	552	1,594	1,025,269

These figures, and those for profits, are all taken from a Parliamentary report prepared at the end of 1860.

Telegraph Street

By February 1859 the Electric & International Telegraph Company outgrew its handsome Central Station at Founders' Court and offices in Moorgate Street, moving its secretary's, accounting and engineering departments, with a new telegraph gallery for clerks and instruments, a few hundred yards north to a new building, its *General Offices*; a tedious three-storey-and-basement, ten-window wide brick building on the northern side of Great Bell Alley off Moorgate Street. The Company had 200 employees there in 1868, over half of which were women clerk-operators. It was, remarkably, next adjacent to the office that W F Cooke had once occupied in the 1840s at Copthall Buildings. The architect was the same Henry Arthur Hunt who had designed their Founders' Court premises, now elevated to the position of Surveyor of Her Majesty's Works and Public Buildings, with chambers at 4 Parliament Street, Westminster, rather than lowly Lambeth.

The pneumatic tubes from the satellite offices at Mincing Lane, Cornhill and the Stock Exchange, as well as a new line from Founders' Court, were brought together at a single station in the General Offices, and a further internal "air circuit" added to transmit documents and even small packages from room to room between departments.

The 'Illustrated London News' in 1859 gave a comprehensive description of the new General Offices:

"Messrs Hunt & Stephenson have had to apply architecture to the novel requirements of the telegraph, and have, for the sake, principally, of obtaining light, extended this great telegraphic gallery over the whole top of the building."

"It is well known that the cause of female labour owes much to this company. The directors have developed a new branch of female employment, and one which appears admirably suited to their capabilities and comfort. The foreign gallery in this building is worked by male telegraphists, nearly all foreigners; but the great gallery, in which the telegraphic business of the United Kingdom is performed, is worked solely by young females. There are, at the present time, ninety-six or ninety-seven young ladies engaged daily; and, apart from the telegraphic requirements in the gallery, every arrangement appears to be made for their comfort and privacy."

"It may be interesting to give the dimensions of this unequalled telegraphic gallery: The room is about eighty feet in length, thirty feet in width, and thirty feet in height. It is lit from the roof with a steady northern light, and by large windows at the sides and ends: these serve also for ventilation. Two large sun burners (ceiling gaslights and air-extractors) are provided, and a gaslight with shade to each instrument."

"Adjoining this room is the foreign department, thirty-one feet by twenty-four feet."

"The male and female telegraphists have separate staircases to gain their respective offices: that for the men leads from the principal staircase. The female clerks have a private staircase, leading from their large room direct to the street-door of the premises. By this staircase also they descend to a dining-hall and cloak-room, which are provided exclusively for them. The ground floor is occupied by the sending-out offices and superintendent's room. The secretary's offices and the board-room are on the first floor."

A writer for 'The Electrician' magazine was conducted around the new General Offices during late January 1861. They were accompanied by W H Winter, the Company's assistant engineer in London. The description of the Instrument Room or Gallery described it as being 80 feet by 37 feet in size, with all of the desks or tables facing north. Wiring was all concealed behind panels with only brass connecting screws visible. Each of the lady clerks at the American telegraph was responsible for four pieces of apparatus; the transmitting key, the inker or receiver, the relay magnet for the receiver and a galvanometer. Unlike older relays, that for Varley's current reversing operation did not require constant adjustment. In the same room there were also Bain writers still being worked and Cooke & Wheatstone needle telegraphs for lines along the railways. For the divisional lines batteries were now connected only at either end of the circuit and kept connected, as in American working, so the line was always live. The American inker was generally operated at 22 words per minute, up to a maximum of 30 words per minute, as on, for example, the long line from London to Liverpool.

The principal Instrument Gallery was headed by Mrs Craig, the Lady Matron; the Continental Gallery by Mr Fischer. It was noted by the latter that the direct line from London to Berlin in Prussia was automatically retransmitted by Varley's relays at Amsterdam and Hanover. The clerks had to be aware that there was a 19 minute time difference between London and Amsterdam and 54 minutes with Berlin.

The journalist visited the Battery Cellars and the Engine Room in the basements. "Arranged side by side upon shelves, like the coffins in some ancient catacombs, are a multitude of wooden boxes from which the proceeds the life of the electric wire." There were 750 battery boxes each containing either 10 or 12 cells. They were divided into three categories, for the continental lines, for the domestic lines and for the local relay magnets. The first two sorts were Muirhead's adaptation of the Daniell sulphate battery, being a 40% improvement in material consumption. The local relays were powered by Varley's gravity batteries. Distribution was by means of circuit boards with brass binding screws in sets of four; the lower pair of the four being connected to a set of batteries, the upper pair connecting to circuit boards in the Instrument Gallery. There were 800 wires leading from the battery cellar to the instrument galleries where more circuit boards connected with the instruments and from the instruments to the external lines, with one multi-core earth wire connecting to an earth plate attached to the gas and water mains.

Remarkably, the Company persuaded the district's municipal authority, the City Corporation, to rename the alley, Telegraph Street; so that its formal headquarters' address became 12 – 14 Telegraph Street.

Of course, all of the metropolis' underground electric circuits had to be diverted to originate at Telegraph Street: these in 1859 were 1] west to Paddington railway station by way of Gresham Street, Holborn and Oxford Street; 2] south-west to Westminster and Parliament by Fleet Street and the Strand; 3] south to the Borough (Union Street, Southwark) via London Bridge railway station; and 4] north to the Angel, Islington along the City Road, past Euston Square and King's Cross railway stations. From these conduits, the two other vital underground trunks ran 5] from Finsbury Square eastwards to Shoreditch railway station, and 6] the very first subterranean cable, south from the Strand to the Waterloo Bridge railway station.

A correspondent of 'The Telegrapher' magazine of New York added his observations on the Company's General Offices in May 1, 1867, "The largest and most extensive telegraph station in the world... is anything but an imposing or creditable specimen of the architecture of the nineteenth century. It appears to have no design or plan in particular, but consists of an irregular conglomeration of dark passages, staircases with sharp angles, ill-shaped and worse proportioned rooms, and doors placed in all sorts of uncomfortable positions, and without the slightest attempt at finish or decoration, and the whole rendered, if possible, more dismal by the faint, sea-sick looking green, with which favourite colour passages and rooms have one and all (apparently not very recently) been painted." [*The charm of S F B Morse was apparently still alive and well.*]

"The most remarkable features about the establishment are, of course, the operating rooms, which are situated at the top of the building. There are but two rooms, the largest containing about eighty instruments, principally Digney's ink-marking registers, with Siemens' improvements, together with a few needle instruments. All these instruments are worked by young ladies. They appear not only to be well-fitted for the work, but the employment seems to suit them; for they chat and read and work while waiting at their instruments for a message, and seem, altogether, very merry."

"The instruments in this room are entirely devoted to the English circuits."

"The smaller room, called 'the Continental Gallery,' is devoted to the Continental and other important submarine lines. Here all the instruments, about twenty in number, are worked by young men. The lines are now worked through direct to the Dutch Government offices in Amsterdam. Direct communication is, however, daily kept up to towns far beyond that point, the lines being switched through at Amsterdam to such towns as may be required, from day to day. Berlin being an important telegraphic point, one wire is kept constantly through to the office there, so that all messages destined for that city, or points beyond, are sent to Berlin direct. Frankfort is nearly always, in a like manner, communicated with direct, the wires being 'put through' at Amsterdam as occasion requires. Constantinople and St. Petersburg are also frequently spoken with direct, though not as a general rule."

"On the English circuits, Edinburgh is now always worked with direct, and as twenty years ago it was considered a feat to work through fifty miles, some idea may be formed of the improvements that have since been made in the insulation of these wires."

"The batteries for all the instruments, both for the main and local circuits, are kept in the cellars underneath the building. The Muirhead battery - a modification of Daniells' - is employed, no less than *nine thousand cells* being in use in this station. The combined length of wire within the building is over thirty-five miles."

"Mr Latimer Clark [had] introduced the pneumatic system, by which the message papers are, as it were, sucked through a lead pipe from some of the nearer metropolitan stations to the central station, whence they are telegraphed on in the usual manner. By this process messages could only be sent to the central station, the plungers which contained the messages having to be carried back by messenger. Mr Varley added the employment of a plenum chamber, and pressure to send messages from the central station."

"The apparatus consists of a wrought-iron vacuum-chamber, five feet in diameter, and ten feet high. A twenty horse engine works an air-pump, which constantly exhausts air from this chamber, and another pump pumps air into the plenum chamber. Lead pipes, 1 5-8 inches in diameter, for the shorter distances, and 2 1-8 [inches] for the longer distances, are encased in cast-iron pipes underneath the streets. A small plunger or carrier, consisting of a cylindrical box of gutta-percha, open at one end, and the edges of which just fit the pipe, carries the message papers. When a carrier has to be sent, the station signals by telegraph to the central station, and the pipe is turned in to the vacuum chamber, and the carrier arrives and is taken out through a door in the side of the pipe. In sending carriers from the central station the pipe is turned into the plenum chamber. There are several ingenious details in the arrangement."

"The time of transit varies according to the number of pipes open at the same time. There are seven of them in all, the largest being nine hundred and eighty yards, or a little over half a mile in length. The time of transit for this distance is from forty-five to sixty seconds."

By 1870 there had been some alterations to the General Offices; in the later 1860s east and west wings were added to the building. The basements then contained the engine room, the messengers' waiting and dining rooms and the stores; the ground floor, the offices of the station manager, the accountant and the engineers; the first floor, the board room, the secretary's offices and the intelligence department; the second floor, the dining rooms for the male and female clerks, and the third floor, the instrument galleries for the receipt and transmission of messages. The Anglo-American Telegraph Company and the Indo-European Telegraph Company then both leased rooms for their instruments, connecting with America and India respectively.

The General Offices had no counters for taking in messages, it was, in the Company's language, a "transmission station" through which messages to and from all of its London offices passed; Founders' Court in Lothbury was to remain to the end its largest and most profitable public office, originating over *one-third* of the Company's annual income. It even had a small Post Office for letters adjacent to its main hall, replacing the old "Founders' Arms" public house.

Table 11

The Electric Telegraph Company
Profits 1850 - 1859

	Gross Revenue	*Dividend*
1850*	£ 43,523	4%
1851	£ 49,866	6%
1852	£ 67,525	6½%
1853	£ 104,185	6¾%
1854	£ 123,231	6½%
1855	£ 144,928	6%
1856	£ 165,776	6½%
1857	£ 180,734	8%
1858	£ 177,638	6½%
1859	£ 201,674	6¾%

The drop in profits after 1857 can be explained by the American financial panic of that year brought about by outrageous speculations which had Atlantic trade at a new low for a couple of years.

* The year 1850 figures as published by the Company; otherwise they are from government returns

The complicated freehold and leasehold arrangements of the Founders' Court premises were finally rationalised in 1863. The building and the connected house in Moorgate Street were sold for £5,839 and the ground rent reduced by £800 per annum. The Company only retained the great public hall as its Central Station, the upper floors being taken over by offices for merchants and brokers. All of the electrical apparatus had then been moved to Telegraph Street and connected by pneumatic tube to the public counters in Lothbury.

Organisation & Structure

The Electric Telegraph Company was organised in geographical Districts each under a District Superintendent assisted by an Electrician and a Cashier, managing a corps of Inspectors, Mechanics and Linemen. The Superintendent also had responsibility for any construction works in their area. The Superintendents reported weekly and monthly to Moorgate Street and met together each quarter to address management and technical problems. The Districts were based on responsibility for between 250 to 500 miles of line. Originally these were founded on and designated by the largest cities and railway companies, however by the end of the 1850s they had consolidated into nine administrative areas:

- Northern District, York
- South Western District, Southampton
- London District, Central station
- Midland District, Derby
- Western District, Bristol
- Scottish District, Edinburgh
- Eastern District, Norwich
- North Western District, Liverpool
- Irish District, Dublin

There was also a Submarine Electrician of District responsibility overseeing the new cables, based in Lowestoft, on board the Company's cable-steamer, the *Monarch,* and a large stores department.

Each District comprised several Divisions; from four to six telegraph stations in their own circuit, of from fifty to a hundred miles length. At either end of the circuit was a so-called *transmission station* in a large office which connected to the separate long-lines that paralleled the Division wires. Messages in and out of the Divisions were switched or transcribed at these points.

The Districts each employed six or so Inspectors of Division, a Mechanic to maintain the apparatus, sixteen or so Linemen looking after the insulators and overhead wires and around forty Labourers. The number of labourers in service varied widely, dependent on construction and maintenance needs.

Management had a flat hierarchy: the Board of Directors, the Secretary & Manager, the District Superintendents and Clerks-in-Charge of stations; supported by accounting, electrical and engineering staff. There was also the corps of Inspectors that visited offices and stations to record problems for head office. It employees, whether clerks, mechanics or messengers, worked long hours, as it had a policy of paying overtime rather than taking on more people.

In 1868 the annual salaries of senior members of staff, indicating their importance to the Company, were:

- Henry Weaver, Secretary and General Manager, £1,600
- C V Boys, Superintendant of the Intelligence Department, £775
- Henry Schütz-Wilson, Assistant Secretary, £575
- W T Ansell, General Superintendant in Ireland, £406
- Benjamin Sutterby, Sporting News Reporter, £400
- John Muirhead, Superintendant of Stores, £360

To these can be compared the retainers for:

- Latimer Clark, consultant engineer, £100
- Cromwell Varley, consultant electrician, £200

These two would, in considerable addition, earn fees for work that the Company commissioned of them.

Message charges were now going down and efficiencies increasing - during 1855, the average cost of the Electric's messages was 4s 1¾d, of which working expenses were 2s 7d; in 1868 the average cost was just 2s 0¾d, with working expenses reduced to 1s 0¼d.

The Last Decade

The Company approached the French government in 1859 with an offer to lay a new cable across the Channel between Newhaven and Dieppe, guaranteeing a low tariff. This was done to break the monopoly concession of the Submarine Telegraph Company between France and Britain, which was then renegotiating its rights in Paris. The French rejected the proposal but compelled the Submarine company to make the new cable instead.

By 1860 the Electric Telegraph Company's paid-up capital had reached £827,885, consisting of £719,900 in consolidated stock and £107,895 from an issue of 7,199 new £25 shares, on which £23 was paid-up. This had been applied to its expansion in land lines and, particularly, in domestic and continental underwater cable circuits. Its income in that year was £4,000 per week, up from £100 a week ten years previously.

On July 31, 1860 the Company contracted to erect a private wire from the city of Aberdeen to the Queen's new residence in Scotland at Balmoral Castle.

It also opened its own telegraph office in Hamburg on August 9, 1860. This, managed by Henry Ree, was at 5 Arcade, in the Hamburg *Bourse* or Exchange. As one of the Hanse cities Hamburg was, at that time, independent of the telegraph systems of the surrounding German states, and one of Europe's largest trading ports.

In June 1861 George Warren, a twenty-two year-old telegraph clerk in the Electric company's service, was attached to the Royal Household. On July 30, 1862 he was appointed *Court Telegraphist*, a position he held until his death in 1896, transferring his employ from the Company to the Post Office in 1868.

A couple of years later, on October 24, 1863, the household of Prince and Princess of Wales announced that a private telegraph had been completed to their country residence at Sandringham Hall in Norfolk, East Anglia. A clerk from the Electric & International Telegraph Company was provided to take and send messages.

The Company also maintained from 1861 a station with a clerk and apparatus within the Foreign Office at 7 Whitehall Gardens, Westminster. This received and sent government diplomatic messages on the Company's international circuits. The Foreign Office had a running account with the Electric company, settled monthly. Neighbouring government departments, the Home Office, the Treasury and others, also used the services of the Whitehall Gardens telegraph but they had to pay the clerk cash, like any other customer!

In a rare addition to its basic annual reports to the Board of Trade in December 1861 the Company stated that it had 123 separate agreements with railway companies and public bodies; these included free transmission of their business messages. The messages were said to be *three times* the volume of its public traffic!

It was ruthless in trying to prevent the introduction of cheap rate competition at this time. The Electric placed all manner of legal obstacles in the way of the creation of the United Kingdom Electric Telegraph Company in 1861. It challenged the United Kingdom's right to roadside lines in the Courts and even had its railway allies prevent its wires crossing their tracks. It recruited additional support from the Magnetic company and even the Rothschild family to harass and physically obstruct the building of these competing lines.

Table 12

The Electric Telegraph Company

Growth in Message Traffic 1851 - 1868

The Company's message traffic during the eighteen years of its existence as a mature organisation grew enormously, the negative fluctuations being primarily driven by external financial and political influences, wars, post-war booms, investment booms and several money panics. From government returns of the number of messages in thousands and the percentage increase from the previous year were:-

Year	*Messages '000*	*% Increase*
1851	99.2	-
1852	211.1	112.81
1853	345.8	16.41
1854	572.1	132.76
1855	745.3	30.27
1856	812.3	9.00
1857	881.3	8.49
1858	870.1	-1.26
1859	1,025.3	17.83
1860	1,117.4	8.98
1861	1,201.5	7.53
1862	1,534.6	27.72
1863	1,825.4	18.95
1864	2,356.4	29.09
1865	2,971.1	26.09
1866	3,150.1	6.03
1867	3,351.9	6.41
1868	3,755.3	12.04

The Company itself published slightly different numbers for messages: 1850 – 66,634; 1851- 101,216; 1852 – 215,137; and 1853 – 350,500. The differences probably accounted for by Press and Service (company) traffic.

This final period was marked by external events that affected all of the telegraph companies. There was a fratricidal war in America, which generated huge public interest in Europe – requiring special resources for news-gathering. In Britain there occurred a *Little Mania* from 1862 until 1866; speculation in all manner of joint-stock enterprises, with a second burst of railway promotion, although the most profitable lines had been built; there was now a lot of money available for investment. Internationally, flaws were appearing in the stability of Europe, with wars consolidating the German and Italian states, and the fragmentation of Turkey, requiring new routes for secure electric communication to India and the east rather than the most direct.

By 1860 the Company had started to rely on the Cooke & Wheatstone single-needle apparatus, although many circuits retained the two-needle apparatus to the end. It had then also adopted the American telegraph, the key-and-inker, initially on its foreign circuits to Holland, and by that year also for its long lines in Britain, connecting London, Manchester, Glasgow, Edinburgh and Aberdeen in 1862, slowly replacing the Bain writer. It also used the American telegraph on its long line and cable to Dublin in Ireland.

During 1861 it replaced its large *Franked Message* stamps with small *Telegraph Stamps* similar to postage stamps, portrait proportioned in eight denominations for domestic traffic, and landscape in three prices for continental messages. These had to be used on the Company's message forms that had the rules and regulations on the reverse.

The Company then had 6,727 miles of line, 32,787 miles of wire and 772 stations with 3,529 instruments in use.

At a public Telegraphic *Soirée* or exhibition organised by the British Association for the Advancement of Science attended by 3,000 people in the Free Trade Hall, Manchester on September 7, 1861 the Electric & International Telegraph Company demonstrated the potential of their continental circuits. At 8 o'clock in the evening their clerk in Manchester connected with the station at The Hague in Holland, at 8.10 he was in conversation with Hamburg, at 8.20 Berlin was in circuit. At 8.51 he was exchanging pleasantries with St Petersburg, and then at 9.05 with Moscow. A connection was next tried onward to Odessa on the Black Sea coast, 2,200 miles away from Manchester by way of Berlin, St Petersburg and Moscow and messages exchanged at 9.17. All this amicable 'talking' was done directly, using the American telegraph and C F Varley's automatic relays.

In preparation for the exhibition the Company had organised a direct circuit from Founders' Court to Taganrog in south Russia on Sunday, August 25, 1861. The city of Taganrog was the centre of the wheat trade, then of considerable importance to Britain. It covered a distance of 2,500 miles – the longest yet achieved.

This Telegraphic *Soirée*, in which the Magnetic and Submarine Telegraph companies participated, also allowed the Electric to demonstrate its historic family of instruments; Cooke & Wheatstone's double and single needle, Bain's chemical printer and the American telegraph, as well as to show a twenty-four-year-old section of Cooke & Wheatstone's very first line between Euston Square and Camden Town. It put the instruments in touch with Balmoral, Falmouth, Aberdeen and The Hague in Holland. The Prince Consort personally responded to the message to Balmoral, wishing the *Soirée* well.

During the night of January 6, 1862 a direct telegraphic link was made between Founders' Court in London and Smyrna in Ottoman Turkey, courtesy of the German-Austrian Telegraph Union. It had a complicated route. The *königliche Staatstelegraphenbureau* in Leipzig, Saxony, co-ordinated the connection; it went from London to Amsterdam by land and cable, then overland through Hanover, Prussia, Saxony, Bohemia, Moravia, Galicia, Moldavia, Wallachia, Turkey in Europe and Greece, going submarine at Cape Hellas to Scio (Chios) hence by cable to Smyrna! The connection was maintained for a half-hour and 3,000 characters sent and received. It is interesting to note that *both* ends of this 'circuitous circuit' were in the hands of English firms, the Electric in London and the Levant Submarine Telegraph Company on Scio.

By 1864 the Electric was able to 'talk' directly with Omsk in Siberia from Telegraph Street, 3,000 miles distant, by way of Berlin and St Petersburg; Varley's relays then introducing "fresh electricity" every eight hundred miles on the long lines in Prussia and Russia.

At the Electric's shareholders' meeting of January 28, 1862 the directors announced a new cable to Holland would be commissioned of Glass, Elliot & Company for £56,000, payable over one year in instalments. Also a hodge-podge of new railway contracts were revealed; the West Midland Railway was to have the telegraph extended to its Worcester & Hereford and Severn Valley lines; and circuits were to be added on the Eden Valley, South Durham, Lancaster Union and Inverness & Rossshire Railways, as well as on branches of the North Eastern, London & North Western and Midland lines. The Admiralty was to have an additional wire from Pembroke Dockyard to St Ann's Head in South Wales, and city connections were to be made to Lower Thames Street in London and the centre of Oxford. The Company then has 6,727 miles of line, 37,787 miles of wire and 3,529 instruments in operation.

During 1862 the Company's profits from domestic circuits were severely affected by cut-price competition, to the extent of "several thousand" pounds. This was only compensated for by opening 167 new offices, mainly at railway stations, to generate additional revenue, and by increased, hugely profitable foreign traffic. In January 1862 the Board approved participation in a new cable from South Wales to Ireland for traffic to America and to Cork and Queenstown, the active ports of southern Ireland. This was to be carried out by a subsidiary. The line was rapidly completed in March 1862.

There was great confusion in regard to the new cable connection between South Wales and the South of Ireland in 1862. Two concerns were created to make the connection: the *London & South-of-Ireland Direct Telegraph Company* and the *London & Queenstown Direct Telegraph Company*. Both managed to raise capital and both commenced construction works in the early part of 1862. The South-of-Ireland company proposed a cable from Milford to Wexford, with branches to Cork and Queenstown, with a land line to the pilot station at Roche's Point by Cork using an india-rubber insulated cable made by S W Silver & Company, of Silvertown, London. It had a capital of £100,000 and appointed Charles Wheatstone as "scientific referee" or advisor. With a capital of £30,000 the Queenstown company was less ambitious and proposed a cable based on existing technology, insulated with gutta-percha and armoured by Glass Elliot & Company, running between Pembroke and Wexford. The Electric Telegraph Company agreed on January 28, 1862 to work its circuits in concert with the Queenstown company's cable.

On March 7, 1862 the South-of-Ireland company announced that it had connected Roche's Point with Queenstown and Cork and was about to lay its cable to Wales. However it was pre-empted by the completion of the Queenstown company's telegraph between Abermaw Bay by Pembroke and Greenore Point near Wexford on March 28, 1862. The 63 mile cable, weighing 6½ tons per mile, insulated by the Gutta-Percha Company, armoured with twelve iron wires and treated with an anti-corrosive and anti-fouling compound by Glass Elliot, was laid from the latter's steamer *Berwick*.

With this success the South-of-Ireland Direct company sold out its land lines connecting Wexford with Cork and Roche's Point to the Electric Telegraph Company. A circuit from Cork using these lines by way of Wexford was opened to London on April 18, 1862. By September 1862 the Electric company had also purchased the assets of the London & Queenstown Direct Telegraph Company, which it already worked, "on moderate terms".

Previously telegraph messages, especially news messages from America, between Queenstown and London had travelled via Cork, Dublin, Belfast, Donaghadee, Port Patrick, Dumfries, Carlisle and Liverpool; now the new route was from Roche's Point via Queenstown, Cork, Wexford, St David's Head in South Wales, Milford to London, saving four hours.

For the first time this allowed the Company to open offices in Ireland, other than in Dublin. In December 1862 it listed telegraphs at Cork, Dublin, Duncannon (Wexford), Dungarran (Waterford), Passage, Roche's Point, Waterford, Wexford, Youghall and Queenstown. With the exception of Dublin these were all on the South-of-Ireland company's land line from the cable end to Cork. Messages between the southern towns and Dublin were sent via England!

In the early morning of March 7, 1862, the Company in London made its first direct connection with the station at Pera in Constantinople, over a distance of 2,000 miles. The clerk at Pera turned out to be a very chatty gentleman by the name of O'Connor, who quizzed the operator in Telegraph Street about his name and the weather, exchanging other gossip, so pleased was he to be in touch with England, he then handed over to a Greek clerk speaking French to do the real work. Ten commercial messages were received from the Ottoman capital, at a speed of seven to eight words a minute, with just two word repetitions needed.

The "Tycoon" or Emperor of Japan despatched a Mission to Europe in the spring of 1862. The Royal Navy carried his emissaries from Yeddo, his capital, to Marseilles in France to start their progress in April. The British portion of their visit commenced on May 1, when the ambassadors, there were three, and their staff attended the International Exhibition in South Kensington, London, stealing the show from all the exhibitors, and starting a minor vogue for all things Japanese. Their exhaustive month long tour covered Parliament, industrial, military, naval, medical and botanical establishments, as well as popular entertainments and shopping, closely followed by intrigued crowds. On May 19 the Japanese embassy arrived at the General Office of the Electric Telegraph Company in Telegraph Street to be met by Cromwell Varley, the electrician, and Mr H C Fischer of the Continental department. They were introduced by Varley to the ladies of the Instrument Gallery and to the men of the Continental Gallery, were shown the pneumatic apparatus connecting with satellite offices; their polite curiosity was such that they took an interest in the machine used to cut the rolls of paper tape for the printers, going down into the cellars to see the batteries and the steam engine, before retiring to the board room to view the exhibits of old instruments. An artist making sketches accompanied the ambassadors and extensive notes were made in Japanese script. Their devotion to the interests of the "Tycoon" was such that previously one the emissaries and several of their staff had descended a coal mine in Newcastle.

The hundred men working at its Gloucester Road instrument and battery factory were allowed a day off in October 1862 to visit the International Exhibition at South Kensington, at the instance of the manager, John Muirhead.

Table 13

The Electric Telegraph Company
Statistics on Revenue

Message Rate Analysis	*1860*	*(1868*)*
1s 0d (within London)	01.10%	(55%)
1s 6d	21.70%	(30%)
2s 0d	15.90%	(10%)
3s 0d	13.11%	
4s 0d	31.00%	(5%)
5s 0d (to Dublin)	00.90%	
Foreign	11.30%	
Miscellaneous	04.70%	
Revenue Sources 1859		
Messages, home	£ 113,886.2s.9d	54.7%
Messages, foreign	£ 33,219.0s.0d	15.7%
Maintenance for railways	£ 25,956.3s.8d	12.7%
Frank stamps	£ 19,777.0s.9d	9.5%
Intelligence	£ 11,685.13s.2d	5.6%
Other	£ 3,470.1s.7d	1.7%
Total	£ 207,994.1s.11d	100%
Annual Circuit Revenues 1860		
London – Liverpool	£ 10,612.19s.8d	
London – Manchester	£ 6,334.9s.4d	
London – Birmingham	£ 2,481.0s.0d	
Liverpool – Birmingham	£ 462.0s.0d	
Manchester – Birmingham	£ 147.0s.0d	

From a confidential report from Mark Huish to Robert Grimston, chairman of the Electric Telegraph Company, October 1860. (* Parliamentary Report 1868, 1s 0d rate within 100 miles, 3s 0d and 4s 0d to Ireland)

In 1863 labourers working on the rails leading to the eastern side of the London & North Western Railway's terminus at Euston Square uncovered sections of Cooke & Wheatstone's wooden battens containing the original five wire circuit of 1838. Pieces were immediately carried off to sit in a place of honour in the Electric Telegraph Company's boardroom in Telegraph Street. They were to be displayed alongside examples of the earliest apparatus devised by Cooke & Wheatstone and others used by the Company from its beginning.

Throughout the 1860s there was a special effort to reduce costs. By the end of the decade on the most intensely worked circuits between London and the cities of the north, starting with Newcastle-on-Tyne in July 1867, the Company mechanised its traffic using the automatic equipment devised by Wheatstone in 1858: several clerks could prepare messages on punched tape to continually feed one high speed circuit.

It also introduced small switchboards, called at the time *umschalters*, from their Prussian origins, to manage connections between its increasingly complex network of circuits, and Varley's more sophisticated electrical relays, also known as 'translators' or 'condensers', on its longest circuits eliminating the need for manual transcription.

With the exception of its 'invisible' underground circuits in large towns and cities the Electric's lines were once again overhead wires on poles. The increasing number of close parallel wires on its most valuable routes was found to affect the efficiency of its circuits, in the short-term this was addressed by increasing the number of cells used.

Memoriam

J Lewis Ricardo, the first Chairman of the Company, died in August 1862, aged 50: the offices of the Electric, Magnetic and District telegraph companies closed for a day and their flags lowered to half-mast in commemoration of his services in founding their new industry.

The Board of Directors in mid-1862 consisted of the Hon Robert Grimston, chairman, Mark Huish, deputy-chairman, G P Bidder, Thomas Brassey, the Earl of Caithness, W F Cooke, T Critchley, William Dunlop, John Hawkshaw, E R Langworthy, Frederick N Micklethwaite, Mark Philips, Lord Alfred Paget MP, W H Smith MP, Richard Till, Joseph Whitworth, and Major-General William Wylde CB. This mass of seventeen compares with the original board of five in 1846.

Ireland at Last

The Company's final years showed only a gradual expansion of its domestic lines; it concentrated on creating foreign connections - especially towards the East. As will be seen, it abandoned the combating of competition in the courts for creating alliances in fixing charges and services with the 'enemy'. The telegraph companies in their maturity began to co-operate in so many ways, such as pricing and news supply, that there appeared to be a virtual monopoly, against the public interest. In this the Electric as the dominant concern customarily took the initiative.

The Electric Telegraph Company's domestic preoccupation from 1862 was its belated expansion into Ireland from its cable-end at Dublin. It had replaced its underwater circuits after damage in 1861 with a single core cable, moving the 'English' end from the port of Holyhead on Holy Island to Rhosneigr on the main body of Anglesey island, where it was less vulnerable to anchor damage and close to the Chester & Holyhead Railway which carried the Company's inland circuits. As it was to transpire in Ireland the Company had to erect poles along the Grand Canal from Dublin to reach Athlone and Galway, along the Barrow Navigation, south from the Grand Canal, to reach Carlow and Waterford, and along the Royal Canal from Dublin, to reach Mullingar and Longford, hence by the Ballinamore & Ballyconnell Canal, the Ulster Canal and the Lagan Navigation to reach Belfast. In Ireland the Company did not have instruments at railway stations; even by 1855 they were already occupied by competitive telegraph companies.

In the south of Ireland these lines eventually connected with its small network based on Cork, formed in the summer of 1862 by the London & South-of-Ireland Direct Telegraph Company.

To achieve its objectives in John Bull's other island the Company appointed William Thomas Ansell to be its General Superintendent and Engineer, a unique grade in its hierarchy, for Ireland. Ansell had worked for the Company since 1846, eventually becoming District Superintendent for the North-West in Liverpool, before taking a break between 1858 and 1861 to advise R S Newall & Company on their cable works in the Levant. In his new job he successfully and speedily organised the network of canal-side circuits that connected the island's principal cities, challenging the Magnetic company's local monopoly for the first time.

The Telegraph in Society

What was to be the handsomest social event in the telegraphic world of the 1860s took place during the evening of March 26, 1862. It was a grand *conversazione* held at the London home of Samuel Gurney, the greatest money-dealer of the age, at 25 Prince's Gate, Hyde Park, in support of the Atlantic Telegraph Company and its ambition to complete the cable between Europe and America. Dukes, countesses, bankers, directors and officers of all the telegraph companies, the Atlantic, the Electric, the Magnetic, the Submarine, the London District, and the United Kingdom, British Ministers of State, the Ministers of France, Prussia and Italy and the Minister representing the abolitionist states in America, as well scientists and engineers such as Wheatstone, Bright, Bonelli and Whitehouse, were all present. The District company laid on three wires to Gurney's mansion, one for its own circuits and one each for those of the Magnetic and Submarine companies. The Electric also provided a circuit. In a side room American, Bright's Bell and Henley's dial telegraphs were set up. During the long evening, between entertainments, messages were sent and received from Falmouth, Edinburgh and Glasgow, Dublin Castle, Tonning, Copenhagen, Turin, the Hague, Odessa and Constantinople.

The final message received was at 12.20 am on the following morning from HRH the Prince of Wales, then visiting Alexandria in Egypt.

A somewhat less glamorous *conversazione* was held at the Royal Polytechnic Institute in Regent Street on the evening of July 16, 1862, still with an excellent turn-out of lords, knights and gentlemen, military and naval officers, and "a vast number of ladies", hosted by Professor Wheatstone. Mr J H Pepper, the scientific populariser and proprietor of the Polytechnic, gave a lecture on electricity, a giant static electricity machine was exhibited and brilliant oxy-hydrogen lights were used to signal between the Poly and Highgate Church across the roofs of London. The principal room was effectively lit with four electric lights, where electro-plated and pure metal items were shown for comparison, and a concert held with several eminent vocalists. Once again the London District, Magnetic, Submarine and Universal Private Telegraph companies showed off their competitive apparatus, the latter allowing the attendees to try their telegraphic skills.

Almost an Empire

Suddenly, in 1862, the attention of the Electric & International Telegraph Company was drawn to places five thousand miles away from its home in London. In the Far East the transfer of the East India Company's telegraph to the government in 1858 had been less than satisfactory. Public service was a minor consideration, messaging was slow - taking several days to cross the sub-continent, privacy was minimal, message costs high and, as with the state systems of continental Europe, the poorly-trained, poorly supervised staff was overwhelmed by bureaucracy and by the volume of government messages that had absolute priority. Its circuits were, by and large, along dirt roads or across country, so subject to poor maintenance and reliability.

The government telegraphs extended to 14,500 miles and cost £1,146,861 by April 1864. The average message charge on the India telegraph monopoly in 1860s was 10s 0d; whilst in Britain, on the Company's circuits, it was 2s 0d.

By 1862 there was an alternative: British-financed railways were spreading over India, each of them having self-contained line-side telegraphs for traffic control, for their own messaging and for public messages, licensed by the government. The railways of India by 1864 had 3,141 miles of telegraph line, which had cost them £411,924 to erect.

Early in 1863, the chairman of the Electric, Robert Grimston, and the deputy chairman, Mark Huish, the former general manager of the London & North-Western Railway, projected the *Oriental Electric Telegraph Company* to extend the Electric's business model into the heart of India. The Oriental was to construct new wires, not exceeding six circuits, alongside of the railways at its own cost and pay the railway 40s 0d per mile a year for 21 years, installing its own apparatus, paying also 10% of the cost of iron posts and 25% of wood posts per annum provided by the railway. If necessary it would acquire the railway's entire telegraph works at cost. The railway companies would share the profits from the public telegraphs and each would provide a director and the Electric two directors to manage the scheme. The engineers were the experienced and authoritative Charles Bright and Latimer Clark. They proposed to adopt the American telegraph, with key and printer, rather than the American "sounder" or acoustic telegraph used on the government lines, for reasons of accuracy, security and privacy.

The Oriental Telegraph Company, by which title it was also known, had first been promoted by the British-Indian railway companies with a prospectus on July 19, 1859. It was then something of a forlorn hope against the state monopoly. But the service offered by their telegraphs was so appalling that on January 15, 1862 the government in India unilaterally invited commercial interests to offer an alternative. This immediately led to the directors of the Electric Telegraph Company in London to seize on the vast new opportunity that India offered...

During April 1863 the East Indian Railway (with 1,078 miles of telegraph line), the Great Indian Peninsula Railway (781 miles), the Madras Railway (532 miles), the Great Southern of India Railway (79 miles), the Eastern Bengal Railway [including the Calcutta & South Eastern Railway] (138 miles) and the Bombay, Baroda & Central India Railway (185 miles), all except one of the railway companies in India, had agreed to the terms proposed by the Oriental company. Together these connected the major cities of Agra, Ahmedabad, Allahabad, Bombay, Calcutta, Calicut, Dacca, Delhi, Hyderabad, Madras and Nagpur, offering 4,000 miles of telegraph line to the Oriental company. The exception, the Scinde Railway (which included the Punjaub Railway), was isolated from the others in the west of the country. All of these companies were organised in London and shared directors and shareholders with the major British railways.

The Oriental company intended initially to link the two principal cities of India, Bombay and Calcutta, by way of the Great Indian Peninsula Railway and the East Indian Railway. This would span the sub-continent from west to east and connect with the new cable to the Persian Gulf and onward to Europe.

However, whatever the authorities in India might have thought, the government in London decided on September 1, 1864 that a competitive public telegraph in that country was "not desirable". Unlike in Britain where the railway companies were wholly independent, in India they worked within a system of government concessions and interest guarantees; the railways had to listen to the government's opinion, working their telegraphs under license.

The Oriental Telegraph Company, despite its robust parentage, was abandoned. The Electric company had now set its eye on India and a few years later was to successfully create a 6,000 mile line of wire from London to Calcutta through its child, the Indo-European Telegraph Company.

The Electric Telegraph Company was coy in regard to its relationships with foreign systems. All it would say publicly was that it was in connection with the German-Austrian Telegraph Union through its Holland cables and that the Dutch government's *Rijkstelegraaf*, a member of the Union, represented its interests on the Continent, collecting and paying-out message money on its behalf. Its Assistant Secretary, Henry Schütz-Wilson, and its engineers, such as Henry Pomeroy, also regularly visited the *Rijkstelegraaf* offices in Amsterdam to enable closer co-operation. In a reciprocal manner, *Rijkstelegraaf* engineers, such as J J van Kerkwyk, were allowed to tour the Company's circuits. The Chairman of the Company made it clear to Parliament in 1866 that it was satisfied with its relationship with the Union as regards both service and tariffs. In addition, he revealed that the Company had permanent direct circuits from London to Berlin and Frankfurt, by way of Amsterdam, leased from the Union.

Whatever it said publicly, it had also developed strong relationships with the telegraph administrations of Prussia and Russia; from Frankfurt it worked a direct night circuit to Constantinople in Ottoman Turkey and from Berlin onward to St Petersburg in Russia – the Ottoman and Russian governments both subscribing to the German-Austrian Telegraph Union. Its Assistant Secretary was visiting Berlin and St Petersburg in the 1860s in addition to Amsterdam, and from these negotiations it was allowed to establish ever longer uninterrupted direct circuits from London, reaching east beyond the Urals towards India and China, albeit only experimentally and during the night hours when local traffic was light.

The success of these direct land lines was contrasted in the press with a long series of failures in submarine cables attempting to span the Mediterranean Sea, and the Atlantic and Indian Oceans.

Although the Company had previously been able to send telegraph messages to all of the stations in Europe, this had involved frequent manual transcription or rewriting, often by clerks unfamiliar with the English language. Its technology had advanced to such an extent over ten years, with sophisticated new relays or repeaters of its own design, that the clerk pressing a tapper or key in London could, by 1866, be sure that the inker of the receiver was making a signal mark in Berlin, St Petersburg, Constantinople or even remote Omsk. This gave an incomparable increase in speed and accuracy of transmission.

As context for these ambitions the Company would have been aware that during 1862 their ally, the Russian telegraph administration had begun construction of their immense Siberian line from Moscow to the mouth of the Amur river on the Pacific coast. Lt Col Dmitri Dmitrievich Romanov, engineer of the East Siberian Telegraph, described his task in 'Annales télégraphiques' of January 1862; a two-wire overhead circuit was to be made from Moscow through Nizhni Novgorod, Kazan, Perm, Ekaterinburg, Omsk, Tomsk, Irkutsk hence to the mouth of the Amur river. He emphasised its connections with London. The line to Omsk and Irkutsk was opened to schedule in 1862; the Pacific was anticipated to be reached in 1864. The Imperial authorities planned five extensions to this strategic route: 1] a submarine circuit to Japan, 2] a branch to Vladivostok (the base for a new Russian Pacific Fleet), 3] from Irkutsk south to Kiachta in China and so on to Pekin, 4] from Omsk (in direct contact with London in 1864) south to Cabool in Afghanistan and hence to the Punjaub in British India, and 5] from Kazan south to Teheran in Persia, also anticipating a connection to India. All of these objectives were achieved in the following decade, but mainly though the means of western companies, rather than the Russian state.

With this knowledge it is likely that the Electric Telegraph Company anticipated participating in an end-on connection at the Amur river with the Western Union Telegraph Company's extension from San Francisco, California, in the United States, through British Colombia and Russian America (Alaska) across the Behring Strait by way of a 53 mile cable, across the northern tundra to join the Siberian telegraph at the Amur, which Russian segments the Tsar had authorised on May 15, 1863 (in the Old Style calendar). As background, the Western Union company was at this time in fierce competition with the American Telegraph Company that had been formed by the Morse interests. American Telegraph were deeply involved with promoting the planned trans-Atlantic underwater cable. For these reasons, its enmity to Morse and its reservations as to the great cable, the Western Union was a natural ally for the Electric Telegraph Company.

Building the Western Union extension line north from California eventually commenced in July 1864, W T Henley's Telegraph Works of London being commissioned to manufacture the iron overhead line wire as well as the Arctic cable.

This would provide a circuit from London by way of Moscow and San Francisco to New York! But it was not to be, construction of the Russian America line was abandoned in July 1867...

It is reasonable to believe, from the early 1860s, that the Electric & International Telegraph Company had an "eastern" strategy; planning to implement a new public telegraph system in British India over the railways, uniting this with its domestic circuits by leased direct lines across Europe and Asia. It was only narrowly thwarted in the creation of the first global communications network.

On the Defensive

The board of the Electric company reported to its proprietors at their half-yearly meeting in February 1863 that despite cut-rate competition revenues for the previous six months were up £6,009, and expenses also rose by £4,007. It pointed out that every message sent at the 1s 0d cheap rate between London and Manchester and Liverpool was carried at a loss. Extra new circuits had been made between London and Liverpool and Manchester to meet demand. The heavyweight new cable to Zandvoort in Holland had been successfully laid on August 14, 1862 and on October 4 the old cable, sabotaged in 1858, had been finally restored to its full capacity with four cores working. Unfortunately it was broken on October 17 but repaired again by October 30. The Holyhead cable had chaffed through on the rocks at Anglesey (yet again) on November 9 and that was back in use on November 19. The very old cables across Tay and Forth estuaries in Scotland had both been lifted and replaced. The Company had also acquired the assets of the two competing companies connecting South Wales and Ireland, creating a small system of their own about the city of Cork for the first time. Messages from London took three minutes to reach Cork, a new circuit had been made to Cardiff from London for this traffic. The usual long list of minor railway telegraph extensions was read out; the Vale of Clwyd, the Whitehaven, Cleator & Egremont, the Morecambe branch of the Midland Railway, the Bedford branch of the London & North Western Railway had been completed, those on the Bedford & Cambridge and Cockermouth, Keswick & Penrith were in hand. Town centre offices were opened in Derby, Clifton by Bristol and Leicester, and yet more new wires were needed for Liverpool, Manchester, Edinburgh, York and Southampton, as well as a long line to connect Wexford with Dublin. A 7% annual dividend was declared.

According to Cromwell Varley, its engineer and electrician, the Company in February 1863, had 7,597 miles of line, 35,056 miles of wire and 4,003 instruments in operation.

The threat of government intervention in the domestic market, starting with a moderate Act of Parliament in 1863 imposing limited regulation, balanced by the allowance of some general powers, led to a much more defensive business posture than had previously been the case. An annual dividend limit of 10% was enforced, as with other regulated utilities such as gas companies; however to overcome this imposition the Company began to top-up previous years' dividends to the maximum allowed with substantial bonuses.

As a counter-measure the Company revealed, in addition to its historical average annual dividend of 5%, that it had accrued a further 85% in what it called "reserved profits", which it expected the government to take into account in the purchase price should the state choose to appropriate it. This was an early example of the defensive 'poison-pill' strategy to ward-off unwanted take-overs.

The pressure for acquisition came from ambitious civil servants in the Post Office who sought a communications monopoly "in the public interest". There was only a limited understanding of the real value of the wayleaves over the railways, or unlike the mails that there were few economies of scale in telegraphy. But in their lobbying they were to be supported by large elements of the press who resented their reliance on the telegraph for news. The press was keen to eliminate the growing number of public and private newsrooms that also received intelligence by telegraph, presenting it to their prosperous business clients instantly.

Robert Grimston, the chairman, prepared and published "The Statement of the Case of the Electric & International Telegraph Company against the government Bill for Acquiring the Telegraphs" in 1868.

In this he made several points; first, that in 1867 76% of its income came from just *eighteen* stations; 15% came from another eighty-one stations and that 3% came from the remaining 1,100 stations. Of the 76% half the money came from the Central Station in London and a quarter from the main offices in Liverpool and Manchester. The Company had surveyed all towns in the United Kingdom with populations of more than 1,500 people then *un-provided* with public telegraphy and found that they amounted to just 1,000 places. The Company's view was that extensions of line to these small towns would never pay their costs.

The Company claimed that postmasters in rural districts were unfit to manage the complex apparatus and to deliver urgent telegraphic messages as well as mail.

Grimston recorded that the telegraph companies in Britain had a long history of profitable working and that telegraphs in public ownership in Europe either made operating losses and were a burden on the public purse or were subsidised by so-called *transfer* traffic, which merely passed through its circuits, going to and from other countries, often Britain. The companies' circuits in the United Kingdom were proved substantially cheaper to work than those on the continent.

He also noted that a uniform low message rate, even with very intense traffic, was unworkable in terms of profit, as proven by the competitive but luckless London District Telegraph Company.

With its current pricing regime the Electric had increased the number of messages carried 105% in four years, from 1,534,590 in 1862 up to 3,150,149 in 1866. Yet working expenses had increased just 40%. The number of messages per mile of wire, a measure of efficiency, grew from 44 to 66 in the period.

Grimston declared, "There is no telegraph station *in the World* with which the Electric & International Telegraph Company is not in connexion, and with which they do not interchange communications! And this has been effected by the private enterprise of a few individuals within a period of little more than twenty years!"

He added, "The life of a passenger travelling upon a railway is so protected that not above one passenger out of every *Twenty Millions of Passengers* conveyed is sacrificed by railway accident – a result mainly due to that system of telegraphy which secures immunity for every train which traverses a line."

The Electric proposed finally in Grimston's paper that the three extant national telegraph companies merge their circuits into one joint-stock concern under greater state regulation.

Robert Grimston's predictions turned out to be correct: too many local circuits were built by the government, all losing public money; local post offices had to be equipped with £30 dial telegraphs rather than £6 needle telegraphs requiring trained clerks; a uniform low 1s 0d message rate encouraged a huge traffic which was not counter-balanced by any cost-saving efficiencies of scale. Later, wholly illogically, the message rate was reduced to *half* the charge originally proposed.

As well as the increasing calls for state intervention in telegraphy, mostly emanating from the provincial press and elements of the Post Office, the year 1866 saw the collapse of the entire London financial market. Overend, Gurney & Company, a historically grand firm of money-dealers, topping a pyramid of finance houses, public works, railway, dock and ship-building enterprises, failed through gross speculation in May, dragging with it banks in the metropolis and in the country. The new intercontinental cable companies just managed to raise funds during 1865 and 1866. Capital available shrank to nothing for four years and the events of the year led in part to a thirty-year slump in the British economy. The ability to expand its public facilities, even if the will were there, evaporated.

The Telegraph Act of 1863 gave powers to erect circuits to any incorporated company, removing the need for a Special Act of Parliament, other than when acquiring a patent monopoly. Although government appropriation was being widely discussed these powers to erect telegraphs were adopted by several local concerns for public telegraphs, by large and small railway companies, by large industrial organisations and by bodies such as those managing lighthouses, needing remote communication. The effect on the Electric and its competitors was negligible as those small lines offering public access commonly worked in concert with one or other of the national providers. The Company also assisted in the promotion of several of these, where it felt applying its own capital was not likely to be profitable.

According to government returns, in 1863 the Company possessed 8,282 miles of line, 4,489 instruments and 1,022 stations. In the following year it had 8,658 miles and 5,136 instruments. The number of telegraph stations apparently remained the same.

In 1863 the Electric tried a version of Wheatstone's new *automatic telegraph*, creating a triangular circuit between Founders' Court in London, Bristol in the west of England, Birmingham in the Midlands and back to London. It installed Wheatstone's tape-fed rotary sender but connected it to its ordinary American receiver; 166 letters were transmitted in one minute, which compared with a manual performance by an expert clerk of between 117 and 123 letters. As it did not try Wheatstone's much improved automatic receiver at this time the difference in rates was not overly significant.

In December 1863 a great gale swept the North of England and Scotland. The Electric's board reassured its shareholders in the following January that its "timber" (telegraph poles) in the north had been rigorously reinforced and was proof against storms. It announced, too, that new circuits had been opened between Newcastle and Edinburgh; all the poles on the line were replaced with strengthened timber. The vital Zandvoort cable had been repaired on August 6, 1863; the English inshore end was replaced with a new section taken from spare coils that the Company kept in its stores. In January 1864 the Dublin and Holyhead circuit failed yet again; all of the Company's traffic between Britain and Ireland was diverted through the new Wexford cable. New wires were inserted in the long-lines between London, Liverpool and Manchester in late 1863 so that direct transmission, without manual transcription, could take place to virtually all of the major towns in Britain.

On December 2, 1863 the Company received a message from Irkutsk, 4,000 miles east of St Petersburg, on the way to China and the Pacific. It now took eight hours rather than twenty-three days to reach East Siberia.

What had come to be an annual telegraphic event, dating from 1846; the Queen's speech on the opening of Parliament in November 1864 comprised 965 words and was transmitted to the provinces and Europe in thirty-one minutes. In 1846 it took an hour to send 360 of Her Majesty's words to Norwich.

Earlier in the year, on Tuesday, January 26, 1864, the Members of Parliament for Birmingham, John Bright and William Scholefield, engaged in a great public debate in their joint constituency. It was regarded as an event of national significance. C V Boys, the Company's news superintendant, and Mr Wade, the clerk-in-charge in Birmingham, made special arrangements for transmission of the speeches to 'The Times' in London. Sending commenced at 8.30pm, three American telegraphs and Varley's relays were in circuit. With a half-hour break around 11pm, the transmission was finished at 2.30am. The great debate's 12,000 words, containing 49,000 letters, appeared in the first edition of 'The Times' on Wednesday, January 27, over six whole columns of print. The tape received on the three instruments at Telegraph Street was over one mile long.

In addition to its eastern ambitions, almost invisibly, from the early 1860s, the Company's engineers and electricians took over management of the Atlantic telegraph project, to connect Ireland and Newfoundland in America, but they carefully distanced themselves from raising capital. The parliamentary commission on the failed cable of 1858 was dominated by associates of the Company and its allies, with six out of eight members, including Charles Wheatstone. It also sponsored a new company to make a direct cable from South Wales to connect with the proposed Atlantic cable end in Ireland in 1862. The Electric's engineer, Latimer Clark, and its electrician, Cromwell Varley, displaced the original incumbents in managing the great cable. Together they drove it to ultimate success in 1866.

Its corporate interest in the Atlantic cable, as opposed to the technical support offered by its scientific advisors, engineers and electricians, coincided with the extinction of the old Morse concern, the American Telegraph Company, which had promoted the cable in Washington. It was absorbed by the Western Union Telegraph Company in 1866, with which the Electric maintained a friendly relationship. Its chairman, Robert Grimston, and its original founder, G P Bidder, joined the Atlantic Telegraph Company's board in 1866.

Apart from its domestic and Holland cables, by which it incidentally acquired a substantial knowledge base, the Electric company had avoided direct involvement in expensive and risky underwater telegraphy during the 1850s. Its technology emphasised efficiencies and performance in land circuits; its expansion strategy, on using these improvements in co-operation with land-based allies abroad.

The Wexford cable from South Wales to Ireland was broken at the Irish end during gales in November 1864. As their cable steamer *Monarch* was under repair, the Company employed the 195 ton steam tug *Cruizer* out of Liverpool in her place to lay 8¼ miles of new four core cable. Captain James Blacklock and Chief Mate J Elvish of the *Monarch* were in command of the tug, and, along with the Company's electrician, Cromwell Varley, saw the circuit restored on January 24, 1865. As a precaution the cable landing site was moved away from the abrading rocks that caused the damage, to two miles north from the Tuskar Light; the new Wexford end also had a massive 20 tons per mile weight.

The year also saw commencement of what was the last of the Electric's major domestic circuits, in terms of mileage if not of traffic. Using the line of the Cambrian Railways it extended from Whitchurch in England through mountainous Mid-Wales to the coastal town of Aberystwyth late in 1864. This 95 mile circuit can scarcely have paid its way in public messaging, but was required for working the railway.

The Company, the Board noted at the January shareholders' meeting, had expended £4,485 in the last six months of 1864 on expanding is "air circuits", the pneumatic apparatus, between its busiest offices in Liverpool, Manchester and Birmingham. It had also increased its line mileage by 111, mainly for railway use, and its length of wire by 1,518 miles.

The year 1865 started on a fairly positive note. The chairman informed the shareholders on February 10 that modest extensions had been undertaken; the long lines on the Great Northern Railway had been renewed, new lines had been opened on two branches of the Midland, Hertford, Luton & Dunstable, Llynvy Valley, South Leicestershire and Farringdon Railways. Two new wires had been installed on the Eastern Counties line. To cope with increased traffic new circuits were added between Liverpool and Glasgow, Leeds and Bradford, Birmingham and Leamington, Perth and Inverness, and London and Brighton. New lines were now being added in Ireland, a direct circuit from Dublin to Belfast via Drogheda and Dundalk, as well as from Cork to Limerick.

In its domestic market, in 1865, there were 9,306 miles of line, 45,044 miles of wire, 1,180 stations and 5,778 instruments. In that year 2,196,046 messages were sent on its circuits. On July 10, 1865 the Company, and its competitors, abolished the flat rate charge of 1s 0d for twenty words between the largest cities and towns as unprofitable and reverted to a common zone tariff. Despite this the number of messages increased in the latter half of the year.

Table 14

The Electric Telegraph Company
System Development 1850 - 1868

At December	Line Miles	Wire Miles	Instrument Numbers
1850	1,786	7,206	-
1851	2,122	10,650	-
1852	3,709	18,545	-
1853	4,409	21,315	-
1854	4,954	24,304	-
1855	5,228	27,989	2,603
1856	5,398	28,627	2,777
1857	5,637	29,498	2,938
1858	6,103	30,733	3,024
1859	6,272	31,346	3,195
1860	6,541	32,148	3,352
1861	6,727	32,787	3,529
1862	7,597	35,066	4,034
1863	8,230	39,042	4,489
1864	8,659	41,592	5,136
1865	9,306	45,044	5,778
1866	9,740	47,572	6,491
1867	10,007	49,619	7,245

The statistics provided by Richard Spelman Culley, the Engineer-in-Chief to the Company, in his Report to Parliament on July 6, 1868. These differ slightly from others previously provided.

With the continued absence of the long-promised Atlantic cable the Company worked a forwarding system in concert with the steamship lines to New York, Halifax and Boston. The liners would pause at Queenstown off Cork in Ireland to pick up public telegraph messages for those cities and for sending on to other places in the United States and British North America. Messages could be sent from any of its stations in Britain and Ireland by this route up to an hour or so before the Atlantic steamers touched at Queenstown. In this the Electric had copied the competitive Magnetic company which had launched a similar service from Galway in May 1860.

On October 28, 1865 Richard Till, one of the original directors of the Company in 1846, died. A lawyer and collector of income tax, he was a close associate of G P Bidder and Morton Peto, being a director with them of the Rock Life Assurance Company and the Norfolk Railway, as well as of other railways. He was age 81.

On the failure, once again, of its Howth to Holyhead cable in 1865, and after the breaking of the Wexford cable in the previous November, the Company announced that it would not replace it but instead lay its own cable on the shorter, safer route from Port Patrick in Scotland to Antrim in Ulster – parallel to that of the Magnetic company's – "securing the possession of a double connection to Ireland". It would form new circuits from Liverpool, Manchester and Glasgow to Belfast and Dublin. The new cable was completed between Killantringan, Wigtownshire, and Whitehead, Antrim, on June 19, 1866. It connected in Scotland with its overhead wires already alongside of the Portpatrick Railway to Dumfries and the rest of its network.

More importantly it also wanted a third cable to Europe, to increase the capacity of its existing two through Holland. In 1865 it approached the governments of Holland, Hanover and Prussia for new landing rights. Fortuitously the Submarine Telegraph Company's concession to Hanover was forfeited in 1865; Reuter's Telegram Company, the news agency, stepped in and acquired the rights and immediately offered a quarter share, one wire, for use of the public to the Electric & International Telegraph Company. The Company thus gained additional access to the Continent without increasing its capital.

On the morning of January 11, 1866 an immense storm devastated its overhead circuits within a fifty mile radius of London. A heavy fall of snow in severely subzero temperatures coated wires with ice to a thickness up to six inches. The lines alongside of the Great Western Railway between London and Bristol, and on the London & North Western Railway between London and Rugby, a total of 450 miles of wires and poles, were "entirely destroyed" by snow and winds. Henry Weaver, the company secretary, estimated the cost of repairs at £20,000. The Company's system was only fully restored on February 19, 1866.

In addition to this extraordinary expenditure from its reserve fund, the Board announced that the circuits to Edinburgh, Leeds, York, Derby and East Anglia were to be increased in 1866 to cope with increased demand. A new line was also laid along the south coast of England between Brighton, Portsmouth and Southampton.

Despite all of these issues the chairman reported on February 2, 1866 that the previous half-year's revenues were £168,291, and expenditure was £95,922, giving a net profit of £72,380, enough for a second 5% dividend and leaving £80,000 in the reserve fund. Messages had increased by 262,447 and earnings by £26,700 over the previous six months. A bonus of £4,394 was given to be shared by all the employees for their "unremitting attention" in a difficult period.

Events abroad in 1866 were to affect its traffic, particularly that to the Levant and India. The war between Prussia and Austria, and their many allies, which lasted from June 14 to August 23, 1866, the so-called "Seven Weeks War", put a stop to virtually all messages east of the Rhine. Telegrams for India "entirely disappeared" for over two months due to extended problems with rerouting, and the construction of Reuter's new cable to Hanover was delayed, so the chairman reported to the shareholders on August 11, 1866. The War was costing the Company £500 a week in lost revenues.

In 1866 Richard Spelman Culley, formerly District Superintendent for the West of England, who had worked for the Company since 1846, was appointed engineer in place of Latimer Clark. The assistant engineer then was W H Winter. Both were to join the Post Office Telegraphs in 1870.

With the success of the cables between Ireland and Newfoundland the Electric and Magnetic companies came to a joint agreement with the Atlantic Telegraph Company and the Anglo-American Telegraph Company, the cables' owners, on November 13, 1867. A two wire circuit dedicated to Atlantic traffic, between the cable end at Valentia and London, via Wexford, was leased by the former to the latter.

During 1868 the Electric & International Telegraph Company advertised its principal stations as:

London: Central Station, Founders' Court, EC; and branches, Blackwall, at the railway station, EC; 13 Bank Buildings, Metropolitan Cattle Market, N; 6 Coal Exchange, Lower Thames Street, EC; 149 Cheapside, EC; 27 Cornhill, EC (7am to 12 midnight); Crystal Palace, Sydenham, SE; 6 Edgware Road, W; Fenchurch Street, corner of Mincing Lane, EC; 30 Fleet Street, EC; 10 Foster Lane, EC; General Post Office, St Martin's le Grand, EC; Gloucester Road North, Camden Town, NW; 17a Great George Street, Westminster, SW; 241 High Holborn, WC; Highbury, corner of Highbury Place, Islington, N; House of Commons, Central Lobby, SW; 8 Leadenhall Street, EC; Lloyd's Merchants' Rooms, EC; London Docks, main entrance, E; Subscription Room, Jack's Coffee House, Old Corn Exchange, EC; 74 Old Broad Street, EC; 314 Oxford Street, W; 28 Regent Street, SW; 22 St George's Place, Knightsbridge, SW; Shoreditch, archway, front of railway station, EC; 2 Southwark Street, Borough, SE; Stock Exchange, New Court entrance, Throgmorton Street, EC; 448 Strand, WC (open day and night); 89 St James's Street, SW; Tattersall's, SW; 178 Upper Thames Street, EC; West London Railway, Kensington W; 32 Wharf Road, City Road, N; 106½ Camden Road, NW; New Court, Throgmorton Street, EC; and at the termini of all the railways, Euston Square (London & North-Western Railway), King's Cross (Great Northern), Liverpool Street (Great Eastern, formerly the Eastern Counties), Fenchurch Street (London & Blackwall), London Bridge (South Eastern and London, Brighton & South-Coast), Cannon Street (South Eastern), Waterloo Bridge (London & South-Western), Victoria (London, Chatham & Dover and London, Brighton & South-Coast) and Paddington (Great Western). This gave the Electric a total of forty-five public telegraph offices in the metropolis.

Aberdeen	59 Marischall Street
	Railway Station
Bath	8 New Bond Street Buildings
Birmingham	Temple Buildings
	Corn Exchange

	Railway Stations
Belfast	Victoria Street
	8 Donegal Square
Brighton	18 Old Steine
	Bedford Hotel
Bristol	Exchange Buildings
	Railway Stations
Cambridge	Town Hall
	Railway Station
Cardiff	5 Powell Place, Docks
	Town Hall
	Railway Station
Cork	89 South Mall
Derby	Corn Exchange
	Railway Station
Dublin	4 College Green
	Canal Harbour
	Eden Quay
Dundee	Corner, Cowgate & Wellgate
Edinburgh	68 Princes Street
	Parliament House
	Railway Stations
Falmouth	Arwenack Street
Glasgow	The Exchange
	St Vincent Street
	Railway Stations
Hull	53 Low Gate
	Paragon Street
	Southend
Leeds	4 Park Row
	Railway Stations
Leith	26 Bernard Street
Liverpool	25 Castle Street
	9 Exchange Buildings
	12 Walter Street
	Lime Street Stations, &c.
Manchester	4 York Street
	Ducie Buildings
	Stock Exchange
	1 Mosley Street
	Railway Stations
Newcastle-upon-Tyne	1 & 2 Lombard Street
	Railway Station
Newport	Old Masonic Hall
	Monmouthshire Rly. Station
Norwich	Royal Hotel, Market Place
Perth	Railway Station
Plymouth	Plymouth side of Railway Bridge
	The Exchange
Portsmouth	12 The Hard, Portsea
	High Street
	Railway Station
Preston	Railway Stations
Sheffield	New Exchange
	Railway Station
Southampton	High Street
	Railway Station
Sunderland	William Street
	Railway Station
Wakefield	Corn Exchange
	Railway Station
Waterford	Chamber of Commerce
Weymouth	Luce's Royal Hotel
York	17 Mickelgate
	Railway Station

But the towns of Cricklade with 37,000 inhabitants, Gateshead with 33,000, Oldbury, with 16,000, Pembroke with 15,000 and Dukinfield, 15,000, were then still without *any* telegraphic facilities. Most of them, however, were a short distance from "telegraph" towns, being within walking distance of Newcastle and Birmingham, for example.

The Electric's last major domestic investments were completed in 1867; their original sub-sea cable to the Isle of Wight of 1852 was duplicated, and an underwater cable laid from Kingston-upon-Hull across the river Humber to New Holland, a distance of two miles, giving access to Great Grimsby, replacing its old submarine circuit of 1856. Hull had been the site of its first underwater cable in 1849.

Also, the English end of the continental cable laid from Dunwich in East Anglia to Zandvoort in Holland in 1858 was moved to Lowestoft, further north, where the companion 1862 Dutch cable was landed, to secure it from damage by ships anchoring in the Orfordness roads. This involved the laying of thirty-three miles of heavyweight four-core cable obtained from the India Rubber, Gutta Percha & Telegraph Works Company of Silvertown, their first work for the Electric company. Engineered by R S Culley, the project involved lifting and cutting the 1858 cable in mid-ocean and splicing to the new section, which was then laid into Lowestoft between August 8 and 28, 1868 by the Company's steamer *Monarch*. Operations were so prolonged as *Monarch* was called away to make cable repairs elsewhere. The old shore section to Dunwich was later recovered.

The Isle of Man Telegraph Company's cable to Whitehaven was repaired in August 1868 with some well-used stock acquired from the Electric company. The eleven miles of single-core cable was re-covered with hemp and re-armoured with No 3 gauge iron wire. It had been first laid between England and Holland in 1854, before being replaced, salvaged and laid again between Holyhead and Howth in Ireland during 1862. After a portion of it failed in 1866 it was "picked-up" once more and re-worked for the Manx circuit.

Wheatstone's *automatic telegraph* with punched tape feed and fast-writing receivers was introduced on its busiest long lines from London during 1867, initially to Newcastle-upon-Tyne, then in the same year to Manchester, Edinburgh and Glasgow. This multiplied the sending and receiving rates by a factor of five over its needle and American apparatus. Wheatstone assigned the rights to the Company on July 1, 1867 in return for a royalty of 7s 6d per mile per annum. To speed up the message entering process, the Company's engineer, R S Culley, devised an automatic punch in 1867 powered by the air produced for its "pneumatic circuits" or message tubes.

Unlike its competitors, the Magnetic and United Kingdom Telegraph companies, the Electric continued investing in and refurbishing its network to the very end. It added 2,500 miles of wire to its circuits in 1866 and 2,000 miles in 1867. With the prospect of government appropriation the other companies increased wire mileage only in three figures. Their roadside overhead wires had similarly been allowed to deteriorate, whilst the Electric's long lines by the side of the railways were maintained in excellent condition, even in the opinion of the Post Office's hireling experts.

The Company's last extension to its network was the opening of the telegraph office in Wick in Caithness, in the far north of Scotland, on September 25, 1868, connecting by a difficult roadside circuit along the coast south to Golspie and then along the new Sutherland Railway to Bonar Bridge and Inverness. Wick was to be the mainland terminal for the new cable of the Orkney & Shetland Islands Telegraph Company.

The final Board of Directors had thirteen members, the Hon Robert Grimston, chairman, Frederick N Micklethwaite, deputy chairman, G P Bidder, Thomas Brassey, the Earl of Caithness, W F Cooke, C W Earle, E R Langworthy, Mark Philips, Lord Alfred Paget MP, W H Smith MP, Joseph Whitworth, and Major-General William Wylde CB.

William Fothergill Cooke and George Parker Bidder had been directors of the Electric Telegraph Company since its founding in September 1845, twenty-three years previously. In that year the Company inherited 1,000 miles of telegraph line from Cooke & Wheatstone.

In 1868, its final year of independent working, the Electric & International Telegraph Company had a paid-up capital of £1,177,425, only a trivial £7,550 of which was on loan, with 10,007 miles of line (50,065 miles of wire) throughout England, Wales, Scotland and Ireland, as well the offshore islands. It was healthy and wealthy enough to pay down £60,000 in debentures, borrowed to finance its cables, in the previous twelve months. The Company's 1,465 clerks and 759 messengers sent 3,137,478 inland messages and 539,188 foreign messages. It possessed 7,245 telegraph instruments, of which 662 were inkers or printers.

As a final moment of drama on December 26, 1868, the officers and clerks of the Electric Telegraph Company were sworn-in as Special Constables in the City of London in reaction to Fenian outrages. The City, in which the Company was then the largest private employer, alone recruited 3,090 men over age twenty-one to watch over property for attacks by incendiaries (terrorists), especially at night, and to assist the City Police in suppressing riot and disturbance of the public peace.

The final act of the last annual meeting of its shareholders, held on Tuesday, August 17, 1869 was to declare an annual dividend of 25%, an award of £5,000 in bonuses to the staff and a further amount of £2,500 to Henry Weaver, the secretary. The money came from the liquidation of its reserve fund as well as from its half-yearly income, which had risen from £71,246 to £89,783.

The Company, and its competitors, had two more years of phoney existence as the government made administrative arrangements and began an extensive array of line extensions. It was not until February 5, 1870 that the Electric & International Telegraph Company ceased working. Only its offshore associates, the Orkney & Shetland Islands Telegraph Company and the Scilly Islands Telegraph Company, were to escape immediate appropriation; the first was to be acquired by the Post Office on April 12, 1876, the latter in 1878.

The officers of the Electric & International Telegraph Company gave themselves a Farewell Dinner on January 11, 1870. Henry Weaver, the secretary and manager, presided. Present were R S Culley, engineer-in-chief, T C Bennett, accountant, and C V Boys, superintendent of the Intelligence Department, as well as the District Superintendents, including W F Preece, E Graves, G G Newman and E G Bartholomew. The superintendents awarded Weaver, Culley, Bennett and Boys each a testimonial for their twenty-four years service with the Company and for their support.

3.] **COMPETITORS AND ALLIES**

On November 29, 1850 'The Times' newspaper contained four consecutive advertisements that all commenced "Notice is hereby given that application is intended to be made to Parliament in the ensuing session for an Act..." These related to the submissions of the Submarine Telegraph Company between Great Britain and Ireland; the Submarine Telegraph Company between Great Britain and France; the European & American Electric Type-Printing Telegraph Company, all dated November 14, 1850; and the Magneto-Electric Telegraph Company, dated November 12, 1850.

The five year monopoly that the Electric Telegraph Company had exercised had now formally ended:

a.] **The British Electric Telegraph Company**

The British Electric Telegraph Company was incorporated by Special Act of Parliament on July 29, 1850 with a capital of £100,000 in 4,000 shares of £25. It was promoted by the Highton family, brothers and son, to "assimilate its charges to the American tariff, thus to call into existence the use of the Telegraph to an extent hitherto not contemplated by the public". Edward Highton Jnr was the Company's managing director; the secretary was, from its inception, George Saward.

This was the first real challenge to the Electric company's patent monopoly. Edward Highton had launched its statement of intent on November 14, 1849.

The Board of Directors was chaired by James Simpson, an eminent civil engineer, and consisted of J C Cobbold, M P and brewer, W Gilbertson, A Henderson, E Highton Snr, E Highton, Jnr CE, W W Pearson MA, G G Scott and T Webster, MA, FRS. As well as the promoter, his father, also called Edward Highton, age 68, sat on the first board.

The British company was to remain inert for two years, without a mile of line, until Cooke & Wheatstone's master patent expired and until it was able raise working capital. The latter was made difficult by the shareholders' lack of limited-liability, compounding the risk being incurred in opposing by the well-established Electric Telegraph Company.

By 1854 the British company's board was to include, among others, William Gibb, a distiller, George Peel of the Soho Ironworks, Stephen Symonds, a calico printer, and John Pender and Alexander Corran, both of Pender & Company, merchants, all of Manchester. Pender was to be a massively significant figure in submarine telegraphy.

According to the prospectus dated January 10, 1851 the British Electric Telegraph Company was to acquire revenue from the sale of licences and applications to gas and water works, fire and police establishments, mines, docks, etc., and to make arrangements with railway companies for laying wires to the most important towns in England, Scotland and Ireland. Its Bill before Parliament in 1850 demanded access to all railways for its circuits whether or not they were contracted to other telegraph concerns; the legislature rejected this imposition.

However, this was the first company to compete commercially, although initially only in a local manner, with the Electric; its chief office was in Manchester, England's principal centre for textile manufacture, in the north-west of the country. This was an area that the old company had not yet covered.

It intended, from its statements in the prospectus, to imitate the Electric Telegraph Company by using overhead circuits alongside of railways. It acquired Parliamentary powers to carry wires along highways and turnpike roads only as a "precautionary measure".

The British company was formed to work the patents of Henry and Edward Highton, essentially a single-needle, single-wire telegraphic instrument with galvanic batteries, its wires carried overhead on poles. The brothers had a long history in electrical patents. Edward Highton claimed to have been employed by the London & North-Western Railway at Euston in the late 1840's, as did several others, to investigate alternative technology to that offered by the Electric company.

Highton expected his new concern to be granted a wayleave of the railway between the crucial cities of London, Birmingham, Liverpool and Manchester in September 1851; indeed the new shareholders were brought in on that promise. He and his investors were disappointed; the Electric counter-offered and Euston stayed loyal to the old company. The British company's board were forced to admit on August 31, 1851 that they had no agreement with the North-Western Railway. This stunted the new concern's growth towards London and the south of England.

The Great Northern Railway, just being completed from London to the north-east of England, was initially a supporter of the British company; probably due to the Electric being so close to its bitter competitor, the London & North-Western Railway. But it, too, abandoned the new company. In any event connection from the British base in Manchester to the Great Northern lines to London had to be made by way of the Manchester, Sheffield & Lincolnshire Railway, they refused access as well. Both gave wayleaves to the old company.

The Company also tendered to lay its telegraphs alongside of the Great Western Railway from London to Bristol on April 15, 1851 and again on May 30. The railway ignored its importuning.

In the summer of 1852 it eventually secured its first rights over the Lancashire & Yorkshire Railway in north-west England, with a network centred on Liverpool and Manchester. For these 160 miles of line it ordered 5,000 larch-wood poles, each 16 feet long by 4½ to 5 inches diameter.

To June 30, 1852, the Board announced, £20,645 had been raised on capital account, and that £20,006 had been expended. Another call of £5 was to be made on each share to finance expansion.

These figures were open to interpretation. In May 1852 Edward Highton and George Saward were questioned in Parliament. The former declared that of the 4,000 shares of £25 only 300 had been subscribed for and that he personally held 240. Saward, the secretary, qualified this: there were then thirty-nine shareholders holding 1,330 shares, of the £17,065 paid up capital, £3,187 was from deposits on new shares, £13,937 was from shares deemed paid in full, and £10,000 of that from Edward Highton, the balance from the directors and one or two others. Unfortunately Saward also revealed that Highton had received an identical £10,000 from the Company for his services and patent rights!

Between January and August 1852 the British company negotiated rights to erect its pole telegraphs alongside several railway lines, including those of the Leeds Northern, the Stockton & Darlington, the West Hartlepool, the Newcastle & Carlisle, the Glasgow & South-Western and "a portion of the Midland Railway" companies as well as the Lancashire & Yorkshire, all in the north of England and in Scotland, creating a contiguous regional network. It had cost, up until August 1852, a total of £17,000. These circuits were all constructed as line side poles, with circuits in iron piping in towns.

In September 1852 the Company opened its new office at Exchange Street East, Liverpool, by connecting them with the overhead circuits at the Tithebarn Street terminus station of the Lancashire & Yorkshire Railway through subterranean iron conduits; completing this work in a single night. It repeated the exercise in that month in Manchester, joining its circuits at the Lancashire & Yorkshire's Salford railway station with its principal office at Ducie Street, Exchange, in twenty-two hours by underground cables.

The chief offices of the British Electric Telegraph Company, although advertised as being in London, were at 11 Ducie Street, Exchange, Manchester.

Its west to east long-line from Liverpool, through Manchester, Halifax, Bradford, Wakefield, Leeds, Barnsley and Harrogate, to Stockton-on-Tees was completed on October 1, 1852 alongside of railways.

By February 1853 the Company covered fifty towns with 330 miles of line. In mid-1853 it had 600 miles of line, east and west, from Liverpool to Goole, through every important town in Lancashire and Yorkshire, northeast from Liverpool to Newcastle, and was proceeding northwards to Carlisle, Glasgow and Greenock.

The British company's circuits encompassed the northern counties of England and reached Glasgow, the commercial and industrial metropolis of Scotland by late 1853, expending a little over £20,000 of its capital.

The British company granted railways telegraphic facilities, the railways on the other hand granted the Company "free passes" or wayleaves along their lines, and every facility for making and maintaining their works. Minor telegraphic stations were to be worked by railway clerks, the railway to hand over the proceeds to the Company. As is obvious, these negotiations and arrangements followed the Electric's business model.

The competitive effect of the British company on the market for public telegraphy was thus confined for the moment to the major northern cities of Liverpool, Manchester, Leeds, Hull and Glasgow - it was frustrated in its need to construct circuits to London. It was unable to follow the railways to the capital and had to plan a roadside route 185 miles from Barnsley in north-east England.

For the British company's route from Goole to Hull its engineer John Lavender erected wires 140 feet above the river Humber at Howdendyke in 1853, on masts constructed as those on sailing ships. Lavender also introduced *over-house* telegraph wires for the first time in 1854 between the railway station and the city centre of Halifax. Until then municipal authorities had insisted on underground cables.

Although it had no circuits to the capital the British Electric Telegraph Company maintained its Central Station at 29½ Royal Exchange in London. In early 1853 the Company was advertising as having stations at forty-one other places - 26 Exchange Street East, Liverpool; 11 Ducie Street, near the Exchange, Manchester; 6 Bond Street, Leeds; 9 Leeds Road, Bradford; Corn Market, Wakefield; Union Street, Halifax; Railway Station, Barnsley; Railway Station, Oldham; Railway Station, Newcastle; and Sandhill, Newcastle; as well as at Carlisle, Melton., Alston, Haltwhistle, Haydon Bridge, Hexham and Blaydon; Glasgow, Paisley, Kilmarnock, Auchinlech, Ardrossen, Troon, Ayr, Annan, Dumfries and Sanquhar; Arthington for Otley, Harrogate, Ripon, Thirsk, Northallerton, Stockton, Middlesbro', Redcar, Yarm, Darlington, Sheldon, Bishop Auckland, Etherley and Crook.

Messages of twenty words between the large cities of Leeds and Manchester, Liverpool and Manchester, Liverpool and Oldham, Oldham and Manchester, Leeds and Wakefield, Leeds and Halifax, and other pairs of smaller towns were charged at 1s 0d. The Company added 6d extra for delivery.

To eliminate any confusion with the Electric company it re-titled itself the *British Telegraph Company*, confirming the change in a Royal Charter on June 13, 1853, which also provided its shareholders with limited-liability, and received from Parliament a Special Act to sanction an increase in its capital to £300,000 in that year, reiterating its authority to construct telegraphs on streets, roads, waterway towing paths and railways, and – more importantly – acquiring additional powers to lay submarine cables between Britain and Ireland.

With the failure of the *Electric Telegraph Company of Ireland* and that company's underwater cable and circuits to Belfast and Dublin in 1853 with which it was to connect, the British company determined to lay its own cable to Ireland. This it completed on June 9, 1854, from Port Patrick to Whitehead, with a six wire cable. It then had to erect posts from the coast to Dumfries with four wires to connect with its English circuits at Carlisle, and posts with two wires to Ayr to reach Glasgow. These lines were to be erected in two months. The Irish circuits with wires connecting at Carrickfergus to the city of Belfast were already constructed.

It also reached Edinburgh, the Scottish capital, in 1854. In that year the British Telegraph Company paid a 6½% dividend. The line south to Dublin from Belfast and the cable to England was intended to be made underground along the old coach road using the circuits of the late lamented Electric Telegraph Company of Ireland, during 1855; it was never completed.

In July 1854 the British Telegraph Company began to offer message rates in concert with the Submarine and European companies. Then on August 30, 1854 a general meeting of the shareholders in Glasgow confirmed merger arrangements with *European Telegraph Company* and the addition to its board of directors of eleven new members from the European company. In September of that year the British company completed negotiations to acquire that company's assets giving it access at last to the south of England, and even more importantly to the submarine circuits to the Continent. It exchanged £100,000 in shares and paid £30,000 in monthly cash instalments. The two companies' circuits were merged effectively under the British company's name during February 1855 using Highton's telegraph.

George Saward was appointed Secretary of the new united concern at a salary of £400 per year.

It adopted the European company's subterranean system, devised and patented by the contractor William Reid, for those lines that it had to construct alongside of roads; laying a roadside underground circuit from Manchester to Carlisle to access its new Irish cable by the summer of 1855.

The British Telegraph Company had the following seventy-one stations in June 1854:

Alston; Annan; Ardrossen; Arthington for Otley; Auchinleck; Ayr; Barnsley; Billingham; Birmingham, 104

New Street; Bishop Auckland; Blaydon; Bradford, 9 Leeds Road; Burnley, Post Office; Canterbury, 36 High Street; Carlisle, 6½ English Street; Carlisle, Newcastle & Carlisle Railway station; Chatham, 303 High Street; Consett; Coxhoe; Crook; Dalry; Darlington; Deal, 100 Beach Street; Dover, 7 Clarence Place; Dumfries; Etherley; Eston; Ferryhill; Glasgow, 147 Queen Street; Glasgow, Glasgow & South Western Railway station; Goole; Gravesend, 45 The Terrace; Guisbro': Halifax, Union Street; Haltwhistle; Harrogate; Hartlepool, dock office; Hartlepool, West; Haydon Bridge; Hexham; Huddersfield, Post Office; Hull, 36 Lowgate; Irvine; Kilmarnock; Leeds, 6 Bond Street; Liverpool, 3 Exchange Street West; London, 30 Cornhill; London, 43 Regent's Circus, Piccadilly; Manchester, 11 Ducie Street, Exchange; Melmerby; Middlesboro'; Milton; Newcastle, Sandhill; Newcastle, Central Station; Northallerton; Oldham; Paisley; Picton for Stokesley; Pontefract, Market Place; Redcar; Redheugh for Gateshead; Ripon; Sanquahar; Seaton; Shildon; Stockton, Stockton & Darlington Railway station; Stockton, Leeds Northern Railway station; Thursk; Troon; Thornhill; and Wakefield, Market Place. Except where noted the telegraphs were located at the railway station. The concentration was in northern England, with the long-line to London and the Continent then owned by the European Telegraph Company.

The combined British Telegraph Company listed its premises in London in 1855 as: Secretary and Chief Officials at its Chief Office, 43 Regent's Circus, Piccadilly; Central Message Offices, 30 Cornhill, Stock Exchange, 8 Throgmorton Street, 82 Mark Lane and 34 Parliament Street. It also had a manufactory for Highton's telegraph instruments at Oliver's Yard, 26a City Road, Finsbury.

The British company's line from England through to Dublin, due to open in June 1855, was abandoned. The Company's only office in Ireland was that in Belfast. Its principal traffic was with Glasgow in Scotland.

Its "chief officials" then comprised George Saward, secretary, John Rutherford Duff, accountant, and William Andrews, commercial superintendent in London, who was also responsible for works on the Submarine company's circuits. There were in addition, William Powell, engineer, and Samuel Percy, commercial superintendent in Manchester, at the Company's main offices, 11 Ducie Street, Exchange, Manchester.

The combined company adopted the European firm's policy of cheap message pricing, from 25% to 50% less than the competitive Electric company's rates. This proved to be a huge mistake on its new much larger, less efficient network; profits dropped and the dividend had to be abandoned in mid-1855.

Their inherited property from the European Telegraph Company proved a mixed blessing, although acquiring its valuable roadside wayleaves the workmanship proved to be less than perfect.

George Saward and the British company's engineer, William Powell, personally inspected the entire mileage of the European Telegraph Company from Dover to London and from London to Liverpool in 1854 and found decay in every segment of its gutta percha insulated lines. The wires were covered with "raw" gutta percha, without any preservative coating, buried shallow in untreated deal-wood troughs. Their state was so bad that the 84 miles between London and Dover had to be replaced immediately. This was done by the telegraph contractor, W T Henley, during 1855 without affecting message traffic. The old wires were remanufactured with "rubbed" gutta percha, having a coating of preservative Stockholm tar applied, with a "serving" or additional covering of hemp tape, and were reburied in heavier creosoted hard-wood troughs from three to five feet deep in the earth. These new lines lasted for a decade.

The long underground lines from London to Liverpool were in a similarly poor condition, but still operable. This small piece of cheer was fortunate as the Company lacked sufficient funds to refurbish the newer circuits. Saward was allowed to inspect subterranean lines of the competitive Magnetic company, that paralleled their northern circuits in 1855; they were found to be in a much better state of preservation.

In August of 1855 the British Telegraph Company joined with the Electric and Magnetic companies in fixing a standard message tariff to all towns where they competed. The agreement was not publicised.

Under its original charter its entire capital had to be subscribed by July 1856. However by 1855 there was a general resistance from its shareholders to contribute more than their existing amount; this left a shortfall of £66,000. The balance in the capital account had been raised on loan. The board proposed to issue new preference shares to cover its legal obligations either at onerous 7½% for seven years or at 5% in perpetuity.

In March 1856 Percy reported that the Company had raised £282,530 in capital, with £26,544 in annual receipts and £25,811 in expenses in 1855. It then had 1,200 miles of line and 96 stations open.

The British Telegraph Company in 1857 had a huge Board of Directors of twenty-eight, divided geographically into committees representing clusters of shareholders. As well as the chairman, James Simpson, and the deputy-chairman, William Gibb, the committee in London had eleven members, the majority from the Submarine Telegraph Company, Manchester had five, Glasgow six, Newcastle three and Bradford one.

At the beginning of 1857 the British and Submarine companies advertised their principal offices as at: 30 Cornhill; 43 Regent Circus; Stock Exchange, (New Court Entrance); 8 Throgmorton Street; 82 Mark Lane, corner of Fenchurch Street; and the House of Commons (during its session) in London; 7 Clarence Place, Dover; the corner of Exchange Alley, Exchange Street West, Liverpool; 11 Ducie Street, opposite of the side of the side entrance of the Royal Exchange, Manchester; 147 Queen Street, Glasgow; 2 Donegal Street, Belfast; Sandhill and at the railway station, Newcastle; 36 Lowgate, Hull; 9 Leeds Road, Bradford; 6 Bond Street, Leeds; 303 High Street, Chatham, and 45 The Terrace, Gravesend.

In 1855 and 1856 the British company also had had a public office at 34 Parliament Street, at the corner of Bridge Street, in Westminster, adjacent to the Houses of Parliament. As mentioned before, it never opened its promised office in Dublin.

In early 1857 British company merged with the much larger Magnetic Telegraph Company.

George Saward was to claim to Parliament in 1860 that it was the unaffordable cost of repairing its deteriorating underground trunk lines between London and Liverpool and Manchester that forced it into merger talks with the Magnetic company. It is not known whether the extent of this "poison pill" was revealed to the Magnetic's board.

A special general meeting of its shareholders assembled on August 20, 1858 and voted to wind-up the rump of the British Telegraph Company. At this meeting William Andrews was officially the Secretary, George Saward having left to become manager of the Atlantic Telegraph Company and its cable to America. A final, modest dividend of 4% was declared.

Although the motion was carried the British Telegraph Company remained in existence for a further ten years. The powers written into the Company's Act of Incorporation were to prove useful later. In 1868 its nominal Secretary was William Charles Daniell.

b.] **The English & Irish Magnetic Telegraph Company**
The English & Irish Magnetic Telegraph Company was authorised by a Special Act of Parliament on August 1, 1851 as the 'Magnetic Telegraph Company' with a capital of £500,000 to work the 1848 joint patents of W T Henley and D G Foster. Uniquely at the time its instruments, devised by its promoter, W T Henley, did not require batteries of electric cells but consisted of two small magneto-electric devices that generated current to deflect a pair of needles on a distant dial.

Throughout its several name changes, it was initially promoted by Henley in 1850 as the 'Magneto-Electric Telegraph Company', the company was always known publicly as the '*Magnetic*', just as the original concern, dubbed by its competitors the 'old company', was always the '*Electric*'.

The patent granted to William Thomas Henley, philosophical instrument maker, and David George Foster, metal merchant, on August 10, 1848 provided the Magnetic company with considerable technical differences over the existing telegraph concerns. Of the eight claims in the patent two were to have commercial utility; the third claim for the use of magneto-electric apparatus instead of using galvanic or voltaic electricity, and the fifth claim for a compound of gutta-percha and comminuted sand to make an insulation for cables. These two innovations led, as noted, to the first widely-used magneto telegraph, without batteries of cells, and to the first telegraph network using underground cables.

Henley had been instrument maker to Charles Wheatstone at King's College, making his first magneto devices, becoming a contractor for works to Cooke & Wheatstone and to the Electric Telegraph Company.

A substantial trial of Henley's new instruments was organised by the Magnetic Telegraph Company on the South Devon Railway in August 1850 under the latter's Superintendent of Telegraphs, Thomas Bray Webber. I K Brunel, the railway's engineer, was also present during several of the experiments. The line ran in part for five miles along exposed sea coast and its electric circuits consequently suffered from the damp conditions. In one experiment the magnetic telegraph was worked on the existing wires along the 52 miles of railway between Plymouth and Exeter. The circuit went back and forth between the two cities and then back again to Newton Abbot, giving a length of telegraph line of 138 miles "through 23 instruments". Webber reported to Henley on August 20, 1850 that the results were "highly satisfactory" over twelve days of use despite the "very wet" conditions, with little or no leakage of current that had been prevalent with the old galvanic system.

Webber noted that the strength of the magneto-generated current allowed the dead-beat needle sufficient force to ring a bell, and that it therefore could easily be adapted to acoustic as well as optical working.

Despite this technical endorsement the South Devon Railway retained its Cooke & Wheatstone apparatus.

The Magnetic's provisional Board of Directors of April 1851 included C W Siemens, the controversial Prussian electrical pioneer, as well as W T Henley and what were otherwise professional or 'City' directors, such as Richard Hartley Kennedy, alderman of London, a man to be convicted of bank fraud in 1858, W Rigby, W H Hatcher and W Nicholson. These were soon displaced by capitalists from the north-west of England including Joseph Ewart, a cotton magnate and Member of Parliament for Liverpool, and Edward Cropper, a director of the London & North-Western Railway and latterly of the Atlantic Telegraph Company. They were soon joined by others representing Irish interests. Edward Brailsford Bright was its Secretary.

By January 1854, in addition to Ewart and Cropper the Board consisted of, from Liverpool, Robert Crosbie, Christopher H Jones, Henry Harrison, James Holme, William R Sandbach, William Langton and Thomas D Hornby, from London, Charles Kemp Dyer and Charles B Stokes, from Dublin, Valentine O'Brien O'Connor, John Barton and John M'Connell. It continued to be a Liverpool-controlled concern; this is emphasised by its having the Liverpool Borough Bank managing its funds rather than a City bank.

Bearing in mind the dominance of the Electric company in Britain the Magnetic acquired a Royal Charter under its new, longer "English & Irish" title on April 5, 1852, in addition to the authority by its Act of Parliament. It announced that it intended to connect Britain and Ireland by an underwater telegraph cable and to erect lines throughout Scotland and Ireland. It anticipated circuits covering Dover, London, Birmingham, Wolverhampton, Manchester, Bolton, Wigan, Liverpool, Preston, Carlisle, Edinburgh, Glasgow and Greenock in Britain; and Donaghadee, Belfast, Dublin, Galway, Limerick, Tipperary, Waterford, Cork and intermediate towns in Ireland. It also offered to connect the Home Office in London with the seat of government at Dublin Castle in Ireland.

The Company had a focussed view of their business. Its managers stated that "none but the largest towns yield any profit upon the working expenses of a telegraph, we therefore determined from the outset, not to extend our wires to any point where a profit could not be obtained." Its station list was short, limiting each circuit to no more than five, six or at the most eight stations. Most country towns, they thought, were adequately served by the speed of the post, the business of such towns being steady without any speculative trade. This sad attitude concentrates on the telegraph's initial dependence on commerce and trade, and not its potential.

In the late summer of 1852 it had an eight-wire underground roadside line in operation between Liverpool, Wigan, Bolton and Manchester in the north-west of England; intending to have a six-wire line extending south from Manchester to London and Dover; a four-wire line laid underground north from Liverpool to Carlisle; as well as plans for a six-wire submarine cable between Port Patrick in Scotland (with a road-side circuit to Carlisle) and Donaghadee in Ireland.

In Ireland it already, in June 1852, had a two-wire circuit between Dublin on the east coast and Galway on the far Atlantic coast, laid alongside the lines of the Midland Great Western Railway.

Charles Tilston Bright, engineer to the British Electric Telegraph Company, was poached by his elder brother, Edward, the Magnetic's secretary, to become Chief Engineer during 1852. He made several changes in the Company's technical arrangements, in particular reducing its dependence on W T Henley, the firm's promoter.

The Magnetic eventually became the dominant telegraph company in the relatively small market of Ireland connecting the country's major cities of Belfast, Dublin, Galway, Cork and Queenstown, mainly with wires next to railways. Its circuit south from Dublin to Cork alongside of the Great Southern & Western Railway was completed on June 1, 1853.

Fox, Henderson & Company, railway engineers and contractors, of 8 New Street, Spring Gardens, London, who had constructed the Great Southern & Western Railway and the parallel telegraph line, were commissioned in March 1852 to construct the Magnetic's new lines north from Manchester, including the submarine cable to Ireland, in place of its founder, W T Henley, who had built the lines from London. Charles Fox had been Robert Stephenson's resident engineer at Euston Square on the London & Birmingham Railway in 1837 when Cooke & Wheatstone's original telegraph circuit had been laid. This relationship did not last long and the contract for the underwater works passed to R S Newall, maker of the English Channel cable, and that for the Carlisle to Stranraer subterranean land line, in January 1854, to William Reid, the first and largest telegraph contractor in Britain.

The underground works to Stranraer were laid from Carlisle to Gretna along the Caledonian Railway, and from Gretna through Annan and Dumfries along the turnpike roads.

It succeeded in laying the first undersea cable connecting Britain and Ireland on May 23, 1853, between Port Patrick in Scotland and Donaghadee in Ulster. In England it brought London, Birmingham, Liverpool, Manchester and the major towns of Lancashire in circuit during May 1853 using roadside, underground cables, ten gutta-percha insulated wires laid in wooden troughs, an increase on the initially planned six wires: this was the third circuit to enter London from northwest England. All of the Magnetic's initial long-distance circuits in Britain were laid underground; those in Ireland were mixed, pole and subterranean.

On August 19, 1853 in Dublin the Company completed an underground circuit between the terminals of the Great Southern & Western and Dublin & Drogheda Railways down the middle of Sackville Street. This allowed Cork in southern Ireland to connect through Dublin to Belfast in the north.

Its line from Donaghadee connecting with the cable to Britain was built alongside of the County Down Railway from Newtownards to the city of Belfast. The continuation to Dublin was by way of the Ulster, Belfast Junction and Dublin & Drogheda Railways. The long circuit from Dublin through to London was opened on January 17, 1854, from Cork on January 25.

The Magnetic then possessed the longest subterranean circuit in the world. It worked 670 miles of gutta-percha insulated wires in wooden troughs from London via Manchester, Liverpool, Carlisle, the Port Patrick to Donaghadee cable, and Belfast to Dublin.

The Company acquired wayleaves alongside of the East Lancashire and the Caledonian Railways, among a small number of others, in the north-west of England.

The Company, or more particularly, W T Henley, had ambitions abroad. In 1853 it despatched W G Sprigg to Sydney, New South Wales, in Australia as its Agent. He went with two of Henley's single-needle magneto instruments and a range of publicity material. The Magnetic company offered its telegraph instruments for £35 each and its alarms at £7 5s each, delivered in Australia. Sprigg also gave prices for importing insulators, screw-ratchets and winding apparatus for making overhead lines at £23 per mile. Although approaching the state government and the railways Sprigg had to report in 1856 that he had "been unsuccessful in all cases".

According to Sprigg, Charles Todd had a similar mission from the Company in South Australia. Todd did have the Henley magneto installed on the short marine telegraph between Adelaide and the town of Semaphore, replacing an optical line.

Table 15

English & Irish Magnetic Telegraph Company
Miles of Line in operation in 1853
Compiled by Charles Bright for
Shaffner's Telegraph Companion 1854

Underground (6 wires per line)	*Miles*
London to Liverpool by Birmingham, Manchester, Bolton and Wigan‡	250
Liverpool to Carlisle	130
Carlisle to Port Patrick	125
Port Patrick to Donaghadee (submarine)	22
Donaghadee to Belfast	32
Belfast to Dublin	105
Dumfries to Glasgow & Greenock	115
Cork to Queenstown	16
Streets of London, Liverpool, Glasgow, Dublin and other towns†	13
Scottish Central Railway, Great Northern Railway and Haigh Colliery	8
Total 821 miles of underground line, 6,348 miles of wire	
Overground (c. 6 wires per line)	*Miles*
Great Southern & Western Railway*	170
Midland Great Western Railway*	150
Dublin & Drogheda and Belfast Junction and Ulster Railways*	160
Belfast & County Down Railway*	40
Belfast & Ballymena Railway*	40
Ballymena & Coleraine Railway*	30
Londonderry & Coleraine Railway*	50
Londonderry & Enniskillen Railway*	60
Killarney Junction Railway*	50
Kilkenny Railway*	30
Portarlington & Tullamore Railway*	30
Waterford & Limerick Railway*	80
Caledonian Railway	200
East Lancashire Railway	100
Total 1,196 miles of overground line, 7,200 miles of wire	

* Railway lines in Ireland. † 12 wires. ‡ 10 wires

During May 1854 the English & Irish Magnetic Telegraph Company advertised its principal offices in Britain as at 72 Old Broad Street, London, 2 Exchange Buildings, Liverpool, 2 Exchange Arcade, Manchester, and 22 English Street, Carlisle. In Ireland its chief office was at 6 College Green, Dublin.

The large telegraph station at 72 Old Broad Street, City, was opened on January 4, 1854. It was a rented property shared with eight or so other mercantile tenants; located, the Company repeatedly stated in its advertisements, "six doors from the Exchange". This was the busiest office outside of Liverpool, and was to be the temporary head office of the Magnetic Company when it merged with one of its competitors in 1857.

In 1854 it listed its stations as: London, Birmingham, Manchester, Liverpool, Preston, Carlisle, Glasgow, Greenock, Edinburgh, Stranraer, Port Patrick, Donaghadee, Belfast, Armagh, Drogheda, Navan, Dublin, Athlone, Ballinasloe, Galway, Kildare, Carlow, Thurles, Tipperary, Limerick, Waterford, Mallow, Killarney, Cork and Queenstown. A line was under construction along the railway from Limerick to Waterford. The lines from Belfast to Dublin and Dublin to Cork were overhead wires on poles. The Irish business was such that it required six underground wires from Liverpool to the cable-head at Port Patrick in Scotland. Six additional wires, three circuits, were also just about to be laid underground between Belfast and Dublin. Both of these long subterranean circuits were to be constructed by the Company's original promoter, the telegraph contractor, W T Henley of London.

Other stations on its list included Bolton, Bury, Blackburn, Accrington, Dumfries, Lanark, and Lockerbie in north-west England and Scotland; as well as Lisburne, Portadown, Athenry, Dundalk, Mullingar, Oranmore, Maryborough, Kilkenny and Newry in Ireland.

In 1854 the Magnetic paid its first dividend, 5%.

By 1855 the English & Irish Magnetic Telegraph Company had its main offices at 2 Exchange Buildings, Liverpool; 72 Old Broad Street, City, Stock Exchange at Hercules Passage, City and 7 Charing Cross (opposite the Statue) in London; Exchange Arcade, Manchester; 101 New Street, Birmingham; 18 Exchange Square, Glasgow; 6 College Green, Dublin; Bridge Street, Belfast; Pembroke Street, Cork; The Quay, Queenstown; and the Railway Station, Galway.

At the end of 1855 the original English & Irish Magnetic Telegraph Company had 2,283 miles of line in circuit, two-fifths underground, with 14,926 miles of wire. It possessed 201 stations with 492 instruments and worked 264,727 public messages. Annual receipts to June 1855 were then £25,832 and expenses £17,517. Its dividend for that year was a healthy 6%.

The Magnetic considered laying a domestic cable between Burrow Head, Wigtownshire, Scotland and the Point of Air on the Isle of Man in February 1856. It did not proceed with the project.

A little later in that year it merged with the British Telegraph Company.

The final General Meeting of the proprietors of the English & Irish Magnetic Telegraph Company took place in Liverpool on April 28, 1857. As well as announcing the completion of the merger, the board noted that special sums had to be set aside for the repair of damages from the storms that crossed the country in July, August and December, 1856.

c.] **The European & American Electric Type-Printing Telegraph Company**

The European & American Electric Type-Printing Telegraph Company was another successful early, if short-lived, competitor to the old company. In January 1852 it became the second company, after the Electric, to commence constructing a circuit to connect London with the north of England, starting to lay wires next to the obsolete coach road by way of Birmingham to Liverpool and Manchester, completing its line in May 1854 just before the Magnetic company's.

The European concern, the first real national challenge to the Electric company, originated not from within Britain but in France. On August 19, 1849 the government of France granted Jacob Brett monopoly rights to construct underwater electric telegraph cables between the two countries for a period of ten years. It was conditional that the concession be constituted in France. Under an agreement with the French government dated October 23, 1851 the monopoly was vested in a private partnership consisting of Charlton James Wollaston, Francis Edwards, Sir James Carmichael, John Watkins Brett and Frederic Toché, entitled "*Wollaston et Compagnie.* On September 6, 1852 Wollaston and Toché withdrew and were replaced by Lord de Mauley and Frederick William Cadogan, at which moment the firm became *de Mauley et Cie.* On the death of Lord de Mauley in 1855 it was known as *Société Carmichael et Compagnie*. This final private partnership lasted as long as the concession.

To work the concession and to raise the capital required a *Société en Commandité* (effectively a limited-liability joint-stock company authorised and supervised by the government) was formed, *la Compagnie du télégraphe sous-marin,* supported by the Rothschild and Lafitte banks. Its authorised capital was 1,250,000 francs, in 5,000 shares of 250 francs. In England it was to be known as the *Submarine Telegraph Company between France and England,* represented by J Brett, Toché & Co., for the concessionaires, another private partnership, whose *gérants* or managers comprised Sir James Carmichael Bt, Francis Edwards, Charlton J Wollaston, John Watkins Brett and Mons. F Toché. Its capital was effectively secured by its absolute monopoly in telegraphy between England and France. The capital of £100,000 was primarily subscribed for in London; but it had to have an Anglo-French directorate based in Paris. Technically and operationally the company was always headquartered in London. The chairman in Paris was Edgar Aimé, its chairman in England was Lord de Mauley; latterly its driving force was Sir James Carmichael, Bt., who succeeded to the chairmanship in 1856. The Company's engineers were Thomas Crampton, a civil and locomotive engineer, and Charlton Wollaston, an electrician.

John Watkins Brett had previously promoted two expensive Special Bills in the Houses of Parliament on November 12, 1850, one to acquire powers and capital for the *Submarine Telegraph Company between Great Britain and France* and another for the *Submarine Telegraph Company between Great Britain and Ireland.* The need for special powers for France and capital for the proposed Irish line were found irrelevant; and the two bills were withdrawn on June 2, 1851, after having incurred the large cost of legal drafting.

Despite the Company being a joint-stock organisation the capital was raised through a handful of individuals; Crampton put up over one half, the balance was provided by Lord de Mauley, Sir John Carmichael Bt, Davies Sons & Campbell (the firm's solicitors), the Hon F W Cadogan and George Hadden.

The concession acquired by Jacob Brett in August 1849 required that electrical communication be made between England and France before September 1, 1850. To meet this deadline the Company laid a lightweight unarmoured, gutta-percha insulated single-core cross-channel cable on August 28, 1850. It was so light that it required lead weights to stop it floating. After a few messages the circuit failed, but the terms of the concession had been met and the Company gained time, and publicity, for the financing and manufacture of a much heavier, multi-core cable.

The Submarine company successfully laid the first underwater electric telegraph cable between Dover in England and Calais in France on September 25, 1851. The cable possessed four copper conducting wires, each insulated with gutta-percha, covered with tarred hemp and protected with armour formed of spiral-wound No 1 gauge iron wires. *All* subsequent underwater telegraph cables were made to this model. According to T R Crampton, he "undertook the entire charge and responsibility of the form, construction and laying of the cable" from Dover to Calais, as well for that from Dover to Ostend. Crampton therefore may be said to have invented the viable submarine cable.

It initially used the Foy-Breguet instrument in its circuits; this used a small black arm working in jerks from the centre of a white dial, so as to describe angles of 45° and 90°, with a fixed vertical line passing through the centre. Rotating a handle and arm in a very quick rotation indicated letters by various angles to the centre line. The Foy-Breguet instrument imitated the action of the Bonaparte-era Chappe mechanical semaphore telegraph, an optical device with rotating swing-arms on tall posts, used for several decades in France, the Italian states and other European countries until the 1840s. The Submarine company had tested the Foy-Breguet and the Brett type-printer, settling on Cooke & Wheatstone's two-needle telegraph in 1852, until finally adopting the American telegraph in 1855, which was by then used throughout Europe.

Its original London office in 1851 was at 9 Moorgate Street, on the opposite side of the road to the Electric's 'house'. It moved in the same year to 30 Cornhill, City, where it had an instrument room on the upper floor. The Submarine company's official headquarters was at Place de la Bourse 10, Paris. The location of these offices shows its reliance on the mercantile community. It also had, in its first few years, a public office at the railway station at Calais, from where its circuits followed the *Chemin de fer du Nord* to Paris.

As the Submarine Telegraph Company did not yet have its own circuits into London when the cable was opened for public traffic on November 13, 1851 messages had to be accepted at the London Bridge station of the South Eastern Railway Company, sent on the railway's overhead wires to Dover. In addition messages were accepted and forwarded to London Bridge by messenger at the much more convenient office of Julius Reuter, telegraph agent, 1 Royal Exchange Buildings, across London Bridge, in the City. On Tuesday, February 6, 1852 the Submarine company required that all messages be sent from its new offices at 30 Cornhill, City, nine months before it was to secure its own circuit to the cable end at Dover. These, too, were sent electrically from London Bridge.

Between November 19, 1851, when it opened its circuits to the public, and June 30, 1852 it handled 9,045 messages, receiving £6,889 13s 9d in income. On the latter date it had just two instruments at Cornhill, working to the Continent; this increased, to four by January 1854, when it had access to the European company's long domestic line to Manchester.

If connection with the state-owned telegraph monopoly in France was straightforward, circuits at the English end were to be problematic. As has been mentioned, the partnership of Cooke & Wheatstone had granted a licence to the South Eastern Railway Company to work an experimental circuit on one of its branches in November 1841. This had been extended in September 1845 to cover its main line between London and Dover, as well as the rest of its system in Kent and Sussex. Unfortunately, the South Eastern company resisted a common circuit with the Submarine company. It was already sharing technology with the Electric company; in addition, although lacking permission to land wires in France, the railway company's telegraph department was experimenting with a lightweight underwater cable of its own in the English Channel off Dover. So, for a short period, the Submarine company was without direct connection with the rest of England – messages were hand-carried between the two telegraphs in Dover town and transcribed from one system to the other.

To overcome this isolation the Submarine proprietors in London projected a new company in 1851 under English law, the *European & American Electric Type-Printing Telegraph Company*, with a capital of £200,000, in 40,000 shares of £5, of which £93,000 was soon paid-up, to connect London, Liverpool and Manchester by one mainline (Dover, London, Birmingham, Manchester and Liverpool). It was to be laid underground to be free atmospheric interruption or maintenance (under contractor's guarantee) for 10 years at £112,000 on 300 miles. Its principal promoter was John Watkins Brett, managing director of the Submarine company; his brother Jacob owned (among several other assigned telegraphic patents) the British licence for the original type-printing telegraph patent of Royal Earl House, an American, which the Company acquired. The company and its capital was authorised by Special Act of Parliament on August 7, 1851. Its chief offices were shared with the Submarine company at 30 Cornhill, City.

The European's original Board of Directors had nine members. The chairman was Lord de Mauley, also chairman of the Submarine company, A Anderson MP, chairman of the Peninsular & Oriental Steam Navigation Company, W J Chaplin MP, chairman of the London & South-Western Railway, Samuel Laing, chairman of the London, Brighton and South Coast Railway, John Masterman Jnr of the Submarine company, Sir James Carmichael Bt of the Submarine company, Ernest Bunsen of the Submarine company, and Admiral Richard O'Connor KCH. The original secretary was W M Shaw; he was replaced quickly by George Lockyer Parrott.

The European Telegraph Company (as it was generally, and mercifully, known), unlike all other potential competitors for the Electric's business, had a real commercial advantage – it had for the moment *sole access* to the Continent of Europe through the Submarine company's Dover cable and worked as one with it.

The "Type-Printing" element in the legal title of the Company was almost immediately abandoned from its public information as the Brett type-printing telegraph just could not be made reliable enough for service.

The European became the first effective challenge to the Electric company. It was to quickly lay six resin-insulated wires eighteen inches deep underground in *kyanised* (rot-proofed) wooden troughs, with test boxes at every mile alongside of the old London to Dover coach road, by way of Greenwich, Gravesend and Canterbury. Two of these wires were planned for the Paris circuit, two for Brussels and two for a prospective Mediterranean line. These circuits, it was claimed, were laid by between 200 and 300 men working at the rate of one-and-a-half miles a day during the summer of 1852 from London. They had reached Chatham by September 1852. The line was constructed by Frend & Hamill of 44 Bedford Row, London, a small and short-lived firm of general public works contractors. Their workmanship was not of the first quality and the Dover cables had to be thoroughly renovated by W T Henley, the telegraph engineer, after just three years.

For the difficult metropolitan connection between their new offices in Cornhill in the City of London and New Cross Gate, south of the river Thames in Surrey, a distance of about 7 miles, William Reid was employed as contractor. On July 31, 1852 he billed for the 12 wire section between Cornhill and London Bridge, and on August 21 for the 8 wires hence to the beginning of the Dover Road, and for 6 wires to New Cross Gate. These circuits were laid underground in 4,400 cast-iron troughs with lids, to Reid's patent design.

The South Eastern Railway Company vigorously opposed the construction of the new circuits. It proved in the Exchequer Court on January 16, 1854 that the European's "digging and boring under the railway at the point where the highway crossed" for its roadside underground wires at Canterbury was trespass. This precedent overturned the powers all telegraph companies assumed in their authorising Acts of Parliament regarding rights-of-way along public highways. They could not cross railways without permission.

The division of revenue between the Submarine Telegraph Company, South Eastern Railway and, later, the European Telegraph Company on the circuit between London, Dover and the Continent over the first fifteen months from the public opening of the cable in November 1851 is shown below:

	Mssgs	Sub	SER	Eur	TTL
1851		£	£	£	£
Nov	254	150	43	-	194
Dec	774	455	143	-	598
1852		£	£	£	£
Jan	1,068	626	201	-	827
Feb	716	327	233	-	561
Mar	1,043	417	381	-	798
Apr	1,028	425	367	-	792
Jun	1,002	413	347	-	780
Jul	1,117	455	569	-	760
Aug	1,295	526	446	-	825
Sep	1,231	502	410	-	973
Oct	2,024	829	619	-	912
Nov	1,475	909	20	218	1,148
Dec	2,003	1,223	-	307	1,530
1853		£	£	£	£
Jan	2,016	1,211	-	296	1,507
Total	18,093	8,894	3,974	822	13,691

The European company opened its office in the City, the financial district of the capital, on November 1, 1852; with a direct circuit between 30 Cornhill, London, and place de la Bourse 10, Paris. Under French pressure it tried the Foy-Breguet telegraph once again, using twenty-five to thirty batteries each of twelve pairs of cells on the circuit, but replaced it on the same day with the Cooke & Wheatstone two-needle instrument.

On December 8, 1852 the European company's shareholders resolved to extend the line from Dover to London onwards to Birmingham, Manchester and Liverpool. The extension was estimated to cost £50,000, the same as the newly completed Dover line. A new issue of shares was confidently made to meet these costs.

The firm laid a subterranean circuit from the City to the West End in London and opened a telegraph office at 43 Regent Circus on September 7, 1853. Its new long line of six wires to the north-west of England then already extended past this to follow "Watling Street", an ancient Roman road, commencing at the Marble Arch, striking north along the Edgware Road in West London to Rugby in the Midlands where it diverted west along the turnpike to reach Birmingham.

Within the short period of two years the European Telegraph Company was to lay underground wires to Birmingham, in the midlands of England, completed on August 8, 1853, reaching Manchester, the north's principal industrial city, by way of Wolverhampton, Stafford and Macclesfield on March 1, 1854, and the great Atlantic port of Liverpool on May 6 1854. It also obtained a contract of the Royal Navy to connect the Admiralty in Whitehall, London, with the dockyards to the east of London at Deptford, Woolwich, Chatham, Sheerness, Deal and Dover, all on its roadside route, by leasing it a wire.

The first messages from its office at 1 Market Place, Manchester to Paris and Brussels via London were sent at 7 o'clock in the morning on May 12, 1854. On May 10 and 11, 1854 the European Telegraph Company and the Submarine Telegraph Company created *direct* circuits between their offices in Liverpool and Manchester and those in Paris and Brussels, 535 miles and 520 miles distant. Although experimental these lines, using Cooke & Wheatstone's two-needle telegraphs, demonstrated the capacity of the new technology.

Once the European telegraph arrived John Hunter of 2 Paradise Street, Liverpool, advertised that he would receive telegraph messages from England and the Continent for British North America and the United States and forward them by fast steamer to Halifax, Nova Scotia and New York in America. Hunter was correspondent to the Associated Press of New York. Julius Reuter also opened Continental Telegraph Offices in Liverpool and Manchester to distribute and collect news during 1852 and 1853.

Most of its business was for the Submarine line to cities and towns on the Continent, but domestic traffic within England was increasing. In the latter half of 1853 there were 24,382 messages (earning £2,789) by the first half of 1854 this had become 31,332 messages (£3,572). Rental from the Admiralty for connecting its Kentish naval stations was £1,000 per annum. It paid a modest 3% dividend in its first full year, 1853.

The European Telegraph Company in May 1854 had offices at 30 Cornhill, London; 43 Regent Circus, London; House of Commons, during the session; 23 Castle Street, Liverpool; 1 Market Place, Manchester; 104 New Street, Birmingham; 45 The Terrace, Gravesend; 303 High Street, Chatham; 36 High Street, Canterbury; 7 Clarence Place, Dover; and 100 Beach Street, Deal.

The directors of the European and Submarine concerns also promoted the *Railway Electric Signals Company* in 1855 to work Edward Tyer's patents for train control. This had offices at 30 Cornhill and in Paris, France.

A general meeting of its proprietors in London on August 30, 1854, held on the same day as one by the shareholders of the British Telegraph Company, voted for a merger between the two firms, to create a second national telegraph network.

In an agreement confirmed on September 20, 1854 the British Telegraph Company acquired the capital of the European Telegraph Company by an exchange of shares and a cash sum. The remarkably effective European company vanished from history after just four years existence. The British and European companies immediately merged their circuits, the latter abandoning its own apparatus for the simple Highton single-needle telegraph.

d.] **The Submarine Telegraph Company between Great Britain and the Continent of Europe.**

The owners of the Submarine company had in the meantime negotiated *another* telegraph cable monopoly, this time of the Belgian government, to which end it cloned itself to create the parallel, elaborately and confusingly titled *Submarine Telegraph Company between Great Britain and the Continent of Europe*. It was a company, unlike the original, created in Britain and secured limited–liability protection for its share-holders by means of a Royal Charter on April 14, 1851. In London the two companies had identical boards and to all intents and purposes were one organisation. The new cable between Dover in England and Ostend in Belgium was completed on June 20, 1853, with an office in Brussels at Place de la Monnaie, using Wheatstone's two-needle telegraph and then the American telegraph.

The prospectus called for £150,000 in capital. It was the original intention to expend one half, £75,000, in buying-out the French Submarine company, with the remainder to be used on the Belgian works and promotional costs. The buy-out never happened as money proved difficult to raise. The original Submarine Telegraph Company maintained an independent existence.

The three linked Submarine companies, the 'French', the 'Belgian' and the European, effectively united their managements and operations, though not their capitals, in a set of agreements dated August 19, 1852. This arrangement lasted only for two years.

Table 16

The Submarine Telegraph Company

Message Traffic to Europe and Dividend 1852 - 1859

1852	3,049	6%
1853	34,616	8%
1854	26,931	7%
1855	50,200	6 ½%
1856	71,290	7%
1857	84,146	7 ½%
1858	100,196	7 ½%
1859	122,969	6%

The opening of the International Telegraph Company's England to Holland cables early in 1854 clearly affected the Submarine's continental business.

Before the first telegraph conventions of 1855, which formalised the transmission of messages between national systems, the Submarine companies had offices for continental correspondence at the offices of the European company in England; London, Birmingham, Manchester, Liverpool, Gravesend, Chatham, Canterbury, Deal and Dover; and from its own premises at Calais, Paris, Brussels and Antwerp.

When the British company absorbed the European concern the 'French' and 'Belgian' cable firms henceforth traded simply as the Submarine Telegraph Company, although having separate capital, working from its original office at 30 Cornhill, City.

For their entire existence the Submarine companies worked in tandem with a domestic service provider in Britain, with whom they shared proprietary. This consolidated in 1857 into a monopoly relationship for continental traffic with the British & Irish Magnetic Telegraph Company. In return the Submarine rebated one-fifth of the tariff rate for messages from the Magnetic's London offices, and two-fifths of those from its provincial offices, to the domestic company.

The chartered 'Belgian' Submarine company obtained permission to land and work underwater cables in Hanover, from Cromer in East Anglia to Emden, 280 miles, completed on November 4, 1858, with a 20 year concession acquired for £7,000 from the provisional *North-of-Europe Telegraph Company* in September 1857; and in Denmark, from Cromer by way of the British North Sea island of Heligoland to Tonning, 374 miles, laid on July 14, 1859, with a 25 year monopoly; neither of these cable connections was to be lasting. The Magnetic company constructed a dedicated long line from London to Cromer in December 1858 by way of Norwich and Newmarket.

It was originally planned early in 1858 to lay the Company's so-called 'Direct European' cables from near Hull in the north of England to Emden and Tonning, but the shorter route from Cromer was soon adopted.

An issue of £150,000 in new shares was required to pay for these cables. Interest at 5% was allowed on this stock until the end of December 1858, when the holders would be entitled to the ordinary dividend.

The Ministry of the Interior of the Kingdom of Hanover agreed the concession with the Submarine Telegraph Company on May 8, 1858 for a cable between the English coast and the Hanoverian province of Ostfriesland. The Company was to provide a minimum of two underwater circuits to connect the *büreaus* of the *Königlich Hannoverschen Telegraphenverwaltung* with London.

The Company was to make an immediate deposit of 7,000 thalers for the duration of the concession, and a subsequent 30,000 thalers as security for the successful completion of the works for a period of ten years at 3% interest. The concession, as noted above, was to last for 20 years from October 31, 1858, on which date the cable was expected to be completed. There were then seven thalers to the English pound.

The rate for a twenty-five word message to London from Hanover was set at a maximum of 4 thalers. In the event the tariff was set at 2 thalers 15 gröschen or equivalent currency for twenty words to Britain for all the German states.

The cable from Cromer to Emden was not actually completed for public messages until April 1, 1859. It was soon attracting traffic for England from all of Germany with reduced rates, and without the need to pass through Holland or Belgium.

On January 23, 1860 the Submarine Telegraph Company opened its new long cable from Cromer to Westerhever by Tonning in Denmark, *via* Heligoland. As well as connecting with Denmark, Norway and Sweden, messages to and from the German states for England could now be routed through this cable by way of the important Hamburg station of the German-Austrian Telegraph Union as yet another alternative to the older Hague cable. Ominously the Union described the cable end as "by Tönningen in Schleswig", as if it were a German province, ignoring Danish sensibilities.

To serve these long new cables the Submarine Telegraph Company opened its own station at Tucker's Hotel Yard, Tucker Street, Cromer, in 1858. Its other offices, in London and Dover, were all worked in concert with the Magnetic company.

The working of the Submarine Telegraph Company's Cornhill office in 1854 was described during a criminal court case in 1857 by one of its directors, Frederick Cadogan, and several of its clerks:

"The course of a message proceeding to the Continent is this: it is brought by the sender to the counter on the ground floor, where the number of words is computed; the money is paid, and the message is taken up by a lift to the transmitting room, the instrument room; the message is then sent to its destination immediately, if there is no other message on the file previously sent up; if there are other messages to be sent by the same instrument, it is placed underneath, and is dispatched in its turn. The duty of dispatching it in its turn would attach to the Superintendent of the room in the first place, and to the transmitting clerk at the instrument in the second place."

"The history of a message coming from abroad is this: it is received on and by the instrument in connection with the foreign and Continental line, or town, as the case may be, say Paris; it is received at an instrument in a room at No 30, Cornhill; that room contains several instruments, several clerks; in the centre, the superintendent's table, and the Superintendent; in one corner is the dispatch office, with a hole in the wall, or door; it is received in manifold; that is to say, the clerk reads off the message, and writes it in manifold; that is done either by the clerk at the instrument or by his assistant. As soon as the message is complete, he hands it to the Superintendent sitting in the centre of the room; having been received by the Superintendent, it is read by him, the words are counted by him, the message is prepared for transmission, and all the different formularies are arranged upon it; the hour, etc., is seen to be correct. The time is inserted by the Superintendent, or by his clerk; then it is handed to the clerk, who sits near the door. By him it is put into an envelope, and sealed; he makes some signal, either rings or knocks, and he hands the message, through a trap in the door, to the boy, the next boy on the rota for taking messages."

"In 1853 the Company laid down wires to the West End, to four or five club houses; at the time those wires were opened, the Company made an arrangement with a news agent at Paris, of the name of Havas, who is a general news agent at Paris, to supply them with a summary of news in the afternoon; and that summary of news, which he was in the habit of supplying at a fixed price, was to be sent to the different club houses (in St James's Street), into which buildings our wires were taken—we did that more as an advertisement. It lasted a very short time."

"In January, 1854 the office was open at night for anybody to receive messages. In August, 1854 there were two rooms, and there were three instruments in one, and three in the other. There were always ten or twelve persons there. There were a great many messages to Paris; at certain hours of the day, scarcely anything else—at certain hours of the day the telegraph is almost conclusively confined to stock transactions between Paris and London."

"We do not now translate messages sent to us in English for transmission, but we did in 1852—the translation of a message will very often completely alter the number of words; it is very often impossible to translate a French message of twenty words into an English message of twenty words. All Government messages are in cipher, except those that are upon public matters."

In 1856 the Submarine company benefited from new arrangements between the French authorities and the German-Austrian Telegraph Union. This allowed access through direct circuits from London to Paris, to Hamburg and to Berlin, as well as a reduction in rates to the Union countries. Previous to this the French transcribed or rewrote inward and outward messages at Calais and Paris. The changes were made at the insistence of the Union. The Belgians then also allowed the Company a direct circuit to Brussels, abandoning transcription at Ostend, and reduced their rates.

The Board of Directors were able to report on September 10, 1857, that "Messages are now generally forwarded to most of the chief towns in Europe without retransmission through any intermediate office". This statement was open to question, in regard to the definition of "chief towns" and to the use of "generally". Transmissions by the Company to southern Europe, evidenced by complaints in the daily press, proved notoriously unreliable into the 1860s.

During November 1858 J W Brett, representing the 'French' component of the Company, approached the "Directeur des lignes télégraphiques" in Paris to renew their monopoly concession which was due to expire in 1862 for a further thirty years. In addition Brett sought rights for new cables between Boulogne and Folkestone, Havre and Southampton and between France and the Channel Islands. The concessionaires promised to construct their own land lines from Folkestone and from Southampton to London.

The French authorities on January 12, 1859 authorised the Submarine company to lay two new cables, from Folkestone to Boulogne and from Jersey in the Channel Islands to Pirou for the town of Coutances on the Cherbourg peninsular.

Coincidental with the opening of the Boulogne cable on September 14, 1859, the Company moved its chief office in London from Cornhill to 58 Threadneedle Street; to be in the newly-built headquarters of the British & Irish Magnetic Telegraph Company.

On the same day, September 14, the Company opened a direct line with a Special Wire from the Stock Exchange in London to the Paris *Bourse*, using the cable between Boulogne and Folkestone.

In 1859 the Submarine company possessed six highly-profitable cables; two to France, Dover – Calais (24 miles), and Folkestone - Boulogne (25 miles); one to Belgium, Dover – Ostend (70 miles), one to Denmark, Cromer – Heligoland (a British island) – Tonning (380 miles), one to Hanover, Cromer – Emden (80 miles) and one between Jersey in the Channel Islands and Coutances in Normandy, France (30 miles). Unfortunately for a long period in 1859 only the two cables to Boulogne and Hanover were working, the others being damaged or under construction. It then employed 127 staff, all men, and was working the American telegraph as made by Digney of France and Siemens & Halske of Prussia in all of its circuits.

The Electric Telegraph Company, in an attempt to break the Submarine's monopoly to France, proposed a new cable from Newhaven to Dieppe, just as the Company was renegotiating its concession in 1859. The French renewed the concession for another thirty years but insisted that the Submarine build the new cable to Dieppe, which it completed in 1861.

In 1860 the Submarine Telegraph Company between Great Britain and the Continent of Europe, reported to the government that it and its 'French' equivalent had a paid-up capital of £340,000; £75,000 for the Dover – Calais works, £80,000 for Dover-Ostend, £150,000 for Cromer-Tonning, and £35,000 for Folkestone-Boulogne and Jersey-Pirou. Their receipts in 1852 from 96 miles of *wire* and 3,049 messages had been £4,632 and expenditure £1,922, in 1859 with 2,366 miles of *wire* and 122,969 messages it received £26,995 and expended £14,121. In both years they declared a 6% annual dividend, although in the intermediate years 7%, 7½% and 8% had been paid.

As well as advertising all of its new routes to Europe, especially to Hamburg, by way of Denmark, in March 1860 it, rather prematurely, promoted message rates to India by way of the Red Sea cables. This line was not to be completed for another ten years.

The Submarine Telegraph Company had its monopoly concession with France extended for thirty years on January 2, 1861 till 1890. It sent and received a total of 230,000 messages in 1861, rising to 310,595 in 1863.

The long cable from Cromer to Emden in Hanover broke in December 1860. The Submarine company employed F C Webb to repair it, but after three months was forced to abandon the work because of consistently bad weather. Another expedition was commissioned in April 1861, under its own engineer J R France, and after a further three months work succeeded in repairing the circuit to Germany in June.

On January 31, 1862 a speech of the Emperor Napoleon III in Paris, consisting of 1,200 words with 6,200 letters, was transmitted by the Submarine Telegraph Company from Paris to London in 30 minutes. Four wires and four sets of American instruments were employed.

The Submarine company's semi-annual shareholders' meeting on March 4, 1862 was informed that the Belgian government had renewed its concession on the same terms as that of France, extending the term for thirty years. A disgruntled shareholder pointed out that in addition to the British & Irish Magnetic Telegraph Company's corporate holding in their company of £22,000 its directors held a further £30,000 and independent cross shareholders £40,000. The Company had reduced its continental tariff by 50% on February 1, 1861, this had led to a widely-predicted decrease in revenues and an increase in message traffic and expenses.

The Submarine company opened a temporary office in Cromwell Road, London, opposite the newly-opened International Exhibition at South Kensington in May 1862. The messenger had to be issued with a season ticket to deliver the many telegrams for the exhibitors, the government's event managers not letting him enter otherwise.

Table 17

Number and duration of the cables laid by the Submarine Telegraph Company, 1863

J W Brett to Cyrus Field, July 3, 1863

1] From Dover to Calais (France)
Laid September 25, 1851
4 cores, 24 miles, 96 miles of wire

2] From Dover to Ostend (Belgium)
Laid May 6, 1853
5 cores, 70 miles, 350 miles of wire

3] From Cromer to Emden (Hanover)
Laid November 4, 1858
2 cores, 280 miles, 560 miles of wire

4] From Folkestone to Boulogne (France)
Laid June 26, 1859
6 cores, 24 miles, 144 miles of wire

5] From Cromer to Tonning (Denmark)
Laid July 14, 1859
3 cores, 368 miles, 1,104 miles of wire

6] From Jersey to Coutances (Channel Islands)
Laid January 9, 1860
1 conductor, 21 miles, 21 miles of wire

7] From Beachy Head to Dieppe (France)
Laid June 27, 1861
4 cores, 78 miles, 312 miles of wire

Totals: 25 cores, 865 miles of cable, 2,587 miles of wire, all insulated with gutta-percha

---

In 1863, after it laid the new line from Newhaven in England to Dieppe in France the Submarine Telegraph Company had 887 miles of line containing 2,683 miles of wire in circuit, worked by 51 instruments and carried 345,784 messages to and from Europe. The capital of the 'French' element was then £100,000, of the chartered or 'Belgian' part, which included the cable concessions to Hanover and Denmark, £300,000.

Its cable between Jersey and Normandy was out of circuit through damage between November 1863 and

April 1864. As the competitive cable to England was also broken the Channel Islands were then isolated.

The Submarine company's longest cables to Emden in Hanover and to Tonning in Denmark were disrupted by the war between Denmark and the German states. Hostilities lasted from February 1 until October 30, 1864 with Prussian and Austrian armies occupying German-speaking Schleswig-Holstein, effectively reducing the land area of the Kingdom of Denmark by 40%. In March 1864 the cable end of the Company's Danish cable fell within the German portion and was stated to be in the hands of the "Austro-Germanic authorities" and not being allowed to be worked.

The sector of the Danish cable between Cromer and the island of Heligoland remained operational. On May 9, 1864 it was able to provide eye-witness reports of the sea battle between the Austro-Prussian and Danish fleets, in which the Danes drove off the allied navies under the Austrian Admiral Wilhelm von Tegethoff. The reports were some of the few messages sent over the remnant of the Tonning cable.

Virtually all of the German states were involved in the war; Hanover supported the intervention, and all of the independent Hanse port-cities of Hamburg, Bremen, Lübeck and Rostock were blockaded by the Danish Navy. However, the Company advertised early in February 1864 that messages for Denmark, Sweden and Norway could be telegraphed to Warnemünde, an out-port of Rostock, and forwarded by blockade-running steamer every alternate day to Ystadt in southern Sweden from where the state telegraph was still connected with its Scandinavian neighbours.

Its Emden cable was initially reported as being damaged by a ship's anchor in March 1864 and was then consistently described as "under repair".

The loss of the Emden cable was severe. Its traffic had grown quickly from 7,218 messages in the last eight months of 1859 to 11,390 in 1860, reaching 27,296 in 1863. It succeeded in attracting substantial through traffic from the other German states and Russia away from the Electric company's Hague cable: with 3,143 "international" messages in 1860, and 12,304 in 1863.

In the evening of September 26, 1864 a fire started on the fourth floor of the Magnetic company's central station in Threadneedle Street. It consumed the stationery store and instrument room of the Submarine Telegraph Company that shared the premises. The continental service was considerably interrupted for several days, but the Magnetic lent its Submarine cousin instruments to restore communication.

The concession to Hanover was forfeit in 1865 and the Company's German cable from Cromer to Emden abandoned. The rights were to be acquired by Julius Reuter, a close ally of the Electric Telegraph Company. The Company's access to Eastern Europe, the Levant and to Asia, of necessity by means of the circuits of the German-Austrian Telegraph Union, seems to have suffered from its intimate connection with the Imperial French regime of Napoleon III.

The Hanover cable was not wasted. At least forty-seven miles from the English end were recovered and refurbished in 1866 by W T Henley. This was used in a new cable from Dover to La Panne in Belgium that was completed in November 1867.

The Submarine's board in 1868 comprised Sir James Robert Carmichael Bt, chairman, Francis Edwards, Captain Grant RA, Samuel Gurney, Henry Moor, the Hon Ashley Ponsonby, Charles Saunderson and Arthur John Otway MP. Ponsonby was the grandson of Lord de Mauley, the Company's first chairman.

Its chief manager or secretary in London from 1852 had been Leonard Walter Courtenay. In 1863 he left to become traffic manager of the British government's Indo-Ottoman Telegraph in Constantinople, rising in service to be a Commissioner in the Indian Telegraph Department. Courtenay was then replaced as secretary by Stephen McDonnell Clare, who remained in post until its final year of 1890, sadly to liquidate the concern.

The Company's original electrical engineer for the Calais and Belgian cables had been Charlton Wollaston; he was succeeded in 1852 by William Andrews, who had previously been employed by the telegraph department of the South Eastern Railway. Andrews, who was also commercial superintendant for the British Telegraph Company in London, supervised the construction of the new long lines to Germany and to Denmark before leaving in 1860 to become Secretary and General Manager of the United Kingdom Electric Telegraph Company. James Robert France, a loyal servant of many years who had been called on from assisting Andrews to advise on the Brett brothers' cables in the Mediterranean in the 1850s and on the Atlantic cable of 1858, then became engineer. In the early 1870s France became engineer to Hooper's Telegraph Works Company, responsible for several long cables in South America. The Submarine company's engineer for the balance of its existence was John Bourdeaux, who had started his professional life with the Electric Telegraph Company in 1848, joining its employ in the mid-1850s.

Thomas Crampton, the civil engineer who had supervised the mechanical elements of the first two cables, continued to act as consultant for major works, such as repairs and replacements, at least until August 1859. In that month he and William Andrews inspected the two original cables and found them in "excellent preservation". In those first eight years the Company had needed to spend only £5,000 on their maintenance.

When the domestic companies were appropriated by the government in 1870 the Submarine company had possession of the following cables:

• Dover – Calais, completed September 1851, with 4 circuits and a length of 24 miles

• Ramsgate – Ostend, completed May 1853, with 6 circuits and a length of 70 miles

• Folkestone – Boulogne, completed June 1859, with 6 circuits and a length of 25 miles

• Jersey – France, completed January 1860, with 1 circuit and a length of 30 miles

• Beachy Head – Dieppe, completed June 1861, with 6 circuits and a length of 78 miles

• Dover – La Panne (Belgium), completed November 1867, with 4 circuits and length of 47 miles

• Beachy Head – Le Havre, completed September 1870, with 6 circuits and a length of 69 miles

It then had in its direct ownership a total of 33 circuits to Europe, 343 miles of cable in all. Its other cables had either been replaced or had failed; the Company's long cables between England and Denmark by way of Heligoland and to Hanover had been terminally "interrupted" by the Danish – Prussian war of 1864. The station at Cromer was abandoned in 1865. The profits from the directly-owned circuits were divided between the original or "French" Submarine company and the later "Belgian" company in proportion to their capital; in 1870 this was £75,000 (16.8%) and £370,806 (83.2%).

For a few months from August 1869 the Submarine company handled English and Scottish traffic for the *Société du câble trans-atlantique Français* through its Dover and Folkestone cables to Paris, Brest and the United States. In this it worked in concert with the United Kingdom Telegraph Company, rather than its 'parent', the Magnetic company, which was agent for the Anglo-American cable of 1866. It would have been interesting to see what this new competitive situation might have achieved had not the government appropriation of the domestic telegraphs been carried out in 1870.

Subsequently it also was to lease from the Post Office the two cables to Holland, previously owned by the Electric & International Telegraph Company, and the Norderney cable lately the property of Reuter's Telegram Company. For these an elaborate rental was arranged: one quarter of gross receipts was set aside for repairs, one-fifth of gross receipts from London, two-fifths from English and Scottish country towns and one-half from Irish towns was retained by the Post Office, the balance being divided equally between the Company and the Post Office. This formula effectively doubled the Company's dividend.

e.] **The Electric Telegraph Company of Ireland**

The *Electric Telegraph Company of Ireland* was initially promoted in December 1851 as the "Irish Channel Submarine Telegraph Company" and provisionally registered in January 1852. It talked in the press of a capital of £500,000 for lines from Dumfries in Scotland, where a connection was to be made with the mainland circuits, to an underwater cable between Scotland and Ulster, and by a line "thence to Belfast, Dublin and other places in Ireland".

There was an elaborate provisional structure with *three* noble Patrons, *three* Trustees and *nine* Directors on the Board, many of whom were naval and military retirees and local gentry. It was clear from the beginning that, despite its aristocratic components, the projecting power was George Featherstone Griffin, a wharfinger, trading as Charles & George Griffin & Company, of Beal's Wharf, Southwark, London. The Superintendant Engineer and Secretary was S F Griffin, his son. No one connected with the existing electrical establishment was involved.

The prospectus of the "Irish Channel Submarine Telegraph Company", eventually issued on April 6, 1852, was optimistic in extreme: it had reduced its anticipated capital needs to just £40,000, it anticipated using circuits line side of the railways between London and Carlisle and from Dublin to Belfast, laying two lines each of four wires. Only the land sector between Carlisle and the coast was required to be constructed in addition to the cable. It anticipated also that a Royal Charter would be granted before the laying of the cable from Port Patrick to Donaghadee and the land line to Dumfries, all due to be completed on May 20, 1852. It was to use the system adopted on the French submarine cable, devised by Samuel Statham of the Gutta-Percha Company. A clause in the Company's original deed of settlement bound it to co-operate with the Electric Telegraph Company. Very few in this series of promises were to come to fruition.

It all commenced enthusiastically. By May 1852, the Company had indeed started entrenching a two-core, or "double line", as the Company phrased it, gutta-percha insulated but otherwise unprotected underground land line along the road from Dumfries to Port Patrick, intending to have it complete by June 31.

On July 12, 1852 the old title was abandoned and the scrip for 40,000 shares issued in its newly adopted name of the *Electric Telegraph Company of Ireland*. The much reduced board was chaired by Rear Admiral Sir W H Dillon, KCH, and included the Hon George Massey, the Hon E C Curzon, Lt Col Leonard Morse Cooper, George Featherstone Griffin, and John Newman Tweedy. Its direction and shareholding was still in the hands of Anglo-Irish landholders and mercantile interests, unfamiliar with the management of a large joint-stock enterprise or of new technology. The Secretary was named as Sandiforth Featherstone Griffin.

The Ireland company adopted George Edward Dering's single-needle galvanic telegraph, patented in 1851, in all of its circuits, and took his advice on all matters electrical. G E Dering was a notable scientific dilettante, and, although an English landowner by birth, had strong connections with Ireland through his mother, inheriting 11,200 acres of County Galway from her brother in 1870.

A lone Dering single-needle telegraph survives. It is, like its competitors, in a substantial, nicely moulded mahogany case around eighteen inches high by nine inches wide, with a round-topped, glass-fronted housing for the diminutive single needle, mounted on a squat rectangular base. The commutator or transmitting switch in the base is worked by a horizontal tee-bar; there is an ivory knob to the right to switch between alarm and telegraph. The interior of the dial has two very small coils. The round top contains the mechanism for a large electro-magnetic alarm bell.

William Reid, the telegraph instrument maker and contractor, was a shareholder in the Ireland company and probably made Dering's apparatus, taking the shares in full or part payment.

On July 18, 1852 the *Reliance* under Captain Edward Hawes RN, the Admiralty's general superintendent at Port Patrick harbour, set out from the Scottish coast with S F Griffin, now styled engineer, W L Gilpin, the contractor, G Dering, the electrician, and J Fletcher, the company's superintendent of works, on board. The *Reliance*, accompanied by a steam tug from Belfast, carried twenty-five miles of underwater cable; it successfully laid and electrically-tested seven miles of wire out from Port Patrick. Captain Hawes then decided that strong sea currents were setting in and continuing cable-laying could only proceed after the spring tides were over. The line was marked by buoys.

On the Saturday morning of July 24, the *Reliance* returned to grapple the cable-end, which the crew did with immense difficulty, as it had fouled an abandoned ship's anchor. The ends were joined and the vessel continued towards Donaghadee at three miles per hour, succeeding in laying a further fifteen miles. It reached Ireland at ten o'clock at night in heavy gales. The cable was tested, found electrically sound and, then as it was not possible to land it, buoyed-off in the sea.

The principal length of the Ireland company's first underwater cable was described as being of two copper wire cores insulated with gutta-percha protected by a thick covering of hemp rope. The cores had been manufactured by Christopher Nickels & Company, of Lambeth, who also made the Company's land-lines. For the vulnerable shore-ends at Port Patrick and Donaghadee, which were subject to wave action and abrasion, W Küper & Company, wire-rope makers, of Camberwell, London, were to have made two short armoured cables but money for these apparently ran out. A temporary shore connection was made with unarmoured insulated wire and worked for a matter of days, but eventually the long hemp cable had to be sealed and buoyed-off in the sea at both ends.

At the moment of failure in July the Ireland company was in direct competition with the Magnetic Telegraph Company which had been similarly active with cable works over the same short stretch of water to Ireland during May and June.

In August 1852 William Lawrence Gilpin of Bayswater, London, a civil engineer and partner in a wire mill at Aston, near Birmingham, agreed to complete its entire works in Scotland and Ireland for £27,000. Gilpin had in the previous year been proprietor of Gilpin, Guy & Company of Workington, iron manufacturers, before taking up general contracting.

The Electric Telegraph Company of Ireland belatedly completed all of its legal requirements with the registrar of joint stock companies on December 4, 1852. Just before this event its solicitor, Alfred Mayhew, deposited its Bill for a Special Act on November 25, 1852. The draft Bill sought the same wide ranging powers that other telegraph companies possessed; the right to place its wires over and under railways, roads, rivers and canals throughout England, Scotland Wales and Ireland, cables from Britain to Ireland, and enabling it to acquire patents from individuals and to work them.

Following these legal milestones, on December 27, 1852, the Board of Directors reported that the 69 miles of two-core underground cable in Scotland were completed and they were working messages on the 42 miles from Dumfries to Newton Stewart. It had also received a report by Captain Hawes that the isolated six-month-old underwater cable was still in good condition. With 16,000 out of 40,000 shares already applied for, it confirmed that they had decided to apply to Parliament for a Special Act to authorise its works, rather than obtain a Royal Charter as originally planned.

The state of the cable may or may not be truly reported: the newspapers claimed that a schooner from Larne had accidentally grappled and then cut out 472 yards of four-inch thick hemp cable with a copper core from the sea floor on July 30, 1852. Informed of their error when they landed, the schooner's crew were said to have returned their haul to the owners in Belfast.

In February 1853 the Ireland company advertised two offices for messages in Belfast, at Ann Street and at the Commercial News-room, Waring Street. Twenty word despatches could be forwarded from there to stations in Britain for 6s 0d and 6d for every extra word, by steamer rather than electricity.

The Electric Telegraph Company of Ireland eventually obtained a Special Act of Parliament to authorise its formation, its cable and its circuits in Scotland and Ireland on August 4, 1853, with a modest capital of £40,000 in shares of £1 and £8,000 in debenture debt that could be incurred once all of its share capital was called-up. However only 27,000 of its 40,000 £1 shares were taken up, and not all of the shareholders could be got to pay their calls into its account with the Royal British Bank in London. Parliament granted the Company powers under its Act to open up streets, highways and public roads only through Scotland and Ireland. As it was limited by its Act, in addition to the cable, to circuits in Ireland and Scotland, it apparently intended to connect onward from Dumfries by transcribing messages to the circuits of the British Telegraph Company.

The Annual General Meeting of July 28, 1853 noted the success of the Act and the completion of 73 miles of double line of wire between Dumfries and Port Patrick. Their electrician G E Dering was at that moment supervising the construction of double and quadruple lines of wire from the Irish Industrial Exhibition in Dublin through their office at Eden Quay, shared with W H Smith & Son, the news-agents, in the city northwards way beyond Glasnevin, on the road to Drogheda and Belfast. The double and quadruple line of wire from Belfast was already laid twenty miles south towards Dublin through Lisburne, Hillsborough and Dromore.

A telegraph office had opened at Lisburne communicating with Belfast.

To better prosecute these operations W L Gilpin, the contractor for telegraph works, opened offices at 40 Camden Street, Dublin, in addition to his chambers at 7 Northumberland Court, Charing Cross, London.

Whilst it was not legally associated with its English namesake, the original Electric Telegraph Company of 1845, the Ireland company did participate in a preferential message exchange agreement in 1852 after the old company's Holyhead to Dublin cable failed.

Although reported sound and, in August 1853, capable of recovery, the first underwater cable was not to be put in circuit and was abandoned and the Company adopted G E Dering's curious theories regarding insulation in 1853 for a replacement cable.

Dering described his theory on underwater cables in his patent of 1853 as follows "I have discovered that a metallic circuit formed of wires, either wholly un-insulated or partially so, may be employed for an electric telegraph, provided that the two parts of the circuit are at such a distance apart that the electric current will not all pass direct from one wire to the other by the water or earth, but that a portion will follow the wire to the distant end." He apparently successfully demonstrated this discovery across the river Mimram on his estate in Hertfordshire, England, for the Company's board of directors.

The new bare wire cable was shipped to Belfast on September 23, 1853; it was a single No 1 gauge galvanized iron wire instead of a twisted strand wire which Dering had recommended. It was, he said later, poorly made with many bad welds, but it was tested and the weak parts removed. It was then tarred for its whole length and loaded into the contractor's vessel, the *Albert*. The cable was to be laid on November 21, 1853 from Donaghadee to Port Patrick by the *Albert*, escorted by HMS *Asp*. A half-mile shore-end wire was initially laid, then on November 22, in foul weather, the 28 miles of main wire was joined and a further 3½ miles laid before it broke. On November 26 another attempt was made by the *Albert*, this time 12 miles were laid before the wire broke again in 82 fathoms of water. After several attempts to grapple the underwater wire by the *Albert* it too was abandoned.

Its 200 miles of two-core gutta-percha underground cable circuits were all manufactured by Christopher Nickels & Company, of 20 York Road, Lambeth, London, which traded also as the "Gutta-Percha Company of Lambeth". Nickels was a large-scale manufacturer of india-rubber and gutta-percha goods, and was a licensee of Charles Hancock's patent wire-covering machine.

The Ireland company made a brave face at the Irish Industrial Exhibition in Dublin between May and October 1853; displaying three of Dering's instruments, and working traffic from the halls to its office at W H Smith's news-agents on Eden Quay then north towards Belfast. Its much larger competitor, the Magnetic Telegraph Company, which already had a submarine line to Britain, completed in May 1853, did not even have a stand. During 1853 the Ireland company was also supplying news to papers in Dublin and Belfast.

But after this initial burst of enthusiasm money to pay the contractor Gilpin ran short and work slowed down over the coming year. The extension south from Newry through to Dundalk was completed on June 2, 1854, and the final connection between Belfast and Dublin was to be made only on August 1, 1854.

After laying 192 miles of underground line with 400 miles of wire in Scotland and Ireland, but being without the intermediate cable, the Ireland company was in severely difficult financial circumstances, having raised and expended £26,255 in share capital and, despite not having Parliamentary authority to do so, having raised £16,560 in loans; whilst still owing money to its contractor, W L Gilpin, to Nickels' Gutta-Percha Company of Lambeth for its land-lines, and having judgements for other debts made against it. Gilpin agreed to forgo all of his claims against the Company and surrender the works and materials still in his possession in July 1854 in return for a final payment of £600 and the writing-off of a debt of his of £2,000 to the Royal British Bank used to buy materials. The Ireland company's new secretary, James Troup, and three directors had to find the money among themselves to settle his claim.

In February 1855 W L Gilpin was lodged in the Queen's Prison for Debt. In the previous two years it was revealed that he had had twelve different private and business addresses. He had traded in that period as coal merchant, iron master, chemical manufacturer, steel maker, general contractor for engineering works, and contractor for telegraph works.

The line from Dublin through Belfast to Newtownards, a distance of 117 miles, was complete and ready for business. In Scotland the line had been laid down from Dumfries to near Port Patrick, about 79 miles. But with no more working capital the Company had to close its offices and the shareholders led by George Massey and its solicitor, Alfred Mayhew, finally resolved to petition the Court of Chancery to wind it up on May 7, 1856. Shambles continued; another set of shareholders under the director John Newman Tweedy deposited a competitive petition on May 26, 1856! When the complex and disputed winding-up went before the court it was ordered that the miserable, long-suffering shareholders in addition to losing their investment had, as "contributors" to its management, to pay off all of the Ireland company's debts.

William Reid, the telegraph contractor, took 1,000 of the £1 shares in the Ireland company, of which 750 were paid-up. On January 16, 1856, presumably getting wind of its likely failure and his liability for additional loss, he transferred his holding to his youngest son, John Reid, age 15, for the sum of five shillings on the assumption that the Company could not pursue a minor in law. He did not comprehend the depths to which the Ireland company had sunk: in February 1856 John Reid, 15, was elected a director as no one else would take the position! The Courts rejected William Reid's ruse and found him liable as a contributory to the Ireland company's many debts a year after its failure in May 1856.

Latimer Clark, engineer to the original Electric Telegraph Company of London, was appointed by the Court of Chancery to inspect the condition of the Irish works. He completed this in September 1857 and provided a detailed report evidencing that the lines were complete and viable. An independent contractor then offered to complete the whole line from Dumfries to Dublin for £15,000.

The Court ordered that all of the Ireland company's assets and rights be sold-off to the highest bidder. The auction in the City of London on August 27, 1858 of the 196 miles of line in Ireland and Scotland, as well as its plant and materials, ended with a bid of £500.

As a final nail in the Ireland company's coffin, its bankers, the Royal British Bank, had collapsed in criminal disgrace in September 1856. Richard Hartley Kennedy, once a director of the competitive Magnetic Telegraph Company was Deputy Governor of the bank.

But some people never learn; the promoter of the Electric Telegraph Company of Ireland, George Featherstone Griffin, and the Company's contractor for works, William Lawrence Gilpin, got together once again with another set of investors during 1857 to form the 'London Anti-Oxyde Paint Company'. It was bankrupt within a year. Subsequently W L Gilpin, after another period in debtors' prison, became sales agent in 1862 for the railway fishplates patented by G E Dering, the Ireland company's electrician. G F Griffin met his fate in July 1858 after the failure of the paint enterprise: he, too, ended up bankrupt and enjoying accommodation in the Queen's Prison for Debt.

The British Telegraph Company, which anticipated working in concert with the Ireland company, subsequently promoted its own underwater cable from Scotland to Ireland which was successfully completed on July 9, 1854.

f.] **The Irish Sub-Marine Telegraph Company**

The Irish Sub-Marine Telegraph Company was first promoted on January 5, 1852. A novelty was its formation under the Anonymous Partnership Act of 1781, which applied only to Irish companies, enabling it to offer joint-stock limited liability without a Special Act or a Charter. Using the authority of this Act it proposed to issue fifty thousand "certificates" of £1 as capital. Against this it would provide the public with 15,000 preference shares on which 7% per annum was guaranteed. However, by March 1852 it had adopted a more conventional corporate structure, registering under the Joint Stock Act of 1844 and stating its intention to apply for a Royal Charter.

It was to be incorporated by Royal Charter on May 15, 1852, with a capital £100,000 in shares of £5, with power to increase that to £200,000, however only £20,000 was called-up. Its board of directors was under the chairmanship of Lord Erskine, a former diplomat, with Edward Hoare, a landowner of Cork, and George Lathom Browne, a barrister and author; Cusack Patrick Roney, onetime Secretary of the Eastern Counties Railway Company, was Managing Director in Ireland. Its secretary was William Morgan, and its engineer was Charles West, who had obtained permission from the Admiralty for a telegraph cable from Britain to Ireland as early as January 1846. The Charter covered not just a long submarine telegraph between Anglesey in North Wales and Ireland, from Holyhead to Howth, the most direct route from England to Ireland, but also included additional powers for connecting London and Dublin and various towns in Great Britain and Ireland, and with the Submarine Telegraph at Dover. The Earl of Howth donated the cable's landing site on his estate at Howth. It negotiated an exclusive connection with the Electric Telegraph Company in Britain for Irish traffic and was to have a dedicated circuit on that company's lines between Holyhead and London. The Electric was sufficiently interested to allow the Irish Sub-Marine company 25% of the cost of messages between Britain and Ireland, in addition to the cable charges.

The Irish Sub-Marine company's land line to Dublin city was planned to run from Howth on the coast to the Amiens Street terminus of the Dublin & Drogheda Railway just as the British end ran to the Holyhead terminus of the Chester & Holyhead Railway. Its engineer, Charles West, designed and had made an experimental length of two-and-three-quarter miles of underwater cable, of four cores insulated with india-rubber covered in spun yarn and armoured with *plaited* iron wire early in 1852. There were twelve plaits, each of six closely-woven No 15 BWG galvanized iron wires. It had the advantages that it could not untwist or form kinks; its disadvantage was that it could not be coiled but had to be stored in straight lengths. The armour was manufactured by Binks & Stephenson, makers of patent wire-rope, 17 West Ferry Road, Millwall. The Company rejected this innovation; so different from the existing, successful, gutta-percha insulated, spiral-wire armoured cables made by R S Newall & Company.

As the dispute continued R S Newall, without a contract from the Company, manufactured a very light, single-core underwater cable for use between Holyhead and Howth in just four weeks to the design of Thomas Allan. It was laid on June 2, 1852 supervised by Henry Woodhouse for the Irish Sub-Marine company, using the City of Dublin Steam Packet Company's steamer *Britannia*, accompanied by HMS *Prospero*. Connected with the Irish Sub-Marine company's land line to Dublin and to the Electric's to London, it failed three days later. The connection did not affect Woodhouse's career; he went on to be engineer on submarine cables in the Atlantic and Mediterranean.

The Irish Sub-Marine Telegraph Company then came to an arrangement with the Electric Telegraph Company to transfer its landing and other rights on September 25, 1852, by which the old company acquired £16,000 of its £20,000 capital. It then sought to amend its Charter on November 9, 1852, by which alteration it ceased to exist.

The Electric inherited Charles West's original but abandoned plaited cable from the Irish company. It had been left in the maker's yard at Millwall since 1852. The two miles or so of stock was used for the Isle of Wight cable and for several lines in land tunnels.

After a second attempt to connect the two countries by way of Holyhead failed, a heavy single-core cable was eventually completed on September 4 and 5, 1854 by the International Telegraph Company, who worked the long underwater cables of the Electric company. A second single-core cable between Holyhead and Howth was successfully laid by the International company in the following year, on June 13 and 14, 1855. Edwin Clark was engineer to both of these cables.

g.] **The International Telegraph Company**

In 1852 Lewis Ricardo of the Electric company negotiated with the Minister of the Interior of the Netherlands sole rights to lay underwater cables between the two kingdoms; to run from Orfordness in eastern England and Scheveningen in Holland, hence underground to The Hague and, in 1855, by pole telegraph to Amsterdam. In London it claimed it was to connect Amsterdam, Breda, Rotterdam, Haarlem, Dordrecht and The Hague in competition with the newly-formed state-enterprise, the *Rijkstelegraaf*. But apart from the circuit from the coast to Amsterdam the other lines were not built. Its concession to Holland was for 20 years, from May 10, 1852, expiring in 1873.

The Electric Telegraph Company's formed a subsidiary, the *International Telegraph Company,* to contract to lay four separate single-wire underwater cables between England and Holland, one each on May 30 and 31, June 16 and 17 and September 8 and 9, 1853, and then on September 29 and 30, 1855. The board of directors of the International company was identical with that of the Electric in London, J Lewis Ricardo was chairman. Jan Pieter van Hoey Smith was the executive director in the Netherlands.

Edwin Clark of the Electric was engineer, being paid £400 a year, Frederick Webb was assistant engineer at £300. For a few months James Gutteres was secretary and manager, he was summarily dismissed and replaced in September 1853 by Douglas Pitt Gamble, also on £300. At the office in The Hague Henry Weaver was clerk-in-charge, earning £250 a year, with six foreign clerks and two British clerks, two messengers, a linesman and a battery and instrument man. Although paid less than the foreign clerks (17s v 20s per week) the British received 5s 0d a week in subsistence money.

Despite his dismissal, Gutteres joined the English & Irish Magnetic Telegraph Company and was to rise in their hierarchy.

The International was capitalised in an unusual manner. All of its expenditure, £77,174 up to December 7, 1853, was paid by the Electric Telegraph Company which took shares in the International in exchange. These shares were held by its directors Wylde, Till and Crutchley in trust for the Electric. There were then liabilities outstanding of £9,000 to Newall & Co for the manufacture of the cables, of £5,000 to Tupper & Carr for the cost of the iron wire armour, and of £500 to the Gutta-Percha Company for insulation.

There was a plan to extend their lines to Brouwershaven, Brielle and Helvoetsluys in February 1854, but this would only be proceeded with if shares were taken up in the Netherlands.

The Company was keen to extend their circuits from The Hague to Amsterdam. In January 1855 Latimer Clark costed a four wire line at £4,360. They negotiated a contract or wayleave with the Hollands Railway on February 21, 1855, and an office was acquired in the Amsterdam at £1,449 in the same month.

The Company's engineers, Edwin Clark for the first three of its cable and his brother, Latimer Clark for the last, managed the laying operations rather than letting the cable-makers carry out the work, using the Company's own steamer, the *Monarch*.

It used the Cooke & Wheatstone two-needle device in its circuits until 1854 when that was replaced by the American telegraph of Siemens & Halske allowing direct electrical connection through to the rest of Europe.

The International Telegraph Company, an apparently independent new concern, working from the 'Continental Telegraph Offices' at 1 Royal Exchange Buildings, London, separate from the Electric's, was projected to placate Dutch sensitivities to an English intervention, to own and work these foreign circuits. It leased a wharf at Blackwall on the Thames for its stores. The International company was not formed by Act of Parliament (it did not need to as it used the Electric company's circuits in Britain) but was incorporated by Royal Charter on June 13, 1853, on the same day as the British Telegraph Company, so was able to offer its shareholders in England and Holland limited liability. The International had a short independent existence; it and Electric were in common circuit and had a common shareholder base; Parliament formally permitted their merger in 1855.

Its Secretary and Manager, Douglas Pitt Gamble, had been previously sued by the Electric company for trying to introduce Nott & Gamble's dial telegraph in competition with Cooke & Wheatstone's, and apparently forgiven. Pitt Gamble combined his secretary's duties with being the Electric's District Superintendent in London and then manager-secretary of the Channel Islands Telegraph Company.

For a short period the International Telegraph Company had its own station in The Hague, but on September 1, 1855 it moved to share the *Rijkstelegraafkantor* first on Nes and then on NZ Voorburgwal in Amsterdam, which provided connections with Arnhem for German circuits and to Breda for Belgium. It had its own clerks, messengers and linemen in Amsterdam. The Company appointed paid Agents for forwarding messages in Berlin, Vienna, Hamburg and Trieste.

The International Telegraph Company adopted as its motto *Nec nos mare separat ingens*; the wholly appropriate objective "great seas shall not separate".

When the International company opened its circuits to public messages on December 1, 1853 it offered charges to the Continent from Brighton, Bristol, Holyhead, Hull, Leeds, Liverpool, Manchester, Newcastle, Edinburgh and Glasgow the same as from London. It initially worked only to Holland, North and South Germany, Prussia, Austria and Tuscany. It claimed that its charges were 25% cheaper than any competition.

To generate business the International company offered Julius Reuter, on September 14, 1853, as a "collector and transmitter of messages" for others, a commission of 7% to use only its circuits to the Continent. When he commenced distributing foreign news to his business clients in London and British news to his associates on the continent it offered him a rebate of 50% on all messages sent or received containing "public intelligence" on January 12, 1854.

The relationship with Julius Reuter was remarkably close; from mid-1853 until it was absorbed by the Electric in 1855 the Company shared offices with his news agency at 1 Royal Exchange Buildings, City.

The International Telegraph Company, as has been previously noted, when an independent entity and as merged as a trading name, was to manage the Holyhead to Howth cables as well as those to Holland for its parent the Electric & International company.

When Pitt-Gamble was summarily dismissed in 1857 Henry Weaver became Manager of the International Telegraph Company, as well as being Superintendent of the Electric's London District. Weaver had previously been Clerk-in-Chief at the Company's Amsterdam station, where he was replaced by A Bayly, who remained there until 1863.

The *Rijkstelegraaf* acquired ownership of the Company's land lines and stations in Holland during 1859.

h.] **The British & Irish Magnetic Telegraph Company**

In a logical consolidation, in the face of the ever-expanding and combative Electric company, the Boards of its two main competitors, the 'new', combined British company and the English & Irish company, met in Manchester on September 23, 1856 and agreed to merge their capital, interests and circuits to form one concern. The merger was to take effect from January 1, 1857.

The British & Irish Magnetic Telegraph Company was created on April 22, 1857 under the new Joint-stock Companies' Limited Liability Act of 1855. This Act allowed, for the first time, joint-stock companies to be formed limiting the liability of shareholders without Parliamentary approval, merely by legal registration. The original statutory powers possessed by the merged English & Irish and British concerns passed seamlessly to the new, enlarged firm. It continued to be known to all as the 'Magnetic'.

It anticipated replacing all of its message apparatus with Charles Bright's new *Bell telegraph* that used Highton's current-reversing tappers to work two sounders, each with a different note. This proved to be the fastest of all instruments before automatic telegraphs were introduced, working its own "Magnetic Code". Its organisation and finances were such that the Company never quite succeeded in abolishing the Highton and Henley needles that it had inherited, which worked differing systems of coding.

The Magnetic's new motto, a quotation from Virgil's *Aeneid*, was *Quae regio in terris nostri non plena laboris?* This conventionally translates as "Which part of the world is not filled with our sorrows?" - a sentiment with which the Company's shareholders, after its subsequent adventures in Atlantic cables, might have had sympathy. The preferred interpretation was "Which part of the world is not filled with our toils?"

On its formation by merger in April 1857 the British & Irish Magnetic Telegraph Company possessed 3,248 miles of line, 15,365 miles of wire, 230 stations and 574 instruments. It connected all of the major cities and towns in the country and had ten offices in London: 72 Old Broad Street, 30 Cornhill, Royal Exchange (under the Clock Tower), Stock Exchange, 22 Mincing Lane, 82 Mark Lane, 22 Chancery Lane, 7 Charing Cross, 43 Regent Circus and the House of Commons.

Table 18

British & Irish Magnetic Telegraph Company
Combined Revenues
British and Magnetic Companies
1854 - 1857

1854	£37,937
1855	£54,555
1856	£68,980
1857	£73,947

Figures from the report of Edward Bright to the shareholder's meeting, February 16, 1858

Growth 1857 - 1859

	Miles of line	*Stations*	*Staff*	*Messages*
1857	3,441	230	-	423,772
1858	3,655	327	-	433,583
1859	4,196	353	1,044	550,168

Figures from the Parliamentary Report on the State of the Telegraph Companies in Britain, 1860

The Company's head office was still in north-west England, at 2 Exchange Buildings, Liverpool; the offices of the 'old' Magnetic company. It advertised wayleaves over fifty-four railways in Britain and Ireland; it also possessed the two cables between Scotland and Ulster and a News Exchange for provincial newspapers. The Company adopted the same message tariff as the Electric except on its circuits to Ireland, where the latter was only just starting to compete.

It, too, offered pre-paid adhesive franks or stamps for its message forms, allowing purchasers 5% discount for purchases over £1 worth of franks. Franked forms could be sent "in an envelope" by messenger or by post to the nearest telegraph office for transmission.

Edward Brailsford Bright continued as the Company's Secretary and General Manager. The Assistant Secretary, residing in London, was Edward Moseley; he was later replaced by a local Manager, James Gutteres, who had been superintendent in Leeds and Cork.

The merger was not one of equals. Several important figures in the British Telegraph Company were disregarded in the new hierarchy. William Andrews, its London superintendent, and William Powell, its senior engineer, both left the new firm's service. George Saward, its manager, was already working for the Atlantic Telegraph Company.

The first General Meeting of the shareholders the British & Irish Magnetic Telegraph Company took place on February 16, 1858. Edward Bright, the secretary of the combined concern, presented its history to the end of 1857. It had been initially sanctioned by the directors of the two firms in November 1856, and the merger implemented in April. There had been an increase in revenues of £5,000 from 1856 over 1857. A further 193 miles of line, 323 miles of wire had been laid, and 20 more stations opened. This amounted to totals of 3,441 miles of line and 15,888 miles of wire throughout England, Scotland and Ireland, working 240 stations. There were 356,182 messages transmitted, excluding railway, service and press traffic. The Company, Bright claimed, had agreements with 36 railways for wayleaves, although most of its circuits were laid underground alongside highways. "Glass insulators" (sic) on poles, had been installed in the Midland, the North-Eastern and Scottish Districts, in place of gutta-percha insulation on 260 miles of line.

There was a unified capital of £600,000 in three categories of shares, as well as debentures or loans to service. Joint revenues in 1857 had been £73,947, less £2,200 "on account of messages sent beyond the lines of the Company." Working expenses had been £38,888, loan interest £1,775 and the dividend on the Class B preference shares £4,257. This left sufficient to pay 5½ % on the Class A shares and 4½ % on the Class C shares. Rather belatedly, the auditors suggested that a Reserve Account be established to fund contingencies and emergencies, the surplus in the accounts of £2,000 was then allocated to this.

There was slightly euphoric air to the meeting: Bright continued by noting that special facilities had been extended to the corn trade markets to facilitate exchange of information and trade, connections to Spain and Portugal had been opened during the year, and access to the East Indies, China and Egypt was anticipated by new cables being laid from Malta. The Atlantic Telegraph Company, in which the Magnetic was deeply invested, was proceeding rapidly with its immense cable across from Ireland to Canada. He also mentioned that the Company was considering purchasing the Baltic Coffee House, a major trading exchange, to form its headquarters in London. Much of this happy speculation was to prove specious.

On August 13, 1858 the Magnetic company established contact between London and New York in the United States for the first time. The messages were sent from London via Cambridge, Doncaster, Liverpool, Stranraer, Belfast, Dublin and Killarney to the Atlantic Telegraph Company's cable end on Valentia Island in the far west of Ireland using Bright's Bell acoustic telegraph. They were forwarded by the cable company to Newfoundland and New York. The cable, always unreliable in working, failed shortly afterwards.

The Magnetic company took some pains to keep in with the public press of the day from its creation. When Queen Victoria visited Leeds during September 6 and 7, 1858, she stayed at Woodsley House, Woodsley Moor, the home of the Mayor of Leeds. The telegraph company arranged a private wire from there to the Scarborough Hotel, were "Her Majesty's chief attendants" were lodged. Three years later, when the Queen toured Ireland, visiting Dublin and Killarney between August 26 and 31, 1861, J H Sanger, its manager in Dublin, ensured that press messages were forwarded without charge in return for repeated mentions of the Company in the articles published. He also forwarded messages and press comment from London to the Royal party. The Queen sent her thanks for this "public service".

By 1859 the Magnetic had expanded its circuits to 4,196 miles of line and carried 550,772 messages. It then had 350 stations in Britain, including 10 in London, and 83 in Ireland.

By then the Magnetic had had built a new Central Office at 58 Threadneedle Street opposite the Bank of England in the financial district of London; in design much like the Electric's at Founders' Court, with a small alley-like frontage and a large public hall squeezed in behind, with "a rather fanciful and very ornate French Renaissance façade, crowned by a lofty clock-tower. There was a good deal of very well executed carving in the front; the roof with its dormer windows made a leading feature in the composition." The design was by Horace Jones, who was to be appointed architect to the Corporation of the City of London in March 1864.

Opened to the public in March 1859, as originally designed the ground floor at 58 Threadneedle Street contained the Public Office, the first floor the secretary's and clerical offices, the second floor the instruments of the London District Telegraph Company, and the third floor the apparatus of the Magnetic and Submarine companies. It conveniently backed on to the trading floor of the Stock Exchange, one of whose many entrances was adjacent, next to 54 Threadneedle Street.

The gated entrance on the street frontage on ground floor was flanked by the shops of a gunmaker and a hosier. Once the London District Telegraph Company moved to its own premises in Cannon Street in 1860, their rooms in the superior storeys were tenanted to the English & Scottish Marine Insurance Company.

The near-by premises at 72 Old Broad Street, City, were then let go. Pender & Company, merchants, took offices in the building, along with several other commercial tenants. John Pender of Manchester was a director of the Company, and of the Atlantic Telegraph Company.

Its new system of overhead insulation, using porcelain insulators devised by C T Bright, allowed it to telegraph Dublin direct from London by way of the northern underwater cables and Belfast, a distance of 700 miles, without any form of relay. The primary exceptions to the new system were the continuation of underground circuits between London and Dover and London and Manchester.

In 1859 the 'new' Magnetic company had sole access to the six cables of the Submarine company into France, Belgium and Hanover, in which it had invested heavily. These cables contributed a disproportionate amount to its income, reflecting the success of this investment. It retained one-fifth of the tariff rate for all messages sent by the cables of the Submarine company from its London offices, and two-fifths the cost of messages forwarded from its provincial stations.

At the end of September 1859 the Magnetic arranged a telegraph at the Curragh, the large military station near to Dublin, for the War Office in London, where a "competent officer was appointed to the duty of receiving and despatching messages between head-quarters". Every garrison town was to have similar communication, as well as strategic points on the Irish coast.

In addition to the principal cities and towns of England and Scotland the Magnetic company possessed over 300 stations in minor places:

Accrington, Adlington, Ainsdale, Aintree, Alderley, Alne, Alston, Altrincham, Annan, Antrim, Appley, Ardrossan, Ardsley, Armagh, Armley, Arthington, Arundel, Ashton, Auchinleck, Aylesford, Aylsham, Ayr, Bacup, Bagnalstown, Balcombe, Balham, Ballybrophy, Ballymena, Ballpallady, Barnard Castle, Beckenham, Belmont, Belvedere, Billingham, Billingshurst, Bilton, Bishop Auckland, Blackburn, Blacklane, Blackpool (Lancashire), Blackpool (Ireland), Blaydon, Bray, Bricklayer's Arms, Brockhole's Junction, Bromley, Bromley Cross, Brompton, Burnley, Burgess Hill, Burscough, Burscough Bridge, Burton Salmon, Bury, Byer's Green, Cahir, Carlow, Carrick Junction, Carrick-on-Suir, Castle Douglas, Caterham, Caterham Junction, Catford Bridge, Cavan, Chapel Town, Chatham, Chatburn, Chichester, Chorley, Cirencester, Cleckheaton, Clifton Junction, Clitheroe, Clonmel, Cooksbridge, Colwich, Coleraine, Colne, Consett, Cooper Bridge, Corhoe, Cromer, Crook, Crosby, Crystal Palace, Curragh Camp, Curton, Daist Field, Dalry, Deptford, Didcot, Drumsough, Dudley Port, Dumfries, Dunfermline, Dungannon, East Grinstead, Eastbourne, Eastwood, East Woolwich, Elgin, Elland, Enniskillen, Entwistle, Eston, Etherley, Eurton Junction, Evenswood, Farrington, Fay Gate, Featherstone, Fleetwood, Ford, Forres, Forest Hill, Formby, Frosterley, Gainford, Garston, Gartsberry, Gathurst, Gatehouse, Gipsy Hill, Glanmire, Gobowen, Gowan, Guisborough, Hailsham, Halshaw Moor, Haltwhistle, Hartlepool (Old), Haslingdon, Hassock's Gate, Havant, Haydon Bridge, Heckmondwike, Herham, Heywood, Hindley, Hipperholme, Holme, Holmfirth, Horbury, Horbury Junction, Horley, Horsham, Horwick, Hurlford, Hythe (Kent), Inchicore, Inverness, Irvine, Johnstone, Kells, Kendall, Kenley, Kilbirnie, Kildare, Kilkenny, Kilmarnock, Kilwinning, Kingstown, Kingston-on-Sea, Kirkby, Kirkcudbright, Kirkham, Kirriemuir, Lady Well, Laister Dyke, Langho, Lightcliffe, Limerick, Limerick Junction, Littlehampton, Londonderry, Longford, Lostock Junction, Loughton, Lower Norwood, Lower Sydenham, Lowmoor, Luddenden Foot, Lurgan, Lymington, Lytham, Malahide, Mallow, Market Rasen, Marsh Lane, Mauchline, Melmerby, Mickley, Middlesbrough, Middleton Junction, Milton, Milcham, Moate, Monaghan, Moses Gate, Musselburgh, Nairn, Navan, Newark (Nottingham), Newbridge, Newburgh, Newby Witte, New Wandsworth, North Camp, North Dean, Norton Junction, Norwood, Oldbury, Oldham, Omagh, Ormskirk, Orrell, Oswestry, Over Darwen, Parsonstown, Pemberton, Petworth, Picton, Piere Bridge, Pimbo (Lancs), Pimlico, Plumstead, Polegate, Pontefract, Portarlington, Port Glasgow, Portsea, Port Talbot, Poulton, Prestonpans (Tranant 1 mile), Preston Junction (Durham), Preston Junction (Lancashire), Preston Road (Walton-on-Hill), Pullborough, Rainford Junction, Ramsbottom, Rawcliffe, Rawtenstall, Redcar, Redheugh, Ribchester, Ripon, Rochester, Roscrea, Rose Grove, Ruabon, Runcorn Gap, St, Boswell's, Sanquahar, Scarva Junction, Seaton, Shildon, Shoreham, Silloth, Sinderby, Sleaford, Slough, Snaith, Snodland, Southboro' Road, Southport, Spenny Moor, Spon Lane, Stanningley, Stillington, Stockton-on-Tees, Stoneclough, Stow, Strabane, Stranraer, Streatham, St Helen's (Durham), St Helen's (Lancashire), Sydenham, Templemore, Thornhill (Yorkshire), Thornton, Thrapstone, Three Bridges, Tipperary, Todmorden, Towsaw, Troon, Tullamore, Uckfield, Valentia, Warlingham, Waskerley, Waterford, Waterloo, Welbury, Wellington College, Westhoughton, Whalley, Whitley Bridge, Whitstable, Wicklow, Wigtown, Winchfield, Windermere, Winston, Witton Junction, Wollsall, Wolsingham, Woodfort, Woodgate (for Bognor), Worthing and Wrexham.

The Magnetic also began to trespass on the Electric company's turf by improving its relationships with the railway companies. It won the Lancashire & Yorkshire Railway's tender to reconstruct its whole overhead telegraph system that it had itself had made in part in 1852. This involved 20,000 insulators, 8,000 poles and 200 tons of iron wire, with 185 new instruments and 400 Daniell cells, and training 200 special clerks. The work was planned by it consultant engineer, Charles Bright, and supervised by its District Manager in Manchester, Robert Dodwell, and was completed in September 1859.

In 1858 it projected the *Dock Telegraph Company* in Liverpool to make use of a wayleave granted by the municipal harbour board along the long waterfront on the Mersey. It was revived under harbour board ownership, and they accepted the Company's tender for the works on January 1, 1860, which were completed in April 1860 using the Magnetic's bell instruments. It had a cheap flat message rate structure, as the London District Telegraph Company's, which the Magnetic had also promoted in 1859.

John Watkins Brett and Charles Tilston Bright of the Magnetic company were to be the driving force for submarine telegraphy in the Mediterranean Sea, Atlantic Ocean and Indian Ocean; being the promoter and engineer respectively for virtually all such works for over twenty years.

The new combined Magnetic company's capital was £284,847 for the 'old' Magnetic, and £297,130 for the British company. Another £110,368 was acquired and spent between 1857 and 1860; to make £692,345 in all.

The new Magnetic was committed to a shareholding of £137,760 in the Submarine Telegraph Company and a substantial £107,210 in debenture debt in 1860.

Its dividends on the share categories were:

	1857	1858	1859
Class A	5½%	5%	4¾%
Class B	7%	7%	7%
Class C	4%	4%	4%

The Magnetic's management was to be distracted for many years from 1857 by its expensive involvement in the Atlantic cable; it owned the land-line from the Atlantic cable-end in Ireland as well as providing the bulk of its capital and engineering support. The Board of Directors, guided by John Watkins Brett and Charles Bright, expected the Atlantic Telegraph to contribute to its income to an even greater degree than its investment in the Submarine company. The great cable's immediate failure substantially hindered the Magnetic's domestic growth and innovation. It, like the Electric, only gradually expanded its coverage in the 1860s but it was not able to introduce the same sort of cost-saving efficiencies through technical advances as the Electric.

Compounding this, unlike the Electric, the Magnetic company did not gain immediate income from foreign circuits to the continent. These circuits were in the hands of its close associate the Submarine Telegraph Company, which retained the extra-domestic revenues. This also meant that it had no opportunity to create relationships with overseas telegraph administrations.

It was also struck with the "sudden decay" of the gutta-percha insulation in subterranean circuits that comprised most of its capacity during 1859. The Magnetic's directors had to declare that "gutta-percha utterly failed underground" and had to start to replace its underground circuits with overhead lines.

The Company used the powers granted to one of its components, the British Telegraph Company, to plant roadside poles on the public highway. The original Magnetic company had no such rights, and the British company maintained a shadow existence until 1870 to keep this legal authority.

The ten subterranean wires of the Magnetic company and the six of the British company between London and Liverpool had to be replaced with overhead poles immediately. The very long and difficult roadside underground circuit from Liverpool through Preston and Carlisle to Glasgow and to the Port Patrick cables was to be taken up and "poled" by 1860.

The great cost was met in some way by selling off the old, rotten covered wire for about £5 a mile to "doll-makers" who separated the gutta percha and the copper for re-use. The Gutta Percha Company also would buy back old wire at 1s 0d a pound, which had cost from 2s 3d to 2s 4d a pound new, for reworking.

The underground wires in Ireland were also attacked by more substantial vermin in November 1860. Over 1,400 lbs of copper wire was lifted from its main Dublin to Belfast roadside cable by thieves at Dunleer in County Louth, destroying its primary revenue-earning circuit in the island. Most of the metal was recovered within the month by the City of Dublin Metropolitan Police from dealers there.

In another case, of embezzlement, a Magnetic clerk in Liverpool in 1861 regularly accepted messages with the firm's telegraph stamps loose rather than stuck on to the forms and resold them...

On August 3, 1861 two boys were fined 2s 6d each for throwing stones that broke the Company's glass insulators at Stamford Hill in London. The penalty could have been higher but no one could be found in the engineer's office to put a value on the damage to materials and to traffic, as the magistrate requested.

The Company was not, however, unaware of its social obligations to Irish culture and welfare. The Magnetic supported the *Queen's Institute for the Training and Employment of Educated Women* in Dublin when the establishment commenced in 1861. It supplied teachers and apparatus to the Institute to train telegraph clerks, and made grants-in-aid to the less well-off women that it later employed.

The Liverpool establishment joined the enthusiasm for the Volunteer movement. On November 31, 1859 Edward Brailsford Bright, the Magnetic's secretary and general manager, announced the formation of the Exchange Rifle Company from the clerks of his firm and others in the city. It was to become the 22nd Lancashire (Liverpool Exchange) Rifle Volunteer Corps. Bright was commissioned Captain in January 1860, then Captain-Commandant in March. He and the other "Magnetic officers" left the Corps in January 1863.

On a lighter note the Magnetic organised a regular annual picnic lunch and a "pedestrian handicap" (walking races by men were fashionable at the time) for its lady and men clerks in London every May.

Starting in 1858 the Magnetic began to replace its long-line and urban underground cables with roadside overhead circuits. John Lavender, its acting engineer, had undertaken similar work for the former British Telegraph Company before the merger, and began to connect London and Manchester with roadside poles, starting with isolated sections at Poynton, Newcastle-under-Lyme and Stony Stratford. Lavender was then sidelined into a clerical role by the Magnetic company and left its employ in 1859, along with several other managers and engineers from the British company.

In January 1860 the Magnetic's board was complaining about the continued absence of its chief engineer, Charles Bright, and the lack of an assistant engineer, at the time of its very large projects on the Lancashire & Yorkshire Railway and in replacing the underground circuits. The works had been left to the District Superintendents to manage, and the engineering stores department, without leadership, verged on chaos. It was compelled to employ John Lavender as a consultant and as contractor for new works.

High poles to Lavender's design were introduced into cities, starting with Manchester in 1862, connecting its central station at Ducie Place with the Salford railway station by sixteen wires. By 1864 poles were also being used in the city centres of Stockport, Newcastle and Coventry. The poles in the cities were 60 and 70 feet tall, formed to Lavender's specification by splicing together two 30 and 40 foot poles, as ships' masts were constructed.

During May 1860 the Magnetic company publicised a new service to accelerate despatches to America, in concert with the new Galway Line of trans-Atlantic steamers. It would accept messages at any of its telegraph offices in Britain and Ireland for New York, to be sent to Galway in the far west of Ireland to be put aboard the mail steamer up to a few hours before it was due to depart for America. By July the other trans-Atlantic steamship lines had joined up, so that "last minute" public messages could be sent by ship to New York, Portland and Halifax *via* the Magnetic's offices in Queenstown (Cork), Galway and Londonderry, in a service that was almost daily in frequency. This combination of telegraph and steamer was only disrupted by the outbreak of yet another war in America in 1861.

The British & Irish company had had a fair year in 1861, according to the report to its shareholders on February 2, 1862. It had reduced message costs to Ireland by 33% and had added 382 miles of line, attracting 90,000 more messages from 1860. However its net revenues were affected by the new 1s 0d tariff of the United Kingdom company and by the failure of the Submarine telegraph Company to pay a dividend on its substantial shareholding. There was also the cost of a new land line from London to Beachy Head on the Channel coast to connect with the latest Submarine cable to France, as well as two new circuits alongside of railways in Scotland, Leith & Dundee and Port Patrick. On the resignation of its chief engineer, Charles Bright, no replacement was appointed. A dividend of 4% was paid on its ordinary shares.

Its finances were, however, less certain. The Magnetic's board felt obliged to issue another £275,000 in 6% preference shares to redeem its even more expensive 7% existing preferences and debentures, and to have £40,000 remaining for extensions into the West of England. The old shares and bonds had been issued to cover its liabilities on the failed Atlantic cables of 1857 and 1858.

Table 19

The Telegraphs in 1859

Miles of Line	10,186
Miles of Wire	48,990
Telegraph Stations	953
Instruments	4,085
Public Messages	1,320,086

From government returns for public telegraphs dated January 1, 1859 from the Electric & International Telegraph Company, the British & Irish Magnetic Telegraph Company, the South Eastern Railway Company and the London, Brighton & South Coast Railway Company

The Telegraphs in 1861

Analysis by Leone Levi 1865

Five companies working public telegraphs were listed in government returns: the Electric & International, the British & Irish Magnetic, the South Eastern Railway, the London, Brighton & South Coast Railway, the London District, and the Submarine.

Miles of land wire	53,036 ¾
Miles of underwater wire	2,484
Stations	1,375
Instruments Domestic	5,067
Instruments Continental	54
Messages Domestic	2,112,040
Messages Continental	230,000

From returns by the companies to the government

During 1861 the Magnetic possessed 3,903 miles of line and 17,043 miles of wire serving 401 telegraph stations with 1,084 instruments. In the next year it had 4,126 miles of line, 16,733 miles of wire, 449 stations and (oddly, just) 932 instruments, when it sent 671,500 public messages.

The Magnetic company had been lax in advancing electric timekeeping, which had served others well in publicity. In 1857 it acquired the patent of Robert Lewis Jones of Chester for regulating electric clocks, and began to use Jones' clocks in its offices. The public appreciation of such clocks it measured from the large electric clock it had in the window of its office at Exchange Buildings, Liverpool, controlled by the local Observatory. On February 4, 1861 it counted the number of people who "took the time from the clock" between 6am and 5pm – the number totalled 1,860.

Professor Charles Piazzi Smyth, Astronomer-Royal for Scotland, introduced the *Time-Gun* to Mill's Mount Battery, Edinburgh Castle on January 29, 1861. In this one of R L Jones' electric clocks and a clock-trigger, regulated by a circuit from the Royal Scottish Observatory, fired a blank charge in a 12 pounder artillery piece at one o'clock every day. The time circuit was led underground from the Observatory to the Nelson Monument on Calton Hill (where a time ball was in use), then by an immense single 4,020 feet seven-strand steel wire span across the city to the Castle. The span was constructed by R S Newall, the wire-rope maker of Gateshead in England. Frederick James Ritchie, a watch and clockmaker of Edinburgh, designed the clock-trigger that instantly ignited the gun as Jones' timekeeper "struck". The time-gun could be heard over a distance of twenty miles. By 1864 the Magnetic company was providing signals from Edinburgh for time-guns in Newcastle, North Shields, Sunderland, Glasgow, Greenock and Dundee. Liverpool Observatory used the apparatus for its own time-gun on the Mersey. Those in Newcastle, North Shields, Glasgow and Greenock, worked in cooperation with the Universal Private Telegraph Company, were short-lived. The Smyth time-gun and the Ritchie clock-trigger devised in Edinburgh were widely adopted throughout the world, in competition with the more sedate, quieter time-ball advocated by the Electric Telegraph Company.

At a Telegraphic *Soirée* in its heartland at Manchester on September 7, 1861, the Magnetic demonstrated its abilities to the visiting public. Bright's Bell telegraph was connected directly to London and Glasgow. Highton's single needle telegraph was in circuit with Dublin through its Irish cables. It also allowed visitors to work their own messages on Henley's new magneto-dial telegraph between the exhibition hall in Manchester and its office in Liverpool, thirty-five miles away. At the same event its close associate, the Submarine Telegraph Company, used Siemens American telegraphs on its circuits through London to send messages to and receive replies from Paris, Brussels, Flensburg and Moscow. However, the Electric company, also exhibiting, went one step further and was in contact with Odessa on the Black Sea!

On June 24, 1862 the Magnetic company enabled the Astronomer-Royal George Airy to determine the exact longitude of the telegraph station on Valentia Island on the extreme western shore of Ireland by exchange of galvanic time signals. This involved a temporary dedicated circuit from Greenwich Observatory through Cambridge, Doncaster, Sheffield, Liverpool, Carlisle, Port Patrick, Belfast, Dublin, Mallow and Killarney to Valentia, about 800 miles in length. After providing Airy with a battery of 192 cells on the island and 144 cells at Greenwich, and having to repair the short cable from Caherciveen on the mainland to Valentia (unused since the failure of the Atlantic cable in 1858), the Company allowed the professor several weeks of scientific traffic in the summer of 1862.

In that spring its board of directors authorised the liquidation of its expensive 7% Class B shares, which it achieved by the end of the year. The remaining Class A and Class C shares and a new issue of £275,000 were then turned into Consolidated Stock from March 1862 onwards.

On January 25, 1862 Sir Charles Bright was presented with a testimonial on his relinquishing the post of engineer-in-chief to the British & Irish Magnetic Telegraph Company. It consisted of a candelabrum costing 140 guineas. Organised by Robert Dodwell, the District Superintendent in Manchester, 260 people contributed £148 12s 7d. Bright reminisced to the party that when he had joined the Magnetic company ten years previously it had 40 miles of line in operation whereas in 1862 it had 4,000 miles, with 20 employees, compared with 1,500. Officers and clerks of both the Magnetic and Electric companies were present to wish him well.

The Magnetic's board allowed Bright to remain as Consultant Engineer on a modest retainer, but chose not to employ another engineer-in-chief. Bright's brother, Edward, the Company's General Manager, took on the role of supervising any technical work needed.

A testimonial of a fine gold watch was presented to Samuel Percy, formerly the Magnetic's District Superintendent in Manchester, on October 18, 1862, in reward for ten years service with the Company and its predecessors. There were fifty-seven subscribers and the award was made by his former colleague, William Powell, engineer of the United Kingdom Electric Telegraph Company.

Somewhat incestuously, on April 8, 1863 William Powell was also given a dinner and testimonial chaired by John Doherty, the United Kingdom company's superintendent, on the occasion of Powell's removing to London. Samuel Percy, of the Magnetic company, was then the honoured guest, presenting Powell with a gold watch and chain.

The Magnetic grew gradually from 4,196 miles of line with 464 offices in 1863 sending 827,424 messages, through to 4,329 miles with 479 offices in 1864.

In Manchester thirty of the Magnetic's clerks, guided by their District Superintendent, Robert Dodwell, met at the George Street Institution on October 4, 1862 to organise a Mutual Improvement Society. The Company, Dodwell announced, would provide a meeting room at the Ducie Street station, with a library of forty books relating to electricity and the current technical journals.

On Thursday, February 20, 1863 an explosion caused by someone leaving the valve of a gas-light open after extinguishing its flame severely damaged the back rooms used as offices on the second floor of the Company's central office in Threadneedle Street. The ceilings of the rooms below were also damaged by water and a great many windows broken. The clerks on duty turned the gas off at the main pipe and fought the fire until the fire engines arrived.

On November 2, 1863 the Magnetic laid a short submarine cable across the New Passage on the Severn river for the Bristol & South Wales Union Railway. This joined England with Wales, and was one of the few domestic cables that the Company worked, other than those to Ireland.

In the same month, November 1863, the Company laid another short cable from Baltimore in County Cork to Cape Clear in far south-west of Ireland with a station to intercept news off the steamers from New York. It was made in competition with a landline from Cork to Crookhaven made for Reuter's news agency. This complemented its marine telegraph from Londonderry in Ulster to Greencastle at the mouth of Lough Foyle that took news off the steamers using the northern route across the Atlantic. The Magnetic had laid a cable along the bottom of the Lough to connect these two stations on April 2, 1863. During the American war, the Cunard liners commonly carried Confederate despatches from Halifax, Canada, past Cape Clear and Crookhaven in the south. The Inman liners carried the U S despatches past Greencastle in the north.

Another fire destroyed the top floors of the Magnetic company's central station in Threadneedle Street on September 26, 1864. It affected the circuits of the Submarine Telegraph Company to Paris and Brussels for several days, in whose instrument room on the fourth floor it started, The lower floors were hardly affected and the Magnetic's service was maintained, but the necessary building works had the Magnetic's secretary and engineer move temporarily to its old branch office in Hercules Passage by the Stock Exchange.

By 1865 it possessed 4,401 miles of line, 18,668 miles of wire, with 491 stations, 1,042 instruments and had improved its working greatly to 1,252,265 messages.

Like all of the companies the Magnetic had to make huge repairs to its pole circuits around London after the storm of January 11, 1866, which cost it over £1,000.

The Company's long-held confidence, and investment, in the Atlantic cable to the Americas was rewarded in August 1866 when not one but two circuits were completed from Valentia in Ireland to Newfoundland. The Magnetic company, unfortunately, did not gain that much in revenues as it was compelled to share access with the Electric Telegraph Company which by then had a shorter route to southern Ireland from London. However its cross-shareholding in the Atlantic Telegraph Company now had a substantial market value.

Fenian terrorists noted how vulnerable the Magnetic's overhead land line was, connecting England with the cable end, on the section between Killarney and Valentia, and cut it for the first time at Cahirciveen on February 13, 1867, isolating America for several days.

As part of its opposition to the campaign for government appropriation of the telegraphs during in 1867 Edward Bright, the Company's chief manager, published a revised version of the widely-circulated book, 'The Electric Telegraph Popularised' of 1855. He added a section comparing the continental systems to that in Britain, to the considerable disadvantage of the former.

In its stronghold of Ireland the Magnetic Telegraph Company and the Electric Telegraph Company pooled their revenues for all public stations. They divided the total in fixed proportion, in reverse of the traffic situation in Britain, to the Magnetic's considerable advantage. In 1866 coverage of Ireland totalled 113 cities and towns; Antrim, Armagh, Athenry, Athlone, Bagnalstown, Ballybay, Ballybrophy, Ballycarny, Ballinasloe, Ballycarry, Ballymena, Ballymoney, Ballypallady, Bandon, Belfast, Birdhill, Boyle, Bray, Cahir, Cape Clear, Carlow, Carrickfergus, Carrick Junction, Carrick-on-Suir, Carrick-on-Shannon, Castlebar, Castleblayney, Castlerea, Cavan, Charleville, Clare, Claremorris, Clones, Clonmel, Coleraine, Cookstown, Cork, Curragh Camp, Donaghadee, Downpatrick, Drogheda, Drumsough, Dublin, Dundalk, Dundreary, Dundrum, Dungannon, Dunbar, Enfield, Enniscorthy, Enniskillen, Ennis, Fermoy, Fiddown, Galway, Gorey, Greencastle, Inchicore, Kingstown, Kinsale, Kildare, Kilkenny, Killarney, Larne, Limerick, Limerick Junction, Lisburne, Londonderry, Longford, Lurgan, Magherafelt, Malahide, Mallow, Markethill, Maryborough, Maynooth, Midleton, Moate, Monaghan, Monasterevan, Mullingar, Nenagh, Navan, Newbridge, Newry, North Limavady, Omagh, Parsonstown, Pomeroy, Portadown, Portarlington, Portrush, Queenstown, Roscommon, Roscrea, Sallins, Skibbereen, Sligo, Strabane, Summerhill, Templemore, Thurles, Tipperary, Tivoli, Tombe, Tralee, Tuam, Tullamore, Tynan, Valentia, Waterford, Youghal and Wicklow. Most of these offices were open from 9 o'clock to 7 o'clock, those in Dublin and Belfast were open twenty-four hours a day, Cork and Waterford stayed open until 11 o'clock at night.

Although the second largest provider of public telegraphs in Britain and Ireland its coverage of the population was far less comprehensive than that of the Electric company. On its creation through merger in 1857 it possessed a substantial and profitable regional network in Lancashire and Yorkshire contiguous with Northumberland and Durham, another between Glasgow and Edinburgh and in South West Scotland, and a virtual monopoly of messages into Ireland and between the centres of population there. These three networks were interconnected and fed its long lines to Birmingham and London. Its principle asset continued to be its relationship with the Submarine company, with its cables to Europe fed by a single line from London to Dover. The rest of England, Wales and Scotland, a truly huge area, much of great telegraphic potential, lacked any Magnetic circuits.

It is of note that throughout is ten year life the Magnetic's busiest stations were Manchester and Glasgow, followed by London.

Its investment in route extension and overall expansion in the 1860s was very limited. In fact there were just two major construction projects in that decade. An eastern long line was made from London through Peterborough, Newmarket and Norwich to connect with Cromer on the East Coast, serving the Submarine company's Hanover and Danish cables in December 1858 and January 1859, later extended northwards from Peterborough to Doncaster to relieve pressure on its original north-south underground circuits *via* Birmingham; and then in 1863 a western long line was created from Birmingham through Gloucester to Cardiff and

Swansea, with branch to Bristol. In addition an independent line was erected from London to Brighton and Beachy Head in 1861, also to link with a cable end.

This effectively was the sum total of the Magnetic company's increase in strategic route mileage from its creation until the appropriation in 1868. It, of course, increased its working capacity in its heartland networks with new circuits, and promoted the London District Telegraph Company to create a new feeder network in the capital. Geographically this still left the bulk of Southern England, Eastern England, South West England, Wales, the Midlands, South East Scotland and Northern Scotland without access to its telegraphs.

At the end of the decade the British & Irish Magnetic Telegraph Company, as well as its Chief Offices, 2 Exchange Buildings, Liverpool, had the following offices in London, the Central Station, 58 Threadneedle Street, opposite the Royal Exchange; and branch offices at Baltic Coffee House; Stock Exchange; 27 Leadenhall Street; 82 Mark Lane; Corn Exchange Chambers, Seething Lane; 22 Mincing Lane; Lloyd's; 7 Charing Cross; 43 Regent Circus; South Sea House; the Central Lobby, House of Commons (during the Session); any office of the London District Telegraph Company; and 98 Lower Thames Street. For most of its existence the Magnetic maintained a large factory for instruments at Bolton, in Lancashire; with another, rather smaller, at 46 City Road, Finsbury in London, acquired and expanded from the old British company's works.

The Company's final Board of Directors comprised William Langton, chairman, Sir James Robert Carmichael Bt, deputy chairman, Edward Cropper, Henry Harrison, Thomas Dyson Hornby, Valentine O'Brien O'Connor, L J McDonnell, William Haughton, Charles Kemp Dyer, David Webster, Anthony Hannay, John Blackie, John Pender, William Gibb, Edward Johnston and John Holme.

The largest stockholders in 1868 were J C Ewart, MP, with £15,850, Edward Cropper, £20,000 and T D and H F Hornby £8,250. The Brett family still possessed £7,500 in that year, as the late J W Brett's estate had yet to be settled. The Magnetic then had around 520 stockholders.

Edward Beresford Bright was General Manager in Liverpool with an annual salary of £1,290, and Sir Charles Tilston Bright, consulting engineer, on an annual retainer of £350, to the end. E B Bright was assisted in London during 1867 by W D S Alexander, the assistant secretary and William Walsh, its District Superintendent there. Walsh had been District Superintendent in Newcastle-upon-Tyne in 1858 before coming to London in the mid-1860s, and was later to become Secretary to the West India & Panama Telegraph Company.

During 1870 the British & Irish Magnetic Telegraph Company was organised in the following Districts each under a Superintendent, whose responsibilities were mainly related to engineering. The names of the District Superintendents, where known, are also given: Central [London], William Walsh; Irish [Dublin], Thomas Sanger; Northern [Manchester], John Walton; North Eastern [Newcastle], J C Chambers; Midland [Birmingham], James Radcliff; Scotch [Glasgow], Edward Tansley; Southern No 1 [Dover]; Southern No 2 [Brighton]; and Western [Gloucester].

There was also a department known as General Maintenance, also under a Superintendent.

During 1868, at the passing of the government's appropriation Act, the British & Irish Magnetic Telegraph Company had a total capital of £779,259 with 4,696 miles of line (19,235 miles of wire). It then had 513 stations. Of its capital £124,484, or 16%, was in 6% fixed interest preference shares, and a hefty £139,605, 18%, was in loans and debentures. It was a sign of its overall weakness that it was unable to sell its ordinary shares to the public even in the 'Little Mania' years of the mid-1860s. Despite this the final two years, 1868 and 1869, saw it reduce expenses to such a cynical extent that it was able to announce dividends of 9½% and 12%. In 1868 its 647 clerks and 433 messengers sent 1,530,961 inland messages and 212,764 foreign messages.

i.] **The London District Telegraph Company**

The London District Telegraph Company was launched on January 4, 1859 by the management of the Magnetic company with a capital of £60,000 in 12,000 shares of £5, one-fifth of which was called-up. It was intended to have *one-hundred* offices in the metropolis within a four-mile radius connected to a central or interchange station. It estimated that only £35,000 would be needed to achieve its object. Messages were promoted as costing 3d for twenty words – in the event they were to be 4d and then, in 1861, 6d for *fifteen* words. It relied on roof-top poles and wires that required laborious negotiation with individual householders and landlords. As with local Post Offices its stations were to be within the premises of other businesses, hotels, public houses, shops, etc, worked with a single lady clerk between 9am to 7pm, six days a week.

It also proposed to provide telegraphs and separate circuits for private subscribers.

Although its promoters had previously deposited a Bill on November 17, 1858, to "lay down, erect and maintain telegraphic wires throughout the metropolis", it was not continued and the District was the only public telegraph company within Britain that contrived to operate *without* powers granted by Parliament in its own name or inherited through a merger, prior to the Telegraph Act 1863, which gave general authorisation for such work. How it managed to avoid the huge expense of an Act of Parliament was concealed from the press for several years.

The District planned for a large central station in circuit with ten district hubs each with nine telegraph stations. The hubs were to be located at Mile End Gate, Kingsland Gate, the 'Angel' at Islington, at the junction of Highgate and Hampstead Roads in Camden Town, at the junction of the New Road and Edgware Road, at Charing Cross, at the north end of Sloane Street, at the

'Elephant & Castle', at Camberwell Green and at Greenwich. In the event its circuits were more *ad hoc*.

It intended to have a station no more than five minutes walk away from any household and to deliver its messages within half-an-hour from their receipt. Although the District company promised that it could deliver messages in nine or ten minutes at a cost of 6d, when a messenger would cost 2s or 3s and take several hours, it opened for business early in 1860 with far too few stations about the metropolis to make this promise come true.

The first meeting of the shareholders on August 20, 1859, noted that it had successfully raised £10,740 in capital, sufficient for its planned growth. It had premises within the British & Irish Magnetic Telegraph Company's new offices in Threadneedle Street. Three "hub" stations were then open, *South Central* at London Road, Elephant & Castle; *South* at Camberwell Green, and *North Eastern* at Kingsland Gate. There was already an agreement with the Magnetic company for an interchange of traffic from local to national circuits. It hoped, vainly, for a similar interchange with "other" companies, presumably the dominant Electric Telegraph Company.

The Magnetic company took a large rebate from the District's revenue for retransmission of messages to its national network, for premises and for other services, hampering its growth considerably. At one point in 1862 this reached 40% of the smaller company's income.

On August 20, 1859 Edward Tyer, its electrical engineer, reported that the contractors had successfully laid underground trunk lines from Threadneedle Street to Charing Cross, to Westminster, to Islington and, south of the river Thames, to the London Road, near the famous 'Elephant & Castle' public house, 6 miles of line and 106 miles of wire. These were all insulated with gutta-percha. Over-house wires were completed along the Waterloo Road, Kennington Road, New Kent Road, Walworth Road and the Camberwell Road, all south of the river, 3½ miles of line and 10½ miles of wire.

A further 5 miles of underground line containing 33½ miles of wire and 3½ miles of over-head line with 4½ miles of wire was in the hands of contractors; and 4½ miles of line with 15 miles of wire was being surveyed by the engineer. This gave a grand total of 22½ miles of line and 169½ miles of wire.

The Surrey Canal Company had granted a wayleave for poles and wires allowing access to the Commercial and Surrey Docks. The first eleven stations were ready for opening; optimistically another 89 small stations were anticipated to be opened by January 1860.

On the same day in 1859 the Board of Directors revealed that to work these stations the Company had taken on fifty-five "young females", of which forty-five were already under instruction as telegraph clerks. Their training was supervised by a matron and several sub-matrons.

The District was to be the only radical domestic innovation of the Magnetic company's management. Its message circuits were worked in concert with those of the larger concern and with those of the Submarine company, sending and receiving messages on their behalf throughout London. However with these it only retained the income from the segment borne by its own circuits.

Its original Board of Directors in 1860 comprised seven members, chaired by Samuel Gurney, a major money-dealer and financier, and a director of the Magnetic and Submarine Telegraph companies; it included Charles Kemp Dyer, a member of Magnetic's board, Robert Taylor, a useful member of the Metropolitan Board of Works (effectively the municipal authority in the capital), John Watkins Brett, a director of the Mediterranean Telegraph Company, but most notable for the promotion of the Submarine Telegraph Company, and a balance of City-men, merchants and financiers, including William A Rose, Charles Reynolds, and George Sheward. Edward Bright of the Magnetic company was later involved in its direction and management for a short period as it struggled through several crises. Its first secretary was Alfred Ogan.

The ill-health of Samuel Gurney caused Robert Taylor to act as chairman for most of the Company's early meetings, to be effectively, in this instance of corporate governance, its chief executive.

Alfred Ogan, the Company's initial secretary and manager, was by profession a public accountant of long experience but was otherwise unqualified for the position. He returned to his accountancy practice in Hackney within a year.

Latterly, from 1861 until 1870, the position of secretary and manager was occupied by Charles Henry Curtoys, who had previously been Assistant Secretary to the British & Irish Magnetic Telegraph Company, and before that District Superintendent with the Electric Telegraph Company for the West-of-England at Paddington railway station in London. Curtoys proved to be an imaginative and determined manager; introducing into the telegraph industry a broad range of marketing innovations in very difficult circumstances.

The Company called-up 50% of its capital during 1859 when it opened its first 22 telegraph stations.

By February 1860 new over-house extensions to Kingsland, Mile End Road, London Docks, Greenwich, Clapham, Camden Town and Highbury were completed, as well as underground cables to Edgware Road railway station and Mile End. Optimistically the engineer reported that the overhead wire had been "severely tested" by the winter weather without incurring any damage. These new works comprised 2 miles of underground cable holding 12¾ miles of wire, and 10¾ miles of over-house line carrying 38½ miles of wire. In hand were a further ½ mile of cable, 5¼ miles of wire; and 20 miles of overhead line, 20 miles of wire. The engineer was surveying 11½ miles of overhead line with 28 miles of wire. In all there were 44¾ miles of new line and 104½ miles of new wire.

On 1st February, 1860, it advertised the following offices open for the receipt of messages:

Central Station, No 58 Threadneedle Street
Baltic Coffee House, No 40
Borough, No 58 London Road
Camberwell Green (West side)
Camden Town, No 12 Cornwall Crescent
Chancery Lane, No 22
Charing Cross, No 7
Corn Exchange, Mark Lane (on Market Days)
Edgware Road, No 94, Grand Junction Terrace
Greenwich, London Street, corner of Royal Hill
House of Commons, Central Lobby (during session)
Islington, No 7, Rufford's Buildings, opp. the 'Angel'
Kennington Cross, near the 'Horns'
Kingsland, No 1, Dalston Terrace, near Turnpike Gate
King William Street, No 3, Adelaide Place, London-bridge
Knightsbridge, No. 21, Park side
Lloyd's, Royal Exchange
Mark Lane, No 82
Mincing Lane, No 22
Oxford Street, No 326
Regent Circus, No 43
Rotherhithe, Commercial Docks
Stock Exchange

Initially it lodged at the Magnetic's Threadneedle Street office, but in late 1860 took its own head office at 90 Cannon Street, City, later renumbered 101. Its next busiest office was at 7 Charing Cross in the West End; this was also owned by the Magnetic company.

In 1860 it joined the seethingly busy wharfs of the London and Commercial Dock companies to the City and offered ship-owners and merchants a substantial discount on its basic message rate for regular traffic by an annual rebate. In that year, too, it made an agreement with the Astronomer-Royal to convey a time-signal from the Greenwich Observatory to all of its offices.

On February 21, 1860 the District company offered a free wire to the British Horological Institute at 35 Northampton Square, Clerkenwell, for the hourly receipt of time from Greenwich Observatory by way of circuits on the South Eastern Railway and its head office in Cannon Street. The Institute used a simple, very sensitive galvanometer made by Henry Moore, of Spa House, Lloyd's Row, Clerkenwell, to receive the time signal; Moore had provided a similar device in 1857 to receive signals on the Atlantic cable.

The Company's difficulties were compounded by the failure of its contractor; it took the construction works into its own management. Even so it handled 73,480 messages from 52 stations, 73 miles of line and 335 miles of wire during the whole of 1860, with an operating loss of £2,200.

On February 27, 1860 the shareholders agreed that the Company might extend its circuits over the four mile radius from Charing Cross up to twelve miles, but only for police and fire purposes.

John Watkins Brett abruptly retired from the Board in February 1860 and was not immediately replaced.

In comparison to London's 52 district stations in 1860; Paris then had just ten telegraph offices, with another at the *Palais législatif* open, as with that at the Houses of Parliament, when it was in session; and New York had a central telegraph office at 21 Wall Street and nine other City offices, to serve ten separate lines.

The report of George Airy, the Astronomer-Royal, on June 2, 1860 to the committee of the Royal Observatory recorded in 'The Athenaeum' magazine shows that the Company continued its interest in "time transmission" and working in the public interest:

"One of the most important departments in the Observatory is that of making Galvanic Communications. Under this head, Mr Airy says: 'Our external galvanic communication has received a very important change. We had found for some time that our two underground wires leading to the Blackheath Gate of the Park, and there adapted to communicate either with one of the Admiralty wires (to the Admiralty, or to Woolwich, Chatham, Sheerness or Deal), or with one of the Submarine Company's wires (to the London offices, or to Calais or Ostend), had become practically useless. One of the four underground wires crossing Blackheath to the Lewisham Station of the North Kent Railway (there communicating by the London Bridge Station with Lothbury and with Deal) had shown signs of decay, but the others were very good; but about the month of August last year the whole of the four wires failed. We have taken up parts and replaced them by new wire, but apparently the whole of the gutta percha has perished. No special fault has been found, but every yard is faulty. I determined after this to trust no more to underground wires; and having received the permission of the Right Honourable the First Commissioner of Parks and Public Works to extend wires at sufficient elevation above the Park, - and having been met in my application to the London District Telegraph Company by the most liberal offer on their part, - I have stretched seven wires in the open air from the top of the Octagon Room to the top of a house in George Street. From this point the wires are carried on in a similar manner to the following destinations: - one is the property of the London District Telegraph Company; four are led to the [South Eastern] Railway Station in Greenwich, whence, under the care of Charles V Walker, Esq., they are continued on poles till they rejoin the continuation of the former North Kent lines at the railway junction (Mr Walker is preparing arrangements for placing the wires in open air all the way to the London Bridge Station); two are led along the poles of the London District Telegraph Company to Deptford Broadway, where they meet the lines of the Submarine Company, and where they will communicate by turn-plate either with the Admiralty line or with the Submarine line, as formerly at the Blackheath Gate of Greenwich Park.'"

On July 21, 1860, His Royal Highness Said Hadj Abderahman el Ajee (Alaoui), emissary of the Emperor of Morocco, then negotiating a loan of the City of London, and His Excellency Said Mahomet el Shamee, the Moorish ambassador to Britain, visited the premises of the Submarine and London District Telegraph companies in 58 Threadneedle Street. As well being introduced to the eighty young ladies in the District's telegraph gallery, His Highness sent messages to and received replies from the Moorish envoys in Paris and Berlin, and, rather more locally, to his aide-de-camp, General Kaid, at Claridge's Hotel, 41 Brook Street, Mayfair. The newspapers pointed out, undiplomatically, that reception of the Royal party was left to the officers of the companies, no directors being present.

Later, on August 25, 1860, revenues from public messages and private wires were reported at £550 19s 11d and expenditure £2,282 10s 7d for the previous half-year. Initial revenues were modest, but increasing: in February 1860, £52 2s 8d; in March £89 0s 1d; April £86 19 11d; May £134 17s 11d; and June £142 14s 1d. New lines opened in the half-year connected the Commercial Road, Poplar, the East & West India Dock Road, Bunhill Row, Blackfriars Road, Westminster Road, the Great Northern Railway Coal Depot and Paddington. An agreement had been made with the Thames Tunnel Company to lay wires connecting north and south London beneath the Thames river, its second such connection. A long circuit was also to be built around the Isle of Dogs in east London, connecting the wharfs, docks, industries and shipyards along the river. A capital of £24,472 had been raised by June 20. This had paid for thirty-seven stations, with another twenty properties in process of lease, and £1,282 had been spent on 80 instruments and office furnishings. There were then ninety "young ladies" employed or in unpaid training.

In numbers; 4¾ miles of new overhead line with 9½ miles of wire had been completed, and 6½ miles more of line, with 15½ miles of wire, were in progress. A further 11 miles of wire were added "on existing supports". A further ½ mile of underground cable was completed, with 5¼ miles of wires. This permitted the opening of 29 new offices. The network total in August 1860 was 47 miles of line and 262 miles of wire.

The District took over its own central office in Cannon Street early in August 1860

The directors agreed to take only half of their annual fees until the District's telegraphs achieved a dividend of 5% on its ordinary shares, saving the Company £500 a year.

The Company's network in at the beginning of 1861 was 73½ miles of line and 335½ miles of wire.

Great changes took place in the District company during first half of 1861. Charles Curtoys, late of the Magnetic Telegraph Company, took over as Secretary and General Manager, imposing better systems and processes, and implementing new ideas for marketing. A new role of Superintendent of Clerks was introduced at the chief office, to be assisted by a Lady Matron, to provide leadership and technical education. "Inferior" stations were to be closed and new ones of a "better class" opened. The Company's network was now almost complete, and, except for private wires, no further capital expenditure was thought necessary. The outlook was healthy, based on revenues in June 1861, estimated annual income was set at £4,680 from messages (£90 a week), from sub-letting property £910 and from rental of private wires £600. Twenty new offices had been opened in the previous six months and an agreement made with the London, Brighton & South Coast Railway to exchange message traffic at the District's low tariff on its West End of London & Crystal Palace branch to Balham, Battersea, Crystal Palace, Norwood, Streatham and other places. Underwater cables were laid for the first time across the entrances of the West India, Victoria and Surrey Docks to shorten its lines. A further 2½ miles of underground cable with 6¾ miles of wire and 2½ miles of overhead line with 7¾ miles of wire were constructed, giving a system total of 78½ miles of line and 350 miles of wire. Another 15 offices were opened by the end of the year.

The meeting of the proprietors on February 21, 1861 noted that the income from the 4d for ten word messages was inadequate, and that ten words were too few for most users. It agreed a new rate of 6d for fifteen words. A porterage charge was also then introduced for messages over a quarter mile from the receiving station, it was hoped that the introduction of more stations would render this unnecessary. Fifty-two stations were then open, fourteen opened in that previous six months and another twenty-one were nearing completion. It was made clear that the new stations were "experimental" and would be closed if working expenses were not covered, or if a guarantee of income was not provided by the local community. The new works completed totalled 12½ miles of new overhead line, with 20½ miles of wire, and 14 miles of cable, holding 53 miles of wire.

Dalston, Stoke Newington, Upper Clapton, Hackney, Cambridge Heath, Bow, Deptford, Lewisham, Blackheath, Sloane Square, Brompton, Kensington, Notting Hill, Shepherd's Bush, Hammersmith, Kentish Town, Haverstock Hill, Hampstead, Highgate, Holloway, Pimlico, Maida Hill, St John's Wood and Kilburn were now provided with telegraph offices.

The mileage of line at the end of 1861 was 92¼, carrying 378¼ miles of wire. This was only slightly increased over subsequent years. There were then 77 telegraph offices open. Although the District often was often condemned for its unsightly over-house wires, one-third, 30 miles, of its line, and nearly 60% of its wire, 218 miles, was actually in underground cables.

In the latter half of same year, 1861, Edward Tyer resigned as electrical engineer, and Sir Charles Bright, of Atlantic telegraph fame, joined the Board of Directors having previously been their consultant engineer.

During a court case in Hammersmith in West London during May 1861 it was revealed that the London District Telegraph Company, to avoid the cost of an Act of Parliament, was erecting overhead wires on public property under the Parliamentary authority granted in the British Electric Telegraph Company's Act of 1851. The British company maintained a shadow legal existence to continue these powers until the end of the domestic telegraph companies, although the Telegraph Act of 1863 gave general powers to all existing service providers and new concerns.

Later in the year, on October 18, 1861, the District launched its major discount scheme for trade customers, offering 100 pre-paid messages for twenty shillings, with an additional incentive of 500 printed advertising flyers included. Among its other promotional devices was the provision of flags and staffs for display by licensed victuallers' outside of their public houses to celebrate the arrival of the local telegraph.

The Company had constructed 78 miles of line with 350 miles of wire by mid-1861. It contracted with the new West-End of London & Crystal Palace Railway in 1861 for circuits to its suburban stations at Balham, Battersea, Norwood and Crystal Palace. But to June 1861 it had accumulated a working loss of £5,672 on an expended capital of £43,231.

"The low rate charged for messages, sixpence for fifteen words exclusive of address, and half-rates for pre-paid answers, does not by any means affect the precautions taken for the safe keeping and delivery of the messages entrusted to the Company's care. Each receives its particular and goes through its regular course from desk to desk and room to room, until its work is finally accomplished, when it is carefully put up in company with all papers bearing in any way upon it, and preserved for three months in one of the numerous presses close at hand, from thence to descend at the end of that period to the cellar, after a two years' sojourn in which it is finally destroyed."

As promised in its prospectus, in February 1861 the District company began a nine-month long campaign offering "Telegraphs for Private Use" with apparatus "of the most simple and cheapest description". It was to construct and lease extra overhead wires along its routes for private subscribers in London and provide them with their own Siemens magneto dial telegraphs. At the annual meeting of February 22, 1862, it claimed an income of £1,000 a year from private circuits and it was said that the private wire business, which until then had utilised spare capacity in its public circuits, required additional investment and capital would be raised for this on loan.

Their private wires were, initially, constructed to the same model as its public circuits, that is running from the subscriber's premises to its central station in the City where messages could be transcribed and sent on to any of its own or to any other public station. Later, from 1863, it also created several closed, wholly private networks within London, on the model of the competitive Universal Private Telegraph Company.

The District commenced a unique arrangement in May 1861, supplying a brief summary of parliamentary debates during the evening sessions each half-hour to Members of Parliament and other subscribers in London at their private addresses. They would be telegraphed from Parliament to the local station, where 'manifold' copies would be made and delivered by the Corps of Commissionaires rather than by its messengers. It is not known how long this expensive service was continued.

Charles Bright, chief engineer of the Magnetic, was Consultant to the District. Its own engineer was Edward Tyer who is best known for the development of a system of railway signal telegraphs. He founded his own signal equipment manufacturing company in Dalston, London, which lasted well into the next century. Tyer left the District's service late in 1861.

Although it used Tyer's simple single needle telegraphs with his "piston" key and Highton single-needle instruments with "tappers", the over-house circuits were difficult and expensive to acquire and construct, vulnerable to the elements and consistent in losing money. During 1862 it sent 250,000 messages, just 10 per day per station, but reduced its annual operating loss to £894.

Always vigorous in its marketing, the District in 1862 offered the public, as well as trade customers, one hundred of their 6d message stamps for one pound; this reduced the charge for a fifteen word message to 2½d. Its message capacity in 1862 with 83 stations was said to be one thousand per hour; but it rarely achieved one thousand messages in a day.

With this discounting the Company was able for the first time to develop the "social" nature of messaging. It became aware that there was considerable increase in traffic about great public and social events, such as the Derby horse race and the Queen's opening of Parliament. The greatest number of messages was sent on the on the day before the new Princess of Wales arrived in London, when 1,500 were transmitted by the public arranging seats and trips to view her cavalcade.

Common 'domestic' messages sent on the District's circuits included booking theatre and opera tickets, calls for doctors, for forgotten door keys, and 'I am on my way home', as well as ordering coal and other deliveries. Suburban tradesmen placed daily orders for perishable fish and poultry with Billingsgate and Leadenhall markets. Travelling salesmen sent orders to their principals in the City. Doctors and barristers were enabled to learn of the need for their services in different hospitals and courts during their day's work.

The Company's greatest success was in attracting commercial firms to use the telegraph for order-taking, with its 100 pre-paid messages for 20s, just 2½d for fifteen words, and the facility to receive orders at any of its offices in London and the suburbs, so that customers could place their orders by telegraph free-of-charge, widening the retailer's catchment area immeasurably. The hundred messages for 20s rate to tradesmen included a bonus of 500 printed circulars that publicised their readiness to take orders by telegraph without charge to the sender. The variety of users can be judged by this selection who advertised this service in the press:

One of the first to give his customers this option was Samuel Plimsoll, coal-merchant, at Great Northern Railway Coal Depot, King's Cross. Orders for coals by telegraph were received free-of-charge from July 20, 1860, and all through the winter 1860-61. The enterprising Mr Plimsoll also advertised a railway "Excursion to the Coal Mines" including a "descent into the mines", the train leaving at 7 o'clock, October 6, 1860; bookings and enquiries to be received free by telegraph. On his previous trip to the Northumberland pits in 1859, widely described in the weekly press, the excursionists were *carried* free as well, as a publicity exercise.

He also had a private telegraph from King's Cross to the Company's central station.

Plimsoll went on to famously campaign for marine safety, brought on by ship casualties among overloaded coastal colliers.

George Walker & Co., wine and spirit merchants, 61 Edgware Road, W, 326 Oxford Street, Regent Circus, WC and Great Tower Street, City, EC, took orders for their fine beverages from December 13, 1860 at all stations of the London District Telegraph Company. Walker was an agent of the Company and had a public telegraph on several of his premises.

The much larger Imperial Wine Company of 314 Oxford Street, W, with cellars under the Marylebone Court House, and export and bottling vaults at 15 John Street, Crutched Friars, EC, also advertised that orders for its wines and spirits, 'direct from the producer', could be made free at any office of the District company in 1862.

The services of George Shillibeer, patent funeral carriage proprietor, 1 & 2 Commercial Place, City Road, Finsbury Square, City EC, could be summoned electrically, free-of-charge, by District telegraph from March 13, 1861. The novelty of the patent carriage was that the bereaved and the coffin were carried, economically, in the same vehicle. Shillibeer had introduced the omnibus to London in 1828.

The Corps of Commissionaires, which gave employment to military veterans after the Crimean war, allowed the London District Telegraph Company to install a public telegraph at their Barracks in the Strand on October 17, 1861. Through this a commissionaire for a message or parcel delivery could be ordered without charge from any part of London and or the suburbs.

In December 1861 Samuel Brothers, tailors, of 29 Ludgate Hill, City EC were advertising the "Instantaneous Transmission of Orders" free-of-charge by District telegraph to their shop.

The Royal Cremorne Gardens and Hotel in Chelsea on its reopening on May 1, 1862 made a point of mentioning that the District company had arranged a telegraph station at its King's Road entrance for bookings.

Dakin & Company of St Paul's Churchyard, a very large firm of retail tea-dealers, received orders for their teas by telegraph without the customer incurring one farthing of extra expense, "indeed, at the saving of a penny [for postage]", and having delivery twelve hours sooner. The firm's owner also had his several branches and his house connected by private telegraph.

Chubb & Company, the famous lock-makers, offered owners of its safes who might have misplaced its key the ability of having a replacement sent to their premises by messenger on receipt of free telegraph message containing the number of the safe.

The District also worked in co-operation with the London General Omnibus Company from early December 1862. The bus company's Express Parcels Service used the telegraph company's agencies in shops as receiving offices for its shipments, and included a free message to the recipient to advise them that it would soon be ready for collection.

Charles Frederick Field, of the Private Inquiry Office, 20 Devereaux Court, Fleet Street, advised use of the District telegraph for speedy communication with his office on February 19, 1863. He went further and had the Company install a private telegraph at his premises on June 4, 1865.

The Ruabon Coal Company, coal merchants to the Queen, of Paddington station on the Great Western Railway, advertised "Coals by Telegraph" on October 7, 1867. Once again orders by the District company could be sent free-of-charge.

During a small-pox outbreak in 1869 there was a scare campaign against the use of public cabs for carrying suspected cases. On January 21, the London Fever Hospital, St Pancras' Old Road, King's Cross, London NW, offered patients and the anxious an ambulance to its wards that could be ordered, without charge for the message, by District telegraph. The cost to the patient for the ambulance being just the cost of horse hire, about twice a cab fare.

Never short of ideas to gain additional revenue, the District printed paid advertisements on the back of its received message forms, rather than the usual list of stations, and on their envelopes. It was the only telegraph company to do so.

It also distributed thousands of almanacs or calendars in December and January each year, advertising its list of stations, its scale of charges and its connections; "in a form that fits into an ordinary pocket book".

After it took its own building at 90 Cannon Street the Secretary advertised offices to let in the spare floors of the new premises in February 1861, as well looking for offers for the offices it had occupied at 58 Threadneedle Street.

The coverage of the Metropolis even in 1862 by the London District Telegraph Company's public offices is shown in this list taken from 'Kelly's Post Office Directory', showing over ninety locations, to which are added the names of their agents, where discoverable:

90 Cannon Street; Chief Office
45 Ernest Street, Albany Street, Regent's Park; *John Morris, hosier*
Baltic Coffee House, Threadneedle Street;
Railway station, Battersea; *West End of London & Crystal Palace Railway*
3 Norfolk Place, [Larkhall Lane], Battersea; *Alfred Fox, furnishing ironmonger*
2 Inverness Terrace, Bayswater; *William Brunker, bookseller & stationer*
30 New Weston Road, Bermondsey (Leather Market); *John Hickson, tailor*
Royal Hotel, 26 New Bridge Street, Blackfriars;
455 New Oxford Street; *William Alfred Putnam, china, glass & chandelier manufacturer*
68 London Road, opposite 'Elephant & Castle'; *Henry Mitchell, chemist & druggist*
8 Great Dover Street; *Robert Sutcliffe, wine & spirit merchant*
21 High Street, Bow; *William Tamlyn, linen draper*
14 Commercial Place, Brixton; *Chesterman & Taylor, baby linen warehouse*
15 Rose Terrace, Fulham Road, Brompton; *Edmund Garbett, iron merchant & contractor*
Camberwell Green, west side;
Cambridge Heath, opposite Gate;
12 Cornwall Terrace, Camden;
32 King Street, near Camden Hall; *George Jay, stationer & tobacconist*
22 Chancery Lane; *British & Irish Magnetic Telegraph Company*
7 Charing Cross; *British & Irish Magnetic Telegraph Company*
153 Cheapside (near Peel's Statue); *George William Henri & Co., manufacturers of cattle feed*
29 Sloane Square, Chelsea; *Thomas Evans & Co., military tailors*
10 High Street, Clapham; *Thomas Hookham Silvester, physician*
Dock House, Plough Bridge, Rotherhithe;
3 Heath Place, Commercial Road; *Gwen Ratcliffe, earthenware dealer*
Commercial Sale Rooms, [30 to 34] Mincing Lane;
Jerusalem Coffee House, Cowper's Court, Cornhill;
Tavistock Hotel, Covent Garden;
30 Crawford Street; *John Dent & Co., cabinet maker & upholsterer*
Crystal Palace railway station; *West End of London & Crystal Palace Railway*
DeBeauvoir Town, corner Downham and Kingsland Road;
Post Office, Broadway, Deptford;
Doctors' Commons, corner Godliman Street;
1 Commercial Street, Shoreditch;
94 Grand Junction Terrace, Paddington; *Alfred Wiseman, printer & compositor*
72 Euston Square, corner Seymour Street; *Charles Shepherd, chemist and druggist*
'Eyre Arms' [public house], St John's Wood;
15 Finsbury Place north, Finsbury; *Thomas Riddington, bookseller & post office receiving house*
102 Fleet Street, the 'Dial' newspaper office;
159 Goswell Street, near Wilderness Row; *Rebecca Odell, tobacconist*
24 Gracechurch Street, corner Lombard Street;
47 Gresham Street, corner Wood Street; *Henry Walker, needle & hook & eye manufacturer*
Guildhall Law Court;
Haverstock Hill, opposite Adelaide Road;
255 Upper Street, Islington; *John Morrell, hairdresser*
285 High Holborn; *London Linen Company*
5 Hercules Terrace, Upper Holloway; *Edwin Applegate, chemist*
House of Commons Central Lobby;
Isle-of-Dogs, near *Pontifex & Wood's factory*;
7 Rufford's Buildings, High Street, Islington; *George Porter, fruiterer*
The 'Horns' [public house], Kennington;
8 Windmill Row, Kennington; *Joseph Sirgood, stationer*
1 Somerset Terrace, Campden Hill, Kensington; *William Cole, tobacconist*
8 New Chapel Place, Kentish Town;
10 Morton Terrace, Kentish Town;
1 Dalston Lane, Kingsland;
4 York Place, Mansfield Street, Kingsland;
65 King William Street; *Christopher Lalor Philpott, stationer & post office receiving house*
21 Park Side, near Albert Gate, Knightsbridge; *John Jones Vaughan & Co., pawnbroker*
2 Leadenhall Street, Billiter Street; *Fribourg & Treyer, tobacconists*
Clock Tower, London Bridge;
3 Adelaide Place, London Bridge terminus;
Railway Station, Norwood; *West End of London & Crystal Palace Railway*
5 Maida Hill East; *William Page, grocer*
82 Mark Lane; *Jay & Baker, corn & seed merchants*
7 Mile End Road; *George Macksey, ginger beer manufacturer*
Railway Station, New Wandsworth; *West End of London & Crystal Palace Railway*
24 High Street, Notting Hill; *Mary Ann Gilbert, tobacconist*
Old Bailey Criminal Court;
Old Jewry, corner of Poultry;
326 Oxford Street, corner Regent's Circus; *George Walker & Co., wine & spirit merchant*
Bishop's Road, opposite 'Royal Oak', Paddington;
Peckham Rye, at Mr *Miller, chemist*;
43 Regent Circus, Piccadilly; *British & Irish Magnetic Telegraph Company*
Victoria Railway Terminus, Pimlico; *West End of London & Crystal Palace Railway*
78 Gloucester Street, [King's Road] Pimlico; *Henry Clinton Cooper, auctioneer*
134 High Street, Poplar; *John Matthews, tobacconist*
11 Southampton Street, Euston Square; *Thomas Kingston, Italian warehouseman and railway booking office*
Commercial Dock House, Rotherhithe at the Thames' Tunnel;
Corn Exchange Chambers, Seething Lane;
1 Commercial Street, Shoreditch;
South Kensington Museum;

16 Southgate Terrace, DeBeauvoir Town; *John William Gibbs, news-agent*
Commercial Road, Stepney;
1 Stockwell Place, Clapham Road, Stockwell; *Charles Martin, chemist*
337 Strand, opposite Somerset House; *William Tweedie, bookseller & publisher*
Commissionaires' Barracks, Exchange Court, Strand;
58 Threadneedle Street; *British & Irish Magnetic Telegraph Company*
1 Bridge Foot, Vauxhall; *Georgiana Quin, tobacconist*
Vauxhall, next Arrival Platform, South Western Railway station;
4 Wellington Place, West India Road; *John Whitmore, dining-rooms*
3 Myra Place, West Ham;
Great George Street, Westminster;
18 Great Smith Street, Westminster; *James Harvey, chemist*
Westminster Palace Hotel, Victoria Street

Several of these ninety-five stations were shared with the British & Irish Magnetic Telegraph Company and with the Submarine Telegraph Company; the District only claimed eighty stations of its own in its returns to the Board of Trade. The District had public telegraphs at the stations of the West End of London & Crystal Palace Railway (shortly to be acquired by the London, Brighton & South Coast Railway) and, from 1863, at the underground stations of the Metropolitan Railway. All could access the Magnetic's national and the Submarine's foreign circuits by transcription at the chief office in Cannon Street.

On January 2, 1862 the District company began advertising "Trade Circulars by Telegraph", in addition to order taking. Retailers and others in trade could use its common 20s for 100 message discount rate to broadcast telegrams promoting their wares to potential customers. The scheme was to cause a storm of protest when unsolicited messages began to be delivered to a general public used to receiving only bad news by telegraph.

In response to virulent press criticism of its service the District stated in March 1862 that it was handing 700 messages a day and that there had been one customer complaint for every 2,100 transmitted. This was less than the industry average.

It was announced on August 13, 1862 that Charles Bright, the controversial engineer of the failed Atlantic Telegraph, was now one of the directors, "in place of John Watkins Brett", who had retired in February 1860.

On March 26, 1862, Samuel Gurney, MP, chairman of the London District Telegraph Company, held an evening soirée at his house at 25 Prince's Gate, Hyde Park. To amuse his visitors the Company laid on a telegraph apparatus in his dining room and connected it with their underground wires in Kensington Road, by which means there were able to communicate with "the capitals of Europe, Malta, Alexandria and the East" through their head office in Cannon Street and the cables of the Submarine Telegraph Company.

Traffic in 1862 was 243,849 messages, a huge increase from 144,022 in 1861. Public business during 1862 went up to £125 a week, from £93 a week. The private wire income then was said to be £1,000 a year, the Company having spent £3,000 to secure that business. The directors said another £2,000 was needed to develop the profitable private wires.

The major factor in the financial affairs of the District was the rebate required by the Magnetic company for retransmission and other services, in July 1862 of its half yearly message income of £6,515 it had to hand-over £2,557 to the larger firm.

On December 21, 1862, the "Great Gale" destroyed lines from the western end of the Whitechapel Road to Mile End Gate; the wires spread across the road were gathered up by police and the clerk at its Mile End office. It was the shape of aggravations to come.

Its half-yearly shareholders' meeting of February 10, 1863, noted that all of the head office batteries, which enabled its entire system, had been renewed, but it had spent only £167 on new lines in the previous six months, with just a few new private wire contracts, but they included an important one to connect the stations of the London Fire Engine Establishment.

By 1863 the District had constructed 107 miles of line and 430 miles of wire across the metropolis; in 1864 115 miles of line and 454 of wire. As its stations dropped from 81 to 80 so the number of instruments in circuit also fell from 192 to 191. Messages rose from 247,606 in 1863 to 308,032 in 1864.

During August 1863 the District announced that messages for its offices could now be sent from most other telegraph stations in the country, having come to an agreement with the Electric & International Telegraph Company as well as with its promoter, the British & Irish Magnetic Telegraph Company. The Metropolitan Railway, the first wholly-underground railway in the world, gave the District its "exclusive commercial and general telegraph business"; its tunnels were laid with a new cable and telegraph offices opened at all of its subterranean stations. The instruments and batteries at most of the District's offices were renewed in the previous six months. Tyer's needle instruments with "push-pull" transmission were replaced by Highton's needle apparatus with double-keys at this time.

Of some importance, the District also completed the first of what was to become one of its many closed private telegraph networks, for the London Fire Engine Establishment.

In September 1863 fifteen of the Company's stations were disabled by a massive electric storm over London with lightning strikes on it over-house wires. No one was injured.

Another gale, on October 29, 1863, brought down its lines in the heart of the City of London, between Bartholomew Lane and Old Jewry, running across the Bank of England, Princes Street and Grocers' Hall. The fragility of its over-house system was all too publically demonstrated to its City investors.

The weather was to inflict far worse damage on the District's fortunes three years later.

The Company's returns to the government recorded that the District carried 316,000 messages over 123 miles of line between its 83 urban offices in 1865. In itself this was a great achievement. In that year too it had a net surplus of £242 and paid its first dividend on its ordinary shares, sadly just 1%.

As has been noted its offices were lodged in the shops of small tradesmen, preferably one that also had the local post-office within it. As well as the Company's lady clerk the tradesman was permitted to receive messages when necessary. A boy was also retained as a messenger; if he were absent for more than ten minutes an "extra messenger", any handy lad, was employed.

Nine hotels, varying between the huge 'Westminster Palace' by Parliament, the almost equally large 'Grosvenor' at the Victoria railway station, the 'Railway Terminus' at London Bridge station, the 'Bridge House' for the packet steamers at London Bridge, the 'Tavistock' in Covent Garden, 'Haxell's' close by in the Strand, the 'Royal' in Blackfriars and the 'Eyre Arms' in suburban St John's Wood, as well as the 'Royal Cremorne Hotel and Pleasure Gardens' in Fulham, had public telegraphs in their lobbies by 1864 for visitors and passers-by; as did the City of London Club and the Junior Carlton Club, for gentlemen in the financial or business and West End districts respectively.

These were eventually joined by the new 'Langham Hotel' above Regent Street in Marylebone.

A sense of gloom set in during 1864 when it was stated that it had made losses for every year of its short existence. But by mid-1865 the economic prospects of the District company improved markedly. For the first time it was able to announce a trading profit, albeit only of £242. Its private wire business was flourishing, now that it was carving a niche in making large closed networks for utilities and government service. Another cable was needed in the tunnels of the Metropolitan Railway as message traffic to and from West London was substantially increased. The public telegraphs of South Eastern Railway, the fourth largest network in the country, had joined the other service providers in accepting messages for the District's offices.

The District was subject to much public criticism due to its ugly overhead iron lines protruding on posts above roof-tops, which, as every station had a single wire connecting to its hub office, led to a great mass of wires in the City centre, and to its general poor performance. In fact nearly 60% of its wires were underground.

Then many of its roof-top circuits were destroyed by the snows of the Great Storm of January 11, 1866, necessitating a temporary increase in rate to 1s 0d for *fifteen* words, as it was unable to raise capital for the immense repair bill. Half of its overhead lines had been brought down and half of its offices were closed for over a month, only its underground cables were unaffected. It started to transfer some of its over-house wires into additional subterranean conduits and to the weather-resistant tunnels of London's new underground Metropolitan Railway Company, which opened in 1863 from the Paddington station of the Great Western Railway beneath the streets to the northern fringe of the City at Farringdon Street, and offered public telegraphy at its seven stations. It planned to leave just a third of its lines on roof-top poles.

Regarding the physical effects of the Storm (reported with the capital 'S'), on January 12, 1866 'The Times' reported:

"The most serious consequence of the storm is the injury it has done to the telegraph posts and wires, and more particularly to those which cross the streets of London. At 9 o'clock yesterday morning the snow had formed a thick coating upon the wires and bent them down at the points midway between the posts, many feet lower than their usual level. In many places they sank so low as to interrupt the traffic, and in others the posts snapped and fell with them to the ground."

"The London District Telegraph Company are the chief sufferers. Their posts have been torn from the tops of the houses in all directions. In Great George Street, Westminster, fallen wires were entwined round several lamp-posts, and in Regent Street they were hanging from one side to the other, and the drivers of the various vehicles had to remove them in order to pass. Similar damage was experienced in the Euston Road, Farringdon Road, and in many of the leading thoroughfares in the city - in some cases the lamps being completely carried away. At the chief office in Cannon Street the poles have been completely demolished, and the wires have been coiled up in heaps on the top of the premises. From the London Road station to the 'Rockingham Arms' the wires, of which there were about twenty, were hanging in loops so low as scarcely to admit vehicles to pass under them. During the whole of the morning gangs of men were employed in coiling up the wires, and every preparation was being made to repair the injury and re-establish communication. It was the opinion of the inspectors that it was not the wind alone that has caused the damage to the wires, but that the accumulation of snow on them has so increased their weight that when the wind blew strong in a lateral direction the lines were unable to bear the strain."

"The wires of the London, Chatham & Dover Railway Company have suffered in the same way. The damage to the wires and posts along portions of the Great Western Railway is very great, miles of wire between Langley, Slough, Taplow, Reading, and Wallingford having been borne down. At Slough the wires lie tangled, broken, and strewn over the station, works, and buildings in the greatest disorder, and from this state it will take some time to restore them. The telegraph wires upon the London & South-Western Railway have also experienced great damage, more especially between the Windsor terminus, near the Home Park, and the Datchet, Wraysbury, and Staines stations of the Richmond and Windsor branch line. Between Mortlake and Barnes the wires and posts lie upon the common. From Barnes to Putney twisted and broken wires are strewn about. The wires are also injured between the Clapham Junction and Waterloo. The result has been the stoppage of all telegraphic communications to the provinces; but the Electric & International Telegraph Company are still able to forward messages to the Continent. The loss to the District Company will be great; but as most of the Electric Company's wires are underground in London it is thought that the communication, so far as they are concerned, will soon be resumed."

It took until the following April for the District company to repair most of its overhead circuits. Its finances were such that, on May 7, 1866, it had to advertise a debenture loan with a hefty 7% interest to help pay for the storm damage. The Company desperately appealed for investments of £25 or more, for periods over two years, with interest payable half-yearly or quarterly. It raised £1,800.

The Company's South Eastern District was still in disarray at the end of 1866, where both public and private circuits remained in disrepair. This was ameliorated by the South Eastern Railway Company granting the District wayleaves along its own lines to several stations.

The only positive element of the year was the remarkable increase in private telegraph business, with large new networks being built for the Fire Brigade, the Salvage Corps and the Post Office.

Table 20

London District Telegraph Company
Growth 1860 – 1868

	Line	*Wire*	*Offices*	*Messages*
1860	73	335	52	74,582
1861	92	378	78	144,022
1862	103	401	84	243,849
1863	107	430	81	247,606
1864	115	454	83	308,032
1865	123	470	83	316,271
1866	150	495	80	214,496
1867	150	495	81	239,583
1868	163	545	81	183,304

Other stations were shared with the Magnetic and Submarine companies

From the 'Returns of the Railway and Telegraph Companies to the Board of Trade'

At its first half-yearly shareholders' meeting after the Storm, on August 16, 1866, the District's directors claimed that "except for a short distance in the south east... [its circuits had been] renewed on an improved and more secure system". Instead of having three-quarters of its lines over-house and unprotected only one-third were then so constructed, the remainder being underground "or equally well-protected". Its private wire contract with the insurance companies' fire service had been successfully transferred to the new state-owned London Fire Brigade; new contracts were in negotiation with the Post Office, the Metropolitan Board of Works and the London Salvage Corps, to connect several of their offices and stations. After the appropriation of their fire engines in 1865 the insurance companies had set up the Salvage Corps to assist homeowners and businesses remove property threatened by fire.

The overwhelming majority of the staff of the District company were women; a considerable innovation for the time. The Board of Directors had particular views on its lady clerks and instructed on August 23, 1859 that "Any male clerk or officer who held communication with them would be instantly dismissed". At Cannon Street, where eighty circuits entered, they worked in a single large instrument room having three long counters for the apparatus. As well as instrument clerks the Company employed ladies as ordinary clerks in the Clearing Room where the paper work connected with each message was collected and collated. The "clerks rustle about in silks, and manage to place a pen behind their ears with the best commercial air." The working hours in the instrument room and in the local stations were very long; from nine in the morning until seven at night. To compensate for this, at Cannon Street, they were provided with a dining room, and a cook prepared the food the ladies brought in for their dinner and tea. They also had use of a lavatory "embellished with a fountain".

The messengers, however, were all 'boys'.

As well as public telegraphy the District company from its inception in 1858 offered individual subscribers private wires to connect offices and residences: for example it connected docks and dock-offices, post offices and fire stations. These private circuits used Siemens magneto-electric dial telegraph, which sent and received the plain alphabet, for use by ordinary people, rather than trained clerks. Each circuit consisted of a single wire and two dial instruments, or multiples of this set where several places were to be connected.

The Company continued with its unique 6d for *fifteen* word message rate and its discounted telegraph stamps which resulted in a rate of 2½d for fifteen words for bulk pre-payers until the 1866 Great Storm. Its circumstances were then such that from May 16, 1867 it needed to adopt a uniform 1s 0d for *twenty* words rate. It also felt compelled to increase its tariffs for its expanding private wire business. With that, at the end of the year, it was at least able to pay the 10% dividend on its £10,000 of preference shares, the other shareholders once again got nothing.

In the first 22 weeks of 1867 under the 6d tariff the Company worked 93,346 messages. In the first 22 weeks of 1868 under the new 1s 0d tariff it transmitted 88,346 messages, a 5½% reduction in traffic.

In comparison the Electric Telegraph Company maintained a 6d for twenty word tariff between its metropolitan stations from January 1861 until 1870. However it did not offer any discounts.

Latterly, in 1867 the District listed 116 stations, some shared with the Magnetic and Submarine companies, in the Post Office Directory, on 150 miles of line, the same mileage as in 1866. In competition with these the Electric company then had a further forty-seven and the United Kingdom company sixteen public stations in London, giving the capital nearly 180 telegraph offices.

In the same year New York possessed 74 and Paris 46 public telegraph stations.

Unfortunately, and uniquely for a telegraph company of the period, the District's messaging business collapsed from its record of 316,272 in 1865, to 214,496 in the Great Storm and Crash Year of 1866, recovering a little to 239,583 in 1867, even after the increase in tariff, plummeting to just 183,304 messages in 1868. This led to yet another annual loss on working of £1,068.

The general meeting of the District on August 27, 1867 altered its name to the *London & Provincial Telegraph Company*, ostensibly to encompass a wider catchment area, and increased its nominal capital to £70,000. The name change was undertaken in an attempt to distance the firm from its unfortunate reputation, no extensions were made. At the end of the year it recorded another operating loss. It was then in a perilous state, just before the reconstruction it had only £269 in the bank and just £10 in telegraph stamps to hand. The District was the smallest of the public telegraph companies and was never an economically-sound business, although it set a world-wide precedent for intense urban telegraphy.

The Board of Directors, ever resilient and ever hopeful, commissioned Stephen H Emmens, DCL, consulting actuary to the long-established Church of England Assurance Institution, to analyse its prospects based on past performance. In his long report of October 13, 1868, Dr Emmens calculated that the Company would be paying a respectable dividend of 4½% by 1871 and an effective 5½% by 1872.

The Board then consisted of George Sheward, chairman, Charles Kemp Dyer, vice-chairman, Charles Reynolds, R P Taylor and William Austin. Most of these had loyally and determinedly stuck with the London District Telegraph Company throughout its ten year struggle for prosperity.

Charles Henry Curtoys was Secretary and Manager on a salary of £550 a year. Little is known about Curtoys who, almost alone, seems to have kept the District company in business. John Isherwood was latterly described as Engineer to the Company; he was to join the Post Office Telegraphs in London in 1870.

The London & Provincial Telegraph Company had a final paid-up capital of £66,350, of which 18% was in new 10% preference shares and loans. It possessed 82 stations, 163 miles of line with 545 miles of wire and had in its employ 114 clerks, almost all of whom were women, and 66 messenger-boys in 1868, who, as noted above, transmitted 183,304 domestic messages.

Its shareholders had some reason to feel aggrieved over the terms of the government appropriation, which, in the case of the other companies, were based on 20 years net profits. As the District / Provincial company had never made a net profit and only once, in 1865, an operating profit it was acquired on the basis of its highest market value in June and July 1868 plus "an allowance" for prospective profits as determined by Dr Emmens, the actuary. The shareholders received £60,000 for assets that had cost them £65,000, countered by accumulated losses over ten years of £15,214.

On February 11, 1870 it was proposed that the Directors liquidate the London & Provincial Telegraph Company in return for a fee of £1,200, the shareholders unanimously rejected this and gave the task to Charles Curtoys, the General Manager, and awarded him £300.

Table 21

London District Telegraph Company
Income & Expenditure 1862 - 1868

Year	*Income £*	*Expenditure £*
1862	6,549	9,741
1863	8,215	9,669
1864	9,128	9,857
1865	9,561	9,432
1866	8,732	8,895
1867	7,347	8,119

There was a loss of £1,068 in 1868, and further operating losses in 1869, though this was reduced to £54 in the final half-year

j.] **The United Kingdom Electric Telegraph Company**
The United Kingdom Electric Telegraph Company had been created in 1851 by Thomas Allan, an engineer, to work his patent instruments and a flat-rate system irrespective of distance, similar in pricing to Post Office letter-carriage, in that every twenty-word message would cost one shilling (12d). It had then acquired rights in an Act of Parliament in 1851 to make telegraphs alongside and beneath public highways with authority for a capital of £250,000. These rights, in 1860, were vested in Thomas Allan, the original promoter.

To recommence the business and to acquire the rights held by Allan, a new concern was registered in July 1860 under the Joint Stock Limited Liability Acts 1855 and 1856, - the "United Kingdom Electric Telegraph Company, Limited". On July 26, 1860 the prospectus for this new Company was issued for a capital of £150,000, in 30,000 shares of £5 each. A deposit 10s per share was payable on application, with 10s more on allotment and the remainder in calls of £1 each at intervals of not less than three months. John Lilwall, who for the previous 20 years had been honorary secretary to the 'Early Closing Association and Saturday Half Holiday Movement', was appointed Secretary to the Company, and Thomas Allan, the electrician and engineer.

The United Kingdom company assembled a populous and businesslike board of twelve in 1860 consisting of an admiral, a railway company chairman, four bankers, Frederick Doulton, the potter, James Pilkington, the glass-maker, A A Croll, a major gas entrepreneur, and, to add some style, Lord Alfred Churchill.

According to Jeffrey Kieve's analysis of the share registration, Angus Croll was to possess 3,000 shares of £5 in the United Kingdom company, Lord Alfred Churchill, 1,350, W B Passmore, a wholesale stationer in London, 622, and W T Henley, the telegraph contractor, 415. Nine directors held over 50% of its share capital in 1865. Otherwise the capital base was divided among many small investors: 89 in 1861, rising to 784 in August 1865, mostly holding under 10 shares each.

Thomas Allan of Edinburgh, owner of the 'Caledonian Mercury' newspaper and printer of the 'Encyclopaedia Britannica', had devised and patented an improved needle telegraph using compound magnets in 1850. He had obtained finance for the 1851 Act that created the Company (and to purchase and work his patent), and had managed the launch of the United Kingdom company's first incarnation in 1853. On July 24, 1860 he agreed generous terms with the new joint stock company: a salary of £2,000 a year as electrician and chief engineer, £10,000 in cash and £15,000 in shares for his previous efforts and a 10% royalty on all net shareholder profits above 5%. The directors of the Company, becoming quickly disillusioned with Allan's competence, gave notice in October 1860 that the relationship would be terminated on January 21, 1861.

Having abandoned, without use, the telegraphic system of its initial promoter, Thomas Allan, during 1861, the United Kingdom company adopted the American telegraph. The American instrument was used on all of the lines it erected until 1863.

With the eclipse of Allan, William Andrews was appointed electrician to the Company on November 20, 1860, and then promoted to Secretary and Manager on January 1, 1861, replacing the ineffective John Lilwall. With eight years experience in the business, Andrews had previously been employed in the engineering department of the Submarine Telegraph Company, and as Commercial Superintendent of the British Telegraph Company. He was soon joined by his former colleague at the British company, William Powell, as engineer. Andrews and Powell had been passed over for promotion in the merger that formed the British & Irish Magnetic Telegraph Company in 1857-8.

During its first year of operation the United Kingdom Electric Telegraph Company made 305 miles of line and 1,968 miles of wire. Its 16 stations possessed 65 American telegraph instruments and worked 11,549 messages. In that first year, 1861, it constructed lines between Liverpool and Manchester and London and Birmingham, with the company seeking local shareholders to finance the intermediate route between Manchester and Birmingham. Although it attempted to erect telegraphs along public highways the Company's right to do so was repeatedly challenged in the courts in 1860 and 1861; all of these circuits had to be made by the side of canals.

The United Kingdom company had the temerity to cross the tracks of the Buckinghamshire Railway, a branch of the London & North Western Railway, at a level crossing with its roadside wires. The circuits were led between poles 35 feet high and 80 yards apart. On November 8, 1861, the railway company despatched a locomotive engine with several workmen who cut the wires. The Crown challenged this action as a malicious act but the Oxford Quarter Sessions found that the railway was within its rights to do so.

By March 1862 the Company had eleven complaints of it obstructing the public highway with its roadside poles, across Buckinghamshire, Middlesex, Oxfordshire and Warwickshire. It was finally determined by the courts that the highway extended for the full width between any fences on either side, not just to the metalled portion set aside for vehicles, animals and pedestrians, and that any permanent obstruction without Parliamentary authority was unlawful. This final decision left the telegraph company unable to use the public highway for its wires without returning to Parliament.

Its legal status was thoroughly confused by its relationship with Thomas Allan, the sole owner of the original United Kingdom Electric Telegraph Company of 1853, who had obtained an Act of Parliament authorising the laying of wires under and over ground along public roads. Although the new body of proprietors initially agreed to purchase the old company and all of its rights the deal fell through in 1860 when they dismissed Allan. The transaction was never completed leaving the new concern in limbo as far as using public rights of way. It had to prepare its own expensive Bill in Parliament in November 1861 against a vicious storm of opposition from the existing telegraph companies, and from the extraordinarily bitter Thomas Allan, who went to the expense of depositing his own competitive Bill. It did not help its case by refusing to include in its Bill a permanent commitment to the hugely popular 1s 0d for twenty words flat rate message charge. This unwillingness is easily explained as by mid-1862 the United Kingdom company, with 415 miles of line in operation working the 1s 0d rate, was failing to cover its operating costs, and had already incurred a net loss of £6,000.

This anomalous situation regarding rights to use public highways was not confined to the United Kingdom company. The Magnetic and London District telegraph companies both lacked any rights to place poles on the roads; they relied through acquisition or license on the powers granted by Parliament to the original British Electric Telegraph Company of 1851.

Thomas Allan continued to be involved with telegraphy, devising armouring for underwater cables, whilst harbouring a considerable grudge against the board of the United Kingdom company. He lost his entire, very substantial, fortune in subsequent, wholly fruitless, legal battles with the telegraph industry.

After much delay and opposition the United Kingdom Electric Telegraph Company Act 1862 was successfully read in Parliament for the third time and passed into law on June 30, 1862.

The first long line of the United Kingdom company, between London, Birmingham, Liverpool and Manchester, was opened throughout to the public on November 16, 1861 using the American telegraph.

It was the flat-rate message that was regarded as the greatest challenge to the existing companies' business; especially when the United Kingdom company launched itself noisily in 1861 with a pamphlet with the headline "Cheap Telegraphs; or, Telegrams for the Million". The two competitive telegraph companies, the Electric and the Magnetic, both adopted the shilling rate in those towns and cities served by the United Kingdom's circuits. They also pointed out that the United Kingdom's 1s rate did not include porterage. The Company's board had to admit in 1861 that the cost of a twenty-word message including delivery four or five miles from one of its offices should *not be more* than 2s 6d or 3s, and even more if for immediate delivery.

On November 19, 1861 the United Kingdom Electric Telegraph Company advertised the following nineteen offices open: London, 200 Fleet Street, Temple Bar; Gresham House, entrance, 162 Bishopsgate Street; 7 Mincing Lane; Stock Exchange, Hercules passage, Old Broad Street; 20 Cockspur Street, Charing Cross (Waterloo Chambers); Birmingham, 101 New Street; Banbury, High Street, opposite Town Hall; Liverpool, Liverpool and London Insurance Buildings (C Basement); Manchester, 24 St Peter's Square; Stock Exchange; Bank Street, St Ann's Square (opposite principal entrance Royal Exchange); Oxford, 1 Carfax and High Street, St Clements (near Magdalen Bridge); Southam, the Post Office; Uxbridge, at Mr Gurney's, chemist, London Street; Wycombe, Mr Ashton, seedsman, Market Place (opposite Corn Market). Four more stations were about to be opened at Chester, the Crypt Buildings; Leamington, 18 Bath Street; Runcorn, Harbour Place; and Wolverhampton, 67 Queen Street (Dudley Place). It was then looking for premises for its instruments in Ashton, Macclesfield, Stalybridge, Tetworth, Warrington, Weston Point, Wheatley and Wigan on its new lines, as yet unconnected with each other!

This crucial line between the centres of English industry and population completed in the autumn of 1861 at a cost of £35,000 connected the principal centres of trade and commerce in England. It gave the Company a vital flow of income, enabling it to acquire capital and hence to expand.

During 1861, too, the Company came under the vigorous chairmanship of Alexander Angus Croll, late Managing Director of the Great Central Gas Consumers Company of London, a man who had a long history of challenging monopolies. Under his control it became to be seen as the 'people's company'.

Challenged as to its rights to use roadside circuits it quickly and cheaply erected lines on tow-paths by the side of waterways between 1861 and 1862; most of these canals and navigable rivers were near-abandoned after the arrival of railway competition for freight. The main circuit connecting London, Birmingham and Manchester commenced alongside of the Grand Junction Canal from Brentford in West London to Braunston in Northamptonshire, reaching the populous towns of Leicester and Northampton on canal branches. It acquired wayleaves northwards along the Warwick & Birmingham Canal, through the Birmingham Canal Navigation and on to the Trent & Mersey Canal. From the latter waterway it used the Duke of Bridgwater's Canal and the Leeds & Liverpool Canal for access to Liverpool and Manchester. From the canal terminal basins overhead and underground lines had to be made by the side of roads to access the city centres.

The United Kingdom company reached the important industrial towns of Blackburn, Bradford, Burnley, Leeds and Wigan in northern England using the Leeds & Liverpool Canal. It accessed the docks of London by means of the Regent's Canal, leading from the Grand Junction at Paddington.

Unlike the railways who had a mutual interest in having the telegraph alongside of its tracks for signalling and messaging the canals did not, and charged substantially for the wayleaves.

In January 1862 the United Kingdom Telegraph Company and S W Silver & Company canvassed a proposal for a new cable between South Wales and Queenstown in Southern Ireland. This was an ambitious venture requiring £100,000 in new capital. It also involved new, untried cable technology. The core was to be insulated with Silver's india-rubber rather than tried-and-tested gutta percha; the outer armour was to be made of metallic tape to Siemens, Halske & Company's design, not iron wire. The tape armour caused it to be observed in the press, "This will be a difficult cable to pay out or manage in water". Already a controversial concern, an expensive Irish cable was a step too far for the market and it was quickly abandoned. The line, but not the tape armour, was immediately adopted by the competitive Electric Telegraph Company.

Then, during 1862 the Company acquired the patent for David Hughes' type-printing telegraph and began to gradually install this complex device in its busiest circuits. The Hughes apparatus, which printed the alphabet on a paper tape, was to be the exception to the needle telegraph then used almost universally in British telegraph circuits.

The first experimental messages using the Hughes printer took place between London and Liverpool between September 15 and 17, 1862. The long-lines were at one stage connected at Liverpool to create a single circuit back to London and the type-printer successfully worked over 700 miles of wire. The tests were extended to Manchester on October 13, 1862. The press reports mentioned that the instruments were made by Froment in Paris.

During 1862 the Company had opened six offices in London, all working the American telegraph: 237 Gresham House, Old Broad Street, EC; Hercules Passage, 82 Old Broad Street, EC; 7 Mincing Lane, EC; 200 Fleet Street, EC; 20 Cockspur Street, SW; and Oxford Circus, Regent Street, W. It then had 371 miles of line, 2,741 miles of wire, 22 stations and 88 instruments, to work 133,514 messages, over ten times as many as in the previous year! The effect on public messaging of the 1s 0d flat rate was remarkable, particularly as the United Kingdom company had so few stations.

In popular culture it soon became known, and often appeared in the press, as "the Shilling Telegraph Company" from its flat rate.

Just a year after it opened its long line between London and Manchester the Company arranged a coup to impress both the public and the newspapers:

Richard Cobden, one of the most important and verbose Liberal speakers of the age, spoke at Rochdale, Lancashire, for two hours between 7.50 pm and 9.50 pm on November 4, 1862. By special arrangement the reporters of the 'Daily Telegraph' newspaper took down his deluge of words meticulously in shorthand and travelled by railway to Manchester, the United Kingdom company's nearest station, transcribing their notes into script on the short train journey. Once there they took a cab to the Company's offices at 61 Stock Exchange Buildings, Ducie Street, Manchester. At 11 pm the Company set aside three wires to send the verbatim report of the speech to London using their American telegraphs. The text arrived at the offices of the 'Daily Telegraph' at 3 am. Within an hour it was "being struck off [their printing machines] at a rate of 40,000 copies an hour", for their morning edition of November 5!

This repeated the performance of the original Electric Telegraph Company reporting one of Cobden's interminable orations from Wakefield for the London papers thirteen years previously, in April 1849.

After extensive trials in the previous autumn the Hughes type-printing telegraph was introduced to the public by the United Kingdom Electric Telegraph Company on January 19, 1863. It was then put into daily operation between London and Birmingham, with the initial messages in type being the Lord Mayors of both great cities at the Company's offices exchanging greetings. The Hughes printers were worked by the lady clerks at the United Kingdom company without difficulty, transmitting 30 to 40 words per minute, or from 40 to 46 messages "of average length" per hour per single wire, a marked increase in speed and efficiency. On January 28, a long speech by the radical politician John Bright in Birmingham was transmitted for the first time verbatim onto printed tape for the London newspapers.

Economy was always a primary consideration for the Company; it installed Hughes circuits – with its expensive type-printers – only where traffic would bear the cost, using the simple American telegraph with the key-and-inker elsewhere.

Its messages off the Hughes circuits, uniquely in Britain for the period, were printed and delivered on a paper tape pasted onto its ordinary received message form. By this system the directors claimed that "errors are almost entirely obviated", important to its principal category of customers, the mercantile class.

Then, after acquiring new powers from Parliament in 1863 authorising roadside lines, the Company began an aggressive expansion. At last free of the canals it doubled its line mileage with overhead pole circuits alongside of coach-roads and turnpikes. It never reached Ireland, only working circuits on the British mainland.

The United Kingdom Electric Telegraph Company's explosive system growth after the acquisition of its Special Act was described at the general meeting of shareholders in August 1864:

In mid-1863 the Company's entire working system comprised the long line working between London, Birmingham, Manchester and Liverpool, with some canal-side branches. It was then anticipated that its new long lines in England would be opened by the end of the year but as finance was not forthcoming these had been delayed.

The new trunk line from London north through Northampton, Leicester, Nottingham, Sheffield, Barnsley, Wakefield and Leeds to Hull, and across west to Bradford, Halifax, Rochdale and Huddersfield, to Manchester and Liverpool, encompassing as well Beverley, Chesterfield, Loughborough, Mansfield, Selby, Sheffield and Todmorden, was opened between October 1863 and March 1864.

The section from Wolverhampton to Manchester, embracing Burslem, Congleton, Hanley, Macclesfield, Stafford and Stone, was also opened between October 1863 and March 1864.

The section from Leeds to Newcastle-on-Tyne, embracing East and West Hartlepool, Middlesbrough, Stockton-on-Tees, Sunderland and Thirsk was opened between February and May 1864. The long line between Stockton, Sunderland and Newcastle was opened on February 23, 1864.

The extension from Newcastle-on-Tyne to Leith, Edinburgh and Glasgow, embracing Falkirk, in Scotland opened on May 19, 1864.

The South Wales line from Oxford to Bristol and Cardiff, embracing Gloucester and Newport opened in June 1864.

Route mileage increased from 370 miles of line and 3,020 miles of wire in August 1863 to 1,305 miles of line and 7,591 miles of wire in August 1864.

Due to pressure of business attracted by the 1s 0d message rate new circuits were also being installed on existing routes; two more between London and Nottingham, three between Nottingham and Wakefield, four more from Wakefield to Leeds, four wires from Birmingham to Wolverhampton, and seven new wires between Liverpool and Warrington. The new long line from Newcastle-on-Tyne to Glasgow also required more circuits. Most of these improvements were intended to create direct circuits between large business centres.

Completely new lines were then under construction from Bristol to Plymouth and from Cardiff to Swansea, and to Dundee and Aberdeen alongside of the Scottish Central and Scottish North Eastern Railway companies. Short branches were being erected to Greenock in Scotland, North Shields in north-east England and a few other places to complete the system.

The United Kingdom Electric Telegraph Company's long line to the West of England, almost its last, was opened to Exeter in Devon on February 3, 1865.

A total of £213,133 had been expended on works by July 1864, with another £25,000 anticipated to finish its entire network, which was intended to total 1,658 miles of line and 9,318 miles of wire.

The United Kingdom company had introduced a new tool in its campaign to extend its system. From 1862 it had had a 'road-show' led by Lord Alfred Churchill and William Andrews travelling the country for the purpose of raising 'subscriptions' in the various towns on its planned long lines, to make it a "consumers' company". They were "asking for subscribers in the towns in the country to be embraced by their telegraphic communication, giving the subscribers stamped bonds, bearing 7½% interest. The system of getting subscriptions formed an intimate connection between the towns and the company; it made the town tied to them, and that had been a great strength of the Company hitherto." The novelty was in the paying of the bond interest in *telegraph message stamps* rather than money. By January 1864 the Company had acquired 133 subscribers in Glasgow, 42 in Newcastle-upon-Tyne, 69 in Edinburgh and Leith and 53 in Hull, as well as others that totalled 734. This had increased remarkably by August 1864 to 1,148 subscribers, 1,000 of whom were people who made considerable use of the telegraph in manufacturing and business.

In May 1863 the Board of Directors explained, "To raise capital the Company issue either the ordinary shares of the Company, or bonds bearing 7½ per cent interest per annum, payable half-yearly, in advance, in frank message stamps. Thus for each hundred pound bond, the bondholder is entitled to send seven pounds ten shilling worth of messages per annum, at the tariff for the time being of the Company," adding "the amount of interest paid in frank stamps constitutes but a small proportion of the sum annually spent by subscribers in sending telegrams."

The Company had been unable to place more shares above the 26,000 already issued given the lack of dividend or prospect of such. Hence the raising of capital through "stamped bonds".

With its massive annual growth in 1864 the state of its finances was approaching the untenable. In August 1864 it had raised £104,709 on its common shares (on which no dividend had yet been paid), £28,087 in bank loans, £15,902 in debentures, £29,266 in "stamped bonds" and £37,784 in open trade accounts.

In the Board of Trade reports at the end of 1863 it had 831 miles of line and 48 telegraph stations, handling 226,729 messages; a year later it had 1,343 miles and 100 stations, with 518,651 messages; by 1865 it had 1,672 miles of line, 9,506 miles of wire, 125 stations and 358 instruments, and was working 743,870 public messages.

Table 22

United Kingdom Electric Telegraph Company
Growth 1861 - 1865

	Line	*Wire*	*Offices*	*Messages*
1861	305	1,968	16	11,549
1862	372	2,741	22	133,514
1863	831	5,099	48	226,729
1864	1,343	8,096	100	518,651
1865	1,672	9,506	125	743,870

From the 'Returns of the Railway and Telegraph Companies to the Board of Trade'

All of its principal telegraph apparatus, comprising American inkers and relays, was purchased from Siemens, Halske & Company of London. The Hughes type-printing telegraphs were bought of Gustave Froment in France.

The United Kingdom company had more than its fair share of accidents. At 11am on November 9, 1864 an explosion blew out the glass front, tore up the inner partitions and even threw over the heavy counter at its busy Liverpool station. There had been the smell of gas when the office opened and two messages had been sent to the gas office to call and inspect the pipes. A private gas fitter was then summoned who "took a light to examine the meter", causing the blast. Surprisingly the only injuries were minor cuts from flying glass. It was noted that the premises were not insured; saying something about its financial circumstances.

At the vital transmission station of the Company in Park Row, Leeds, where its long-lines north and south met, a line-man was re-insulating wire in the main switch box on December 4, 1864. Unfortunately the lamp used to warm the gutta-percha resin set the box on fire and destroyed the circuits within, isolating the office with its twenty-two instruments. Connection to London was restored by carrying an American telegraph and a battery of cells up to the roof and joining it directly to the overhead circuit wire.

In the spring of 1865, just as its circuits reached Plymouth, its most westerly station, the Company's financing became critical. The 1s 0d rate, which the competitive Electric and Magnetic companies adopted wherever the United Kingdom opened offices, had produced traffic but not profit. Its Board, in some desperation, approached the two other telegraph firms; they speedily came to a temporary, secret agreement to subsidise the United Kingdom company. This was achieved by creating a national pool for messaging; the Company being contracted by the older two firms to transmit all messages north of Manchester, sharing the total income in arbitrary proportion. This subsidy lasted three months.

In July 1865 the United Kingdom company joined the existing pricing agreement between the Electric and Magnetic companies and abandoned the 1s 0d national flat rate for twenty word messages. The three companies adopted a simple common zone tariff, 1s 0d within 100 miles, 1s 6d within 200 miles and 2s 0d beyond 200 miles, including delivery.

The struggle that the United Kingdom Electric Telegraph Company went through was summarised by W M Shaw, one of its district superintendents, in 1871:

"With the United Kingdom company it was, as you say, sir, simply a struggle for life. We started a system that none of our clerks really understood, and we had to get inferior clerks from the other companies, and we had to train them from almost the very lowest point that you could train a clerk. I may say that in Manchester, where we first started, I found it necessary myself to establish a school, or schools, so far as this, that every clerk had to be put under a system of instruction, not only of manipulation but of regulating. We started with very bad wires, and we had to use relays, which required a certain amount of training, and the company were not in a position to pay very high salaries, and consequently we got somewhat unskilled clerks. Our system was to take them into the office and put them to the instrument, and to show them the simple arrangements for regulating, and in a very short time we found that they were able to manage their instrument and to regulate it, and afterwards to obtain a knowledge of batteries; but, as I said before, we were obliged to have a small staff, and we had to make the clerks-in-charge their own engineers. It became a standing rule with me, as the superintendent of the company, that every clerk-in-charge of a small station should not only be able to regulate his instrument, but that he should be able to make up a battery, and maintain a battery, and detect a fault in the instrument, and, if a simple one, repair it. The only way in which we could do this with the higher class of instruments which we afterwards used was by giving them some five or six weeks' instruction in the use of the instrument, which I may say was Professor Hughes'. Professor Hughes came over to England and gave us three months of instruction."

It had kept construction costs of its pole telegraphs to a minimum, its "timber" was to a poor specification and they were set with fewer per mile than on other lines, 12 rather than 8 to the mile. The insulators, of its engineer's own design, were of the cheapest nature. To save further on money many of its smaller offices were accommodated in shop premises whose owners were rewarded not with rent but a share of message revenue as agents of the Company.

By 1866 as well as its Chief Office at 237 Gresham House, Bishopsgate Street, City, within what would now be called a block of offices, it had stations at 20 Cockspur Street, Charing Cross; 59 Cannon Street, City; 284 High Holborn; and 7 Mincing Lane, City, in London, working the Hughes type-printer. These effectively covered the residential and retail West End, the banking centre, the legal centre and the produce markets of the capital. In addition it had stations working the American telegraph at 2 Hercules Passage, Old Broad Street; 200 Fleet Street; 51 Mark Lane; 40 Gresham Street; and 64 New Bond Street.

Unlike the Electric or Magnetic companies, the United Kingdom did not contrive to build any regional networks to feed business into its long lines. Its principal traffic centres were London, Leeds, Manchester, Newcastle, Gloucester, Nottingham, Glasgow and Aberdeen. It also had lines to Hull, Exeter and Cardiff. This left much of England, Wales and Scotland, in particular the South and East of the country, as well as all of Ireland, without any access to its circuits.

It achieved a total of 1,676 miles of line and 9,712 miles of wire in operation by mid-1867.

Always regarded as a risky investment given the well-established competition; the United Kingdom company financed its 1,700 miles of overhead line primarily with fixed-interest preference shares and with perpetual bonds on which a substantial 7½% interest was paid in telegraph message stamps. The ordinary shareholders received very little over the life of the Company. It had had to borrow nearly 40% of its capital, an enormous burden in interest payments, although a third of this was paid in its own stamps.

After six years operation, in September 1868, the United Kingdom company achieved its maturity, and gained a valuable new source of income, by connecting its circuits with those of continental Europe through a cable between Newbiggin-by-the-Sea in north-east England and Jutland in Denmark owned by the *Dansk-Norsk-Engelske Telegrafselskab A/S*, and in the following year by another between Norway and Scotland belonging to the *Norsk-Engelsk Unterjøiskstelegrafselskab* of Christiania (now Oslo), both of which were shortly afterwards absorbed into the Great Northern Telegraph Company of Copenhagen. This valuable continental traffic was routed through the United Kingdom company's offices in Newcastle-upon-Tyne in England, and Aberdeen in Scotland.

As its final, if short-lived, triumph before it was appropriated by the government the United Kingdom Electric Telegraph Company contracted to send and receive messages for America from all of its London and provincial offices through France by the cable of the *Société du câble transatlantique Français,* despite its title, an English company, when that opened for public business on August 15, 1869. It worked in co-operation with the Submarine Telegraph Company to connect with Paris.

The United Kingdom's final Board of Directors comprised Alexander Angus Croll CE, chairman, Admiral Sir Henry Leeke KCB, KH, deputy chairman, Lord Alfred Spencer Churchill, Colonel William Elsey HEICS, the Hon Ralph Harbord, Prof David Hughes, Robert

Bryce Hay, Edward Greaves, Edward W H Schenley and George Virtue. William Andrews was secretary and manager, then earning £1,150 a year. William Powell, the consulting engineer, received £50 a year as a retainer.

Eventually the United Kingdom Electric Telegraph Company obtained a capital of £352,247 with 1,692 miles of line (10,001 miles of wire). Only £137,480 was in ordinary shares, the balance was in £112,955 6% and 10% preference shares and £101,812 in debentures and loans at from 6% to 7½% interest. In 1868 its 270 clerks and 207 messengers handled 776,714 inland messages and 30,441 foreign messages.

Somewhat surprisingly the shareholders, at their final general meeting on December 9, 1870, awarded the directors £5,000, the manager and secretary, William Andrews, £1,000 and the remainder of the Company's staff £2,000 from the government's purchase money to reward them for their contribution to its survival.

Even more surprising was the gift of a spectacular testimonial in silver plate to A A Croll, the Company's chairman, at a banquet given and paid for by the late shareholders at Willis's Assembly Rooms, 25 King Street, St James's, on March 22, 1871. The piece, in the form of a fountain, was said to have cost a thousand guineas (£1,100).

k.] **Bonelli's Electric Telegraph Company**

Gaetano Bonelli was one of the instigators of electric telegraphy in Italy in the 1840s and 1850s advocating the American telegraph and is recognised as a pioneer of communication in his own country. In 1860 Bonelli obtained an English patent for the so-called 'typo-telegraph', a substantial desk-top apparatus in which a long rectangular carriage reciprocated on a set of rails beneath a bridge holding two sets of combs of electric feelers, one for sending, one for receiving messages, at the home and distant stations. Messages were set in metallic type in a holder and inserted in the machine. The carriages at the sending and receiving stations were released simultaneously and moved under the bridge either by hand or mechanically by weights upon an acoustic signal. The set of feelers passed over the surface of the metal type making and breaking an electric circuit. Each Bonelli line required from five to twenty wires, one for each feeler circuit, depending on the definition required in the message. The resulting pulses then copied the message set in the metal onto an electrically-activated chemical-treated paper tape on the other side of the carriage in the distant station. Service messages such as "go on," "stop," and "repeat," were made by a separate wire and bell.

The Bonelli typo-telegraph instrument was first exhibited in 1862. Using paper impregnated with manganese nitrate its elements produced a brown image. Only four were ever used in Britain.

On trials in Manchester in 1863 it was found that a single clerk could 'set-up' twenty to twenty-five words in brass metal type in about 85 seconds and slide it under the feelers in six seconds. It was claimed that 20,000 words an hour printed in type could be transmitted by these means; a more realistic claim was for 200 words a minute. However each dispatch received on the chemically-treated tape had to be passed under a stream of water, blotted off, dried by hot rollers and put into an envelope before delivery.

Bonelli's Electric Telegraph Company was formed by the owner of Bonelli's patent, Henry Cook, an American, of 69 Lincoln's Inn Fields, London, and Eastbourne, in August 1860 with an initial capital of £25,000, and obtained an Act of Parliament on June 28, 1861 to acquire the patent and work it throughout the United Kingdom. Its secretary was Simon Rendall, a lawyer, also of 69 Lincoln's Inn Fields, London, used as the Company's offices. Although Bonelli's telegraph was shown in the Italian section of the International Exhibition of 1862 it stalled for some years and it was not until July 1863, when it acquired a further Act to increase the Company's powers and capital, was progress made.

Exploitation of the Bonelli patent had had to wait until after 1862 when the protection provided by the competing patent of Frederick Bakewell for his chemical copying telegraph of 1848 expired.

At the General Meeting of February 2, 1863, Edward Grundy, a Manchester merchant, in the chair, revealed that the Company was "formed to test and if successful introduce Bonelli's telegraphic machines." It had lines in progress between Manchester and Liverpool, and "a number of lines connecting various important towns in the neighbourhood of Manchester," intending to have twenty stations along 120 miles of line with 900 miles of wire. It had, so far, expended "no promotional money".

In March 1862 Bonelli's company stated that it intended to install a total of *fifteen* overhead wires from its office in Dale Street to Market Street, along Deansgate to the New River, which it was to follow to Liverpool, for completion by August. In fact it took until September 1863 to complete the Manchester to Liverpool circuit.

The long experimental line originally had what might be called a 'high definition' printing circuit of eleven wires, plus extra service wires; this was reduced to a lower definition of five wires with one service wire by February 1863. It required a substantial 300 cells, sixty cells per wire, to work a single circuit.

According to N J Holmes, a competitor, Bonelli's business model in 1863 was based on "a cheap tariff for paid public messages and an annual income on capital account derivable from the letting of private wires to manufacturers, and the selling of rights-of-way along their poles to any person applying".

The Company obtained its second Act of Parliament on July 28, 1863, which optimistically authorised a capital of £250,000, as well as powers to take on debenture debt, and it issued a new prospectus for a national network of Bonelli telegraphs.

In 1863 Bonelli's "new" company attracted the Earl of Shrewsbury & Talbot to the chairmanship, as well as several substantial Manchester and Liverpool businessmen, including the glassmaker, John Pilkington. The power in the company still rested in the hands of Henry Cook, who styled himself managing director. He anticipated receiving £25,000 for the Bonelli patent, in return paying all the promotional expenses and settling outstanding debts, once the company was launched nationally. He also sought to buy out the circuits and wayleaves owned by the Economic Telegraph Company (q.v.) in Manchester to extend Bonelli's network.

It completed an experimental five message- and one service-wire line, a single Bonelli circuit, between 2 Dale Street, Liverpool and 2a Victoria Street, Manchester in northern England on September 19, 1863. Except for an underground section between Garston and Liverpool, this was erected roadside on poles. It charged a flat rate of 6d for a twenty word message, printing and issuing Telegraph Stamps in 3d, 6d, 9d and 1s 0d denominations, accounted as 3d for every 10 extra words.

The Company also produced for sale two books of 3d stamps; one containing with seven pages of twelve franks, the other with seven pages of six franks, stitched into paper covers.

The Bonelli company's largest engineering work was an aerial cable across the Mersey at the Runcorn Gap, supported on two 136 foot tall wooden masts. The aerial cable was carried away in a gale in December 1863 and the circuit between Liverpool and Manchester only restored in February 1864. It was damaged again by a ship's mast in March 1864, but speedily repaired.

On April 25, 1864, Bonelli's company was surprised to see the following in the Manchester newspapers:

"The Bonelli Telegraph System: The Directors of the United Kingdom Electric Telegraph Company (Limited), having seen it stated by the Bonelli Telegraph Company that the Bonelli instrument is more rapid and can be more economically worked than any other instrument, whilst it produced the message printed at both ends simultaneously, thus guarding against errors, beg to inform the public that the Hughes printer, the sole right to work which is possessed by the United Kingdom Company, requires only one wire instead of five, that the messages do not need first composing with type, nor any chemical solutions, that the messages are printed in ordinary print by the current itself at both ends simultaneously, and that only one clerk at each end is required to work the apparatus. The Directors of the United Kingdom Company challenge the Bonelli Company to a competitive trial of the system they propose with the system of the United Kingdom Company between Liverpool and Manchester, and are prepared to prove the Bonelli system, wire for wire, to be slower, infinitely more costly, and, from the number of wires required, impracticable. By order, W Andrews, Secretary."

Although initially welcoming the challenge, James Gutteres, the Bonelli company's secretary, contrived to avoid a direct comparison, and all that happened was a public display of the Bonelli machines in Manchester on May 2, 1864. This evasion cannot have helped the Bonelli company's cause.

However Henry Cook was a determined man. He had his son, Harry Whiteside Cook, take Bonelli's typo-telegraph apparatus on a tour of northern English and Scottish cities, during April and May 1864, even visiting Dublin and Belfast in Ireland; demonstrating the new telegraph to potential investors and journalists in mercantile exchanges and public halls across the country.

For much of its short life the Company's board of directors consisted of the Earl of Shrewsbury & Talbot, chairman, Erskine Beveridge, Dunfermline, Albert Cooper, Manchester, Frederick Elin, London, Edmund Grundy, Manchester, Charles Stewart, Manchester, Henry Cook, Manchester, managing director, William Hamilton, Manchester, Charles Trueman, London, and William Hardinge Tyler, London.

James Gutteres, the Magnetic company's London manager, joined Bonelli's as Secretary in London, on a salary of £200 a year. Robert Valentine Dodwell, who had previously been the Magnetic company's engineer in Manchester, managed its works, which were completed by Thomas Robinson & Son, timber merchants and manufacturers, of Oldham Road, Rochdale. Warren Thompson, an American, was employed as electrician. Its Bonelli printing instruments were manufactured by Elliott Brothers of 268 High Holborn, London, makers of scientific instruments.

As well as facing fierce commercial competition, the share issue in March 1864 was ignored by the public and the Economic Telegraph Company sued for its money. The Courts froze its bank account and Bonelli's company failed in June 1864. By 1865 it was looking to lease its wires to other telegraph companies.

In keeping with the tradition of telegraph companies having obscure and recondite mottoes, that for Bonelli's was *Noi usitata nec tenui ferar penna*, "I have not been borne by the accustomed wing, nor have I held the accustomed pen."

In 1867 its rump fell into the hands of Alexander Collie, a cotton-speculator from Manchester, who contrived to sell its rights to the government when it created a telegraph monopoly. The directors of the defunct company had been willing to sell-out for £5,000 but Collie challenged the valuation and got £22,000 from the Post Office, receiving 25% of the purchase money as his reward. In their final years Bonelli's and the South-Western of Ireland Telegraph Company shared the offices of Collie & Company at Leadenhall Street in London.

l.] **The Economic Telegraph Company**

The Economic Telegraph Company was established in August 1863 at Corporation Street, Manchester "prepared to construct and maintain private telegraph wires for merchants and others, between their mills, warehouses and private residences." It was formed by James Edward McConnell of 2 Dean's Yard, Westminster, whose address was also its "Chief Office", and George Hinton Bovill, of 24 Duke Street, Westminster and

Durnsford Lodge, Wandsworth. McConnell had until March 1862 been locomotive superintendent of the London & North Western Railway, and had joined with Bovill, a well-known mechanical engineer, in the mid-1850s to acquire several metal-working patents. McConnell was closely associated with William Fairbairn's engineering works in Manchester.

McConnell and Bovill seem to have had a plan to create a "saleable" concern; assembling sufficient assets in the way of legislative authority and rights of way that together would pose a threat to existing telegraphic interests. This was a tactic that had grown up in the railway world during the 1850s and 1860s with a proliferation of over-capitalised branch lines that offered themselves for sale to competing, established major companies. As part of this, McConnell and Bovill contracted in August 1863 for Thomas Robinson & Son, timber merchants, of Rochdale who had supplied poles to the Universal Private Telegraph Company and Bonelli's Electric Telegraph Company, to construct 94 miles of private wires, all on poles or roof-tops, in Manchester and Liverpool for £5,500. In addition to this they negotiated a series of twenty-one year wayleaves or rights of way in 1863 and 1864 alongside of the waterways across northern England from Liverpool to Hull totalling 400 miles. They commenced with the Aire & Calder Navigation Company, owning thirty-three miles of waterways between Leeds and Goole, and a branch of seven-and-a-half miles from Wakefield to Castleford, on August 21, 1863. This was followed quickly with the Calder & Hebble Canal, owning twenty-one miles of waterway between Wakefield and Sowerby Bridge, the Bridgewater Canal Trust, with a waterway between Liverpool and Manchester, and the Manchester, Sheffield & Lincolnshire Railway Canals which connected Manchester with Ashton and Macclesfield. They also created the *Economic Telegraph Company* as a simple partnership, to work private wires.

On January 9, 1864 McConnell and Bovill agreed to sell their assets to Henry Cook, managing director of Bonelli's Electric Telegraph Company, for £11,000, and to assist in extending that company nationally. Although Bonelli's took over the working of their lines the deal collapsed and Bovill sued Bonelli's, obtaining an order to stop their very limited bank account and effectively ending the company's existence in June 1864.

In the latter half of 1864 the Economic Telegraph Company took back its Manchester and Liverpool lines and the private wire contracts there before launching into *public* telegraphy with a small local network during September, advertising a local message rate of 6d for twenty words, and making arrangements for the interchange of messages with other companies. Its public system extended, allegedly, over 12 miles of line, from Manchester to Oldham, Stockport, Buxton and Bolton, and "nearly" to Liverpool.

On November 21, 1864 the Magnetic Telegraph Company noted that the Economic company had opened a public line between Manchester and Oldham, and was offering a service from Manchester to Liverpool and London. It collected a range of stationery from the new concern. The rate for twenty words from Oldham to Manchester was 6d, to Liverpool 1s 0d, and to London 1s 6d. The distant destinations were offered in co-operation with the United Kingdom Telegraph Company. It had attracted Charles Frederick Clyatt, formerly clerk-in-charge of the Electric Telegraph Company's Manchester office, who in 1863 was practising as a telegraph engineer in that city, to its employment.

The Magnetic soon ensured that the working in pool with the United Kingdom company ended; Mr Clyatt moved on and, in April 1866, felt it necessary to advertise the fact in the newspapers. That was the end of the Economic company's foray into public telegraphy.

The Economic Telegraph Company completed registration for joint-stock limited liability under the Companies Act 1862 on December 15, 1865. It had then, and for several years subsequently, seven shareholders, the minimum allowable in law.

In July 1865 the Company was widely advertising the "Abolition of High Rates for Private Telegraphs" in Liverpool, Manchester, Leeds, Bradford and Birmingham. It offered line rental at £2 per mile per annum, and new French instruments, that "can be worked and read by anybody" at a rental of £2 per annum each.

Unperturbed by its set-backs, McConnell and Bovill, the proprietors of the Economic Telegraph Company, found the money to obtain an Act of Parliament on July 16, 1866 with a capital authorised at £100,000 and powers to raise an additional £25,000 by borrowing.

The new manager was David Leon Bensusan, with offices at the Economic company's former public station at 6 Lord's Chambers, Corporation Street, Manchester. He was to receive a salary of £156 per annum (£3 per week) and the cost of his railway season ticket into Manchester, £34 a year.

It worked the Breguet galvanic dial telegraph in all its circuits, with electric bells made by local artisans.

On June 29, 1866 McConnell was writing to the Earl of Caithness, director of the Electric Telegraph Company:

"I have been organising the formation of a body of gentlemen who agreed to carry out the development of our system and to find the whole capital (which unless otherwise disposed of) will now be done and we can see our way to make it pay well with private wires working in connection with public messages at low rates."

"We have at present about 100 miles of poles and wires radiating from Manchester. We have very valuable leases of rights of way over all the canals and navigations from Liverpool to Hull, including the Bridgewater Navigation, the Manchester, Sheffield & Lincolnshire (Railway) Canals & Navigations, Calder & Hebble Canal, &c."

"We consider the property now the Act is obtained worth £12,000 which the new company is to pay for all the wire rights of way and a present rental for private wires of around £300 a year. If it is worth the serious consideration of your company to acquire us and our

Act it will have to be done at once before the shares are allotted."

McConnell and Bovill met Henry Weaver, secretary of the Electric Telegraph Company, on July 12, 1866. They claimed to work 127 miles of private wire and to rights over the property of the Bridgewater Trust, the Lancashire & Yorkshire Railway and the Aire & Calder canals, with overhead private wires in Liverpool and Manchester. They added that there were 70 miles of public wires "not at present employed". Since the pair were unable to provide any detailed accounts the Electric let the offer pass on July 30.

After this rejection none of the many canal and railway wayleaves negotiated by the Economic company were to be used for public telegraphy.

Charles Edward Matthews of Matthews & Smith, solicitors, of 29 Water Street, Birmingham, was writing to the Post Office on July 19, 1868 reiterating the offer made to Lord Caithness two years earlier. He repeated the list of assets, the canal rights and the Act of Parliament, indicating that £8,100 had been expended as capital and that its wires produced £300 a year in rentals. The principle directors seem to have been Henry Howell, of 47 Anne Street, Birmingham, an accountant, and Jonah Andrew, of Moseley, Worcestershire.

By 1868 the Company had seventeen private wire clients: nine in Manchester, Rylands & Son, Manchester warehousemen, with four circuits, S Hodgkinson & Co., yarn and cloth commission agents, G Andrews & Sons, cotton spinners and calico printers, F W Ashton, calico printers, S Schwabe, calico printers, Berger Spence & Co., chemical manufacturers, Chorlton Union, municipal authority, Thomas Milner & Son, Phœnix Safe Works, and Sharp, Murray & Co., manufacturers of ginghams and checks, contributing £234 in that year; eight in Liverpool, Hamilton's Windsor Iron Works of Garston, Higginson & Co., ship-owners, D Chadwick & Co., of Wavertree Rope Works, J Morrell & Co., provision merchants, Fairrie & Co., sugar boilers, Midland Railway Co., Blood, Wolfe & Co., brewers, and Carstairs, Drysdale & Co., merchants, all with single circuits, producing £170. Its commonest annual rental was around £18 a year. Its expenses included 60 wayleave agreements for poles and wires in Manchester, costing £18 per year, and 90 similar wayleaves in Liverpool that cost £9. The Breguet instruments were then in poor condition and its locally-made bells "all defective".

The line rented of the Economic company by Salis Schwabe & Company, calico printers and bleachers, running between their office in George Street, Manchester, and their great Rhodes' Mill, near Middleton, five miles distant, with two Breguet instruments and bells at £24 a year, is probably typical of the many private wires leased in the textile districts of Lancashire. This was the only contract that survived into 1871.

As four years previously, the chief office of the Economic Telegraph Company was still at 2 Dean's Yard, Westminster, where Charles Holmes was Secretary, on July 17, 1869. On that day the proprietors met and signed the assignment of its assets to the Post Office.

The government agreed to pay £15,000 for its network of private circuits in 1870, acknowledging its £8,000 valuation and paying twenty-years purchase of its rental income. Examination of its cash-book, which commenced in July 1866, showed that the Economic Telegraph Company had never made a profit and that the manager's salary and expenses consistently absorbed half the company's revenue. Mr Matthews, the Company's solicitor, had to harass the Post Office until 1875 to get the final instalment of its money.

m.] **Reuter's Telegram Company**

Reuter's Telegram Company was the last substantial domestic company to be formed, on February 15, 1865 with an initial paid-up capital of £80,000, before the British state took over. This did not offer direct public access as it was projected as a speculation by Julius Reuter to acquire his telegraphic news agency and, more importantly, the 30 year rights to a new underwater cable between Lowestoft in Eastern England and Norderney in Hanover, on the North German coast. Reuter displaced the Submarine Telegraph Company who previously had the Hanoverian landing rights. To fund the new cable Reuter's capital rose to £250,000.

The 224 mile long Norderney cable was engineered by Fleeming Jenkin, a former employee of R S Newall. Construction of its four-wire circuit was let to the Telegraph Construction & Maintenance Company, who took one-quarter of the cost in shares, and then subcontracted the work to W T Henley's Telegraph Works Company. It was a massive cable, the main part weighing 10½ tons to the mile, the 20 miles at the shore ends, 20 tons a mile; completed and in circuit on October 3, 1866 at a cost of £153,000 including its landlines in Hanover. Reuter's company also possessed rights over lines connecting Norderney with the towns of Hanover, Hamburg, Bremen and Cassel granted by the government of the then independent German state of Hanover. After Prussia absorbed Hanover in July 1866 the concession was renewed but the cable head office had to transfer to Berlin. Reuter contracted with the Electric company to send and receive public messages for Europe and the Orient using one-quarter of the cable's capacity, in concert with that company's own Holland cables, for a period of five years from its completion.

The enlarged Company was something of a speculation; its board of directors comprised John Dent, Sir John Dalrymple Hay, Bt, MP, FRS, Col James Holland (London & South Africa Bank), John Sydney Stopford (Agra & Masterman's Bank), and Julius Reuter. Its secretary was Frederick John Griffiths, who had joined Reuter in 1851 as a twelve-year old messenger.

It is not immediately clear why Reuter's Telegram Company was included in the government's appropriation scheme, as it had no circuits in Britain. It is probably sufficient to say that Julius Reuter and the other proprietors knew a good thing when they saw it. They were to receive a total of £725,000 for a company capitalised at £250,000.

Alone among the companies appropriated by the government Reuter's Telegram Company was reorganised in 1868. It then reverted to being a foreign news agency, with its original capital of £80,000. As a point of detail, there has never been a Reuter's "Telegraph" Company; the firm's only name change since 1865 dates from 1916 when it became Reuters Limited.

n.] **Det Store Nordiske Telegrafselskab A/S**
This was the only foreign-owned telegraph company to access British circuits (if one excludes the French-registered Submarine Telegraph Company with its predominantly English capital); providing the continental connection of the United Kingdom Electric Telegraph Company. Known then and now as the *Great Northern Telegraph Company*, it was a merger of the Danish, Norwegian & English, the Danish-Russian and the Norwegian & English Submarine Telegraph Companies, incorporated in Copenhagen, Denmark, on June 1, 1869, with a capital of £400,000. The engineer responsible for its works was the Englishman, Nathaniel John Holmes.

The Danish, Norwegian & English Telegraph Company had been established on January 10, 1868, with a capital of £100,000 and the assistance of R S Newall, the makers of the original Channel cable, to connect those three countries with two cables. It also had financial support from the Danish government, without which it would not have been able to proceed. A few months later, on August 12, 1868, the Danish-Russian Telegraph Company was created in Copenhagen with a capital of £75,000. This series of cables in the Baltic Sea was enabled by a subsidised message rate from the Russian government, making it economically viable, to ensure that it had access to Britain and the rest of the world without passing through Prussia or France. The Baltic cables were made and laid by W T Henley of London.

The Norwegian & English Submarine Telegraph Company had been formed in Christiania, Norway, to connect to Britain avoiding Denmark; the closest point for landing the circuit, incidentally, being in Scotland, not England! This, too, was made by W T Henley.

The cores of all of the Great Northern company's early cables, before armouring and laying, were manufactured with india-rubber insulation by Hooper's Telegraph Works Company of London.

The Great Northern Telegraph Company owned on its formation six underwater cables: the Danish – Norwegian, the Moen – Bornholm (Denmark to a Baltic-Danish island), the Bornholm – Libau (to Russia), the Norwegian – Scottish (with a cable-end at Peterhead, Aberdeenshire) and the Swedish – Russian underwater cables; as well as the original Danish – English cable (the cable-end being at Newbiggin-by-the-Sea, Northumberland). As much of its capital originated in Britain it maintained an administrative office in London.

The original cables were:

Sondervig to Newbiggin	334 miles
Hirtshalts to Arendal	66 miles
Moen to Bornholm and Libau	304 miles
Egersund to Peterhead	270 miles
Grislehamn to Nystad	96 miles

It also acquired in 1868 the lapsed Danish concession for the North Atlantic telegraph that intended to connect Scotland, the Faroe Islands, Iceland, Greenland and Canada by a series of short cables. This had been promoted by several British and American interests since 1854 but was never to be started.

The Company's English cable was opened on September 10, 1868 and the Scottish cable was completed on August 21, 1869. Within Britain, the Great Northern also built and owned a 33 mile overland circuit from the cable-end at Newbiggin to the city of Newcastle-upon-Tyne in England, and a 30 mile land circuit from its cable-end at Peterhead to Aberdeen in Scotland.

In 1870 the Great Northern company leased a land line of the Russian government from Moscow across Siberia to Lake Baikal and Kiachta on the Chinese border and hence to Posietta Bay on the Pacific coast from where it had Hooper's Telegraph Works Company of London lay a 1,200 mile underwater cable to Shanghai and one from there 1,100 miles on to Hong Kong in 1870; anticipating another cable from Posietta to Japan. The Company obtained a 30 year concession of the Imperial Russian authorities in return for 40% of its extension's income. The message charge was to be 100 francs or £4 for twenty words from St Petersburg or Moscow to any station in China or Japan.

The Great Northern's land lines and cables were worked throughout from the beginning with Wheatstone's automatic telegraph and Varley's repeaters.

The Great Northern Telegraph Company is the only telegraphic concern mentioned in this work that still operates today.

o.] **The Indo-European Telegraph Company**
The Indo-European Telegraph Company was founded in 1868, just as the government was legislating to appropriate the domestic telegraph companies. It was almost certainly intended to be a successor-enterprise for the proprietors and management of the Electric & International Telegraph Company. The Chairman of the 'Indo' was Robert Grimston; the Secretary and Manager was Henry Weaver, who had identical positions at the Electric. Its head office was at 16 Telegraph Street, next to the General Offices of the Electric company. Julius Reuter had a substantial interest.

The Indo-European Telegraph Company was incorporated under the Companies Act 1862, as a simple joint-stock limited-liability company with a share capital of £450,000 in seventeen thousand shares each of £25 to construct an overland telegraph to India by special lines, in connection with the government of India cables, through the Persian Gulf. An annual income of £85,000 was expected from 200 messages a day, which would provide a yearly dividend of 20%.

This capital compares with the £2,500,000 raised by the domestic telegraph companies, the £1,200,000 of the British-Indian Submarine Telegraph Company and the £250,000 of the Anglo-American Telegraph Company.

The Indo-European Telegraph Company was registered and projected on April 8, 1868 to complete a line from London to Calcutta in competition with a planned all-submarine route. The circuit extended from Lowestoft to Emden in Prussia, then to Berlin to Thorn on the Vistula river in West Prussia, into Russia to reach Warsaw, Zhitomir, Odessa, Kertch, Sukhumi, Tiflis, Erevan, then to Djulfa in Persia through Tabreez to Teheran, then to Bushire on the Gulf, underwater to Kurrachee, through India to Calcutta on the Gulf of Bengal. Of the capital of £450,000, 80% was taken up in Britain and 20% by the Siemens companies in London and Berlin. Siemens financed their shareholding through the Rothschild, Schaafhausen and Mevissen banks.

The Siemens family were the power behind the Indo-European: they involved their three manufacturing companies, in Berlin, St Petersburg and London. They had used their close relationships with the director of the Royal Prussian Telegraphs, Colonel of Engineers Franz von Chauvin, and the head of the Russian telegraph administration, General of Engineers Karl Karlovich von Lüders to facilitate the concessions in those countries for the line in 1867. In addition the concessions for circuits through the dangerous territories in the Caucasus were negotiated by members of the Siemens family. Werner, Walter, Otto, Karl and William all visited Georgia in connection with the telegraph lines in the Caucasus from Tiflis to Kutaisi, Poti and Djulfa, and the separate wire from Tiflis to Baku. Siemens were to be paid £400,000 for the construction of the Indo line and £34,000 a year subsequently to maintain its length.

Siemens Brothers in London and Siemens & Halske in Berlin jointly acquired a 25 year concession of the Russian government in St Petersburg for transit rights across the Empire to the Caucasus on October 22, 1867 in preparation for the scheme.

The Russian Viceroyalty of the Caucasus was on the margins of the Empire; it had been nominally subdued in a vicious war in the 1830s but was in a constant state of tribal unrest. The Russian Army had a substantial presence and required communications. Lüders had managed the creation of a basic military telegraph from Moscow to Tiflis in Georgia and Erevan in Armenia. Although this had been relatively inexpensive to construct, just a single wire on wooden posts, it was expensive in money and lives to maintain. Lüders was convinced that this militarily-essential telegraph could be made more efficient by having the English mercantile interests in London and India pay for a replacement, effectively subsidising Russian communications. The risks of wires through the Caucasus were such that Siemens proposed an in-shore underwater cable between Kertch and Sukhumi rather than land-lines in the interior. The gangs erecting the line in the Caucasus and in Persia were given an armed escort of cavalry.

Although Walter Siemens was initially unsuccessful in Teheran after several months of talks, Georg Siemens eventually convinced the Persian government to accept 12,000 Tomans per annum on January 11, 1868 as the price of the wayleave, as well as a share of the cost of each message sent through its wires.

The commitment of the Siemens family to the Indo was total; Walter Siemens, on his way home from Persia in 1868, and Otto Siemens, supervising the construction works in 1871, both died of illness in the South Caucasus and are buried at Tiflis in Georgia.

The whole line from London to Calcutta was to be 6,900 miles in length. Of the 3,725 mile segment of this circuit between Emden and Teheran the Company were required to build 2,900 miles as new through Russia and Persia, as well as the 110 mile submarine cable in the Black Sea between Kertch and Sukhumi. For part of the line, through the wild Caucasus and Persia regions, cast-iron poles with iron capped insulators for its overhead wires were used. The bulk of the materials were provided from Britain by Siemens Brothers.

The Indo directly owned only the circuit between Emden and Teheran, it leased circuits from the Electric in England, from Reuter in the Norderney cable from Lowestoft to Hanover, Persian overhead lines south of Teheran, the 1,400 mile long British-Indian cable from Bushire to Kurrachee, and across India to Calcutta. As part of its concessions the Indo provided an extra third circuit in its Black Sea cable, as well as through the Caucasus and on its Persian overhead lines for Russian and Persian domestic traffic.

The *königlich preussischen Telegraphen-Direktion*, Royal Prussian telegraphs, constructed a line of two wires from Norderney to Thorn on the Russian border. Siemens continued these two wires from Thorn to Balta by way of Warsaw in Russia, using heavy oak poles. They continued their construction to Odessa, Kertch and Ekaterinodar in the north Caucasus. These wires were on Siemens patent iron posts. There was a four mile cable under the Dnieper river and a fifteen mile cable across the Straits of Kertch, as well as the longer three-core Black Sea cable to Sukhumi.

For the Persian sector Siemens shipped 11,000 iron posts, 33,400 insulators and 900 miles of iron wire from St Petersburg to Astrakhan on the Caspian Sea by the Neva and Volga rivers and canals. These were then taken by ship to the Persian Caspian ports of Lenkoran, Astora and Resht.

Of the new construction, the three wires of the isolated Persian section between Djulfa on the Russian border and Teheran, 480 miles, was opened by the Indo in August 1868, connecting to Erevan and Tiflis.

The circuit was completed after two years construction throughout to Calcutta on April 12, 1870.

The short underwater cable was almost immediately broken by an earthquake on July 1, 1870, and had to be replaced by a coastal land line during 1871.

The Company adopted Siemens adaptation of Wheatstone's automatic telegraph for its circuits and Varley's relay that allowed point-to-point transmission on its very long lines. It advertised that all of its messages were received on recording inkers for accuracy and that it used the English language with English operators throughout its system.

A twenty word message from London to Calcutta was estimated as costing £3 10s, this was to be split between the Electric Telegraph Company and Reuter's Telegram Company 3s 3d, Prussia 1s 9d, Russia 3s 6d, Persia 8s 0d, the British India cable between Bushire to Kurrachee 16s 3d and for the Indian telegraphs 8s 8d, totalling £2 5s; the balance going to the Indo-European Telegraph Company. The agreement for these rates was negotiated with the recalcitrant Prussian and Russian members of the International Telegraph Conference by William Siemens personally.

In 1870 messages could be sent from any office of the Electric & International Telegraph Company or from the offices of the Indo to Calcutta, Bombay, Madras and all places west of Chittagong. Messages reached Teheran by automatic relay in just *one minute*; Calcutta was reached in twenty-eight minutes.

The Department
The Indo-European Telegraph Company is often, and unsurprisingly, confused with the Indo-European Telegraph Department of the British-Indian government. The Department worked overland telegraphs in South Persia to connect the lines of the Ottoman Turkish system and the British cables to India. It was based on a convention between London and Teheran dated February 6, 1863. A line was erected by government engineers between Khanaquin on the Persian-Ottoman border by way of Hamadan and Kermanshah to the British-Indian cable head at Bushire on the Gulf coast. This was opened for messages on March 1, 1865. As messages on the Department's line had to be transcribed twelve or fourteen times, by Armenian, Greek, Turkish, French and Italian clerks, the messages in that year took an average of 6 days, 8 hours and 44 minutes to travel from London to Kurrachee.

A further convention in April 1868 allowed the Department to build an overhead line from Bushire along the Persian coast to Gwadur in British India which was connected to Kurrachee so as to avoid reliance on the underwater cables.

The *average* message times for telegraph messages between London and India, showing the improvements in the Ottoman circuits and, in particular, the effect of the Indo-European Telegraph Company, were:

via Turkey	*Days*	*Hours*	*Minutes*
1865	6	8	44
1869	5	14	13
1871	1	17	55
1873	0	19	12

via Russia	*Days*	*Hours*	*Minutes*
1865	17	5	5
1869	9	10	39
1871	0	8	37
1873	0	3	9

The alternative, riskier submarine cable, sponsored by the Magnetic company's interests, was to be laid across the Bay of Biscay, into and along the Mediterranean Sea, down the Red Sea and across the north Indian Ocean. This was completed in 1871.

The Indo-European Telegraph Company was not affected by the government's acquisition policy.

Apart from the obvious break in working between August 1914 and August 1923 the Indo was in continual operation until its concession in Persia was terminated in 1931, and the wires abandoned. Siemens engineering was so substantial that its iron posts of 1870, each still with three iron-capped insulators, are still visible on the Caucasian coast and in the Persian desert.

It was here that the era and the legacy of W F Cooke, Charles Wheatstone and the Electric Telegraph Company, the first 'Lords of Lightning', finally ended.

n.] **Other Companies**
Several railway companies worked public telegraphs independently of the telegraph companies:

The South Eastern Railway Company
The South Eastern Railway had the fourth largest mileage of public electric telegraphs in Britain. It had an original Cooke & Wheatstone licence dating from 1841 and connected with the Electric company for national messages. Its superintendent, C V Walker, made serious contributions to electrical science; in railway signalling, cable-laying and the precise transmission of time signals from its station at Greenwich Observatory to its terminus at London Bridge.

The railway opened its telegraph system to the general public on September 1, 1846, connecting all its stations between London and Dover, Folkestone, Ramsgate and Margate.

In March 1850 the South Eastern Railway's entirely self-contained system comprised 182 miles of line with 47 telegraph stations, these utilised 77 instruments and 2,200 galvanic cells. All of these circuits were in the form of No 8 gauge galvanized iron wire suspended from brown earthenware insulators on wooden posts. Its equipment was entirely to Cooke & Wheatstone's patents, with two-needle and one-needle apparatus for messaging, and magnets-and-bells for train management. The railway company organised its circuits in a similar manner to those of the Electric Telegraph Company, with stations arranged in closed groups or divisions of six or seven.

For some years, between 1845 and 1851, the railway's circuits from the English Channel ports of Dover and Folkestone had a profitable monopoly in news reports from Europe for the London papers. This was especially so in the revolutionary year of 1848.

On January 10, 1849 the *Princess Clementine* with C V Walker on board steamed out of Folkestone harbour into the English Channel towards France paying out a weighted gutta-percha insulated cable made by J & T

Forster of Streatham. At 12.45 pm he used a single-needle telegraph to exchange greetings with the South Eastern Railway Company's board of directors at London Bridge station over two miles of submarine wire and 83 miles of land line. Later in the day Walker reeled-in the cable and was to re-use it in a railway tunnel, leaving it to others to complete the underwater telegraph to France.

Walker and the South Eastern Railway continued to be involved in underground and underwater telegraph cables. Its first experimental gutta-percha insulated wire had been bought of J & T Forster on November 11, 1848. Eight wires made by Forster's for the railway were laid in two metallic tubes through Folkestone harbour in September 11, 1850. They were still viable in 1859. A two-core cable was laid under Deptford Creek on January 6, 1853, and another under the Stour river at Sandwich on August 30, 1853. Its underground wires were then made by Nickel's Gutta-Percha Company of Lambeth. On March 12, 1859 Walker used Silver's newly-patented india-rubber insulated wire for a cable through the Martello Tower tunnel at Folkestone.

Charles Dickens' 'Household Words' magazine called upon Walker at Tonbridge in 1851, publishing the interview with the title "Wings of Wire":

"In the telegraph room at Tonbridge, the central station of the South Eastern Company, we find the superintendent of that system, Mr C V Walker, seated before a very business-like, but in a way remarkable, table, covered with papers. The apartment is small; for science, again, claims but little houseroom. Upon the shelf, are a few specimens of apparatus. On one side of the wall, run numerous electric wires, concentrating above a kind of side-board or counter, on which there stands a row of the telegraph instruments, looking at first glance, not unlike the counter-fittings of a very gay public-house; on close observation, like the fronts of little mahogany churches, with very large clocks. Under the counter you may see a number of galvanic batteries - wooden troughs filled with alternate plates of copper and zinc, buried in sand that has been saturated with sulphuric acid water. These batteries generate the electro-galvanic fluid that is to be sent on its eternal round through wires and earth, the interpretation of which is to set the needle in motion that messages may be read between Tonbridge and London or Dover, or any other station on the line."

"Some of the instruments have, on their large clock-looking faces, only one vibrating needle, whilst others have two. The needles, in the improved instruments, are much smaller and lighter than those first constructed; it being naturally demonstrated by experience that the smaller needle turned the more readily and quickly on its axis."

"Mr Walker's fairer and better half is mistress [of the telegraph alphabet], and both despatches and reads messages with great facility, by a little electric telegraph established between the Tonbridge Station and his private house."

The mystery of the telegraph evaporated quickly in regular service on the railways, in one instance the message was asking that "a pounds worth of coppers" be sent by the next train to make up the change in the station's till.

The South Eastern Railway's telegraph stations divided into three categories: those at London Bridge, Tonbridge, Ashford, Folkestone and Dover were open twenty-four hours a day; Red Hill, Reading, Tunbridge Wells, St Leonard's, Hastings, Maidstone, Canterbury, Deal, Ramsgate, Margate, Blackheath, Woolwich Arsenal, Gravesend and Strood were open from 7.30am until 10pm during weekdays and between 8am and 10am, 1pm to 3pm and 6pm to 9pm on Sundays to allow attendance at Divine Services; all of its other stations were open 8am to 8pm each weekday, and 8am to 10am and 7am to 8pm on Sundays.

During 1855 the railway had 285 miles of telegraph line and 1,083 miles of wire, with 73 stations and 130 instruments. In that year it transmitted 35,698 public messages.

Its message rates for twenty words from January 1, 1856 on its own circuits were 1s 0d for twenty miles, 1s 6d for from 25 miles to 50 miles and 2s 0d beyond 50 miles. Addresses were sent free but there was a 1s 0d additional charge for messages sent on Sunday. Until the mid-1860s these were the only telegraph circuits in Britain that worked on the Sabbath.

The railway introduced its own telegraph stamps on September 1, 1860. In the following year of 1861 it had 309 miles of line, 2,432 miles of wires, 89 telegraph stations and 135 instruments to work 55,085 messages.

In May 1862 Walker had a very special pair of miniature single-needle telegraph instruments made at the railway's instrument works at Tonbridge for the visiting Viceroy of Egypt, carrying the Pasha's monogram on their faces. They were permanently connected by a 30 yard cable clad in green silk, made and insulated with india-rubber by Wells & Hall in Southwark. It was identical with a set of portable telegraphs used on Queen Victoria's royal railway trains. The set was delivered to the Viceroy's yacht off Greenwich. The vulgar press claimed it was to be used in his *seraglio*.

By 1863 the South Eastern Railway had 316 miles of line and 2,642 miles of wire with 94 public telegraph stations and carried 62,968 messages. There were in all 299 stations divided into 1) 94 public stations and 205 railway-business stations, 2) 138 speaking and 161 non-speaking stations, 3) 152 bell stations for signalling, 96 bell stations for hearing only, 51 non-bell stations, and 4) 161 stations with bells only, 56 stations having instruments and bells for public use, 31 stations having instruments and bells for railway use, 38 stations with instruments only for public use, and 13 stations with instruments only for railway use. The system was worked with Cooke & Wheatstone needle instruments and C V Walker's bells by 6,900 cells, mostly Walker's graphite batteries.

In April 1864 the South Eastern Railway established working arrangements with the Magnetic and London District Telegraphs for the exchange of messages, as well as with the Electric.

In 1865 the South Eastern managed 323½ miles of line and 3,064½ miles of wire. There were then 104 public telegraph stations working 159 instruments, sending 88,711 messages and producing £6,000 in income.

Although long connected with the Electric company the South Eastern Railway granted wayleaves to the Magnetic Telegraph Company for circuits over its rail lines when the Magnetic had to replace its failing roadside gutta-percha cables to the south coast and, especially, to the Submarine company's cable end for Europe at Dover. These new circuits eventually totalled 1,355 miles of wire for which the South Eastern bargained hard and obtained £1,390 in rent per annum, the largest annual wayleave payment paid by a telegraph company.

In the years 1866 the South Eastern possessed 333 miles and in 1867 and 1868 it had 351 miles of line, with 113 public telegraph stations.

The London, Brighton & South Coast Railway

The London, Brighton & South Coast Railway, which had rails to the west of the South Eastern Railway and to the east of the London & South-Western Railway, was fifth in terms of public telegraph line. It began to work its circuits independently from 1856 when it had 43 miles of line, 86 miles of wire and 10 stations, sending 1,199 messages. This had grown to 192 miles of line, 396 miles of wire, and 35 telegraph stations with 131 instruments by 1861, when it managed 21,680 messages.

By 1863 the Brighton had 212 miles and 541 miles of wire, 46 telegraph stations, and was working 43,208 messages. By 1865 it expanded to 240 miles of line, 57 stations and 66,523 messages. Although it managed its own telegraph system the Brighton's circuits were in connection with those of the Electric company. In the final two years, 1867 and 68, it worked 284 miles of line, in which latter year it had 104 telegraph stations.

The London, Chatham & Dover Railway

In 1868 the recently-created London, Chatham & Dover Railway worked 140 miles of telegraph line and 50 public message stations. It was a speculative promotion of Morton Peto, the great railway contractor, lately a director of the Electric Telegraph Company, and his allies in 1861 set to challenge the continental monopoly of the South Eastern Railway. It imitated the South Eastern in working its own telegraphs, and likewise allowed the Electric Telegraph Company to work long line traffic over its system, whilst retaining the local business.

Other Railway Companies

By 1868 the relationship between the railway companies that owned the rights-of-way between the centres of population and the two major telegraph companies that provided electrical communication had increased in complexity.

In the original mature business model dating from 1852 the telegraph company provided the railway with separate circuits for its own internal messaging and for signalling or traffic control in return for the rights for public messaging for a period of years. This model was the commonest business relationship until the Post Office appropriation.

From the mid-1850s, as the railways grew familiar with the operation of the telegraph, and especially in the late 1860s, when the government first showed interest in appropriating the telegraph companies, a small number of railway companies sought to own and work public messages as well as their internal messaging and signalling circuits. This came about as their wayleave agreements with the telegraph companies gradually expired and came up for renegotiation.

In the last five years of their independent existence the telegraph companies adopted a policy of licensing other railway companies, as their original agreements expired, to work public telegraphs in connection with their systems. This would give the railways another source of income and an additional incentive to oppose the government's plot to appropriate the telegraphs. The Lancashire & Yorkshire; London, Chatham & Dover; North British; Caledonian and Taff Vale Railway companies were among the largest to commence working their own telegraphs, keeping the revenues for the circuit segment alongside their rails. The government in any appropriation would have to buy out these rights as well as the wayleaves or rights-of-way.

Only the three competing railway companies in the South-of-England and the two in Scotland generated any significant telegraph message traffic. The large telegraph mileage owned by the Lancashire & Yorkshire Railway was worked on its behalf by the Magnetic company, a unique arrangement.

In comparison with the 16,879 miles of line worked by the telegraph companies 1868, the Lancashire & Yorkshire Railway had 432 miles of public telegraph line; the South Eastern 351 miles; the London, Brighton & South Coast 284 miles and the London, Chatham & Dover 140 miles, out of 4,871 miles worked by railways.

The railway companies, flush with new capital, had consolidated in the 1860s. This led to them inheriting contracts of various terms and provisions with telegraph companies through their acquisitions. The North British Railway, for example, had agreements with the Electric, the Universal Private and the Magnetic companies. It came to a new agreement with the Electric on December 1, 1867 to rationalise its several contracts and began to work its own public telegraphs on those circuits, allowing the Electric to work long lines alongside of its rails and to handle external traffic. The railway then adopted a flat rate, 1s 0d for twenty words, on these local circuits and achieved a substantial telegraphic revenue.

According to the Post Office there were 96 railways having working agreements with the telegraph companies in July 1868 under the different relationships; with 13,470 miles of line and 54,724 miles of wire in circuit.

The overwhelming bulk of public messages continued to be handled by the three national telegraph companies, who, of course, managed all of the city-to-city long lines and foreign traffic.

The Mersey Docks & Harbour Board

The *Mersey Docks & Harbour Board,* created in 1856 by merging the municipally-owned Liverpool and Birkenhead docks, decided to replace the long-established optical marine telegraph, that advised it of approaching vessels and which extended seventy miles from Chapel Street, Liverpool, over nine semaphore signal stations at Bidston, Hilbre Island, Prestatyn, Colwyn Bay, Great Orme's Head, Puffin Island, Point Lynas and Llanrhyddlad to the observation and reporting post on Holyhead Mount off Anglesey island, North Wales. It had cost on average £1,500 per annum to work.

On February 7, 1851 the Electric Telegraph Company had previously proposed a land circuit to the Docks Committee, predecessor of the Mersey Docks & Harbour Board, which would replace the optical telegraph between Liverpool and Holyhead, reducing the coastal stations by three. It would cost the Docks £800 per annum. Its offer was rejected.

Realising the wintertime weaknesses of its semaphores, during March 1856 the Board sought estimates for an electric circuit from Liverpool to Holyhead, with seven seaside stations. The Electric company quoted £6,400 for construction of a railway and overland line and £500 per annum in maintenance. The Magnetic company proposed to build a roadside and overland line from Holyhead to Woodside, Birkenhead, for £7,000 and a short cable across the Mersey for £130. It also wanted £500 a year to operate seven coastal stations for ten hours a day.

The Board rejected these and proposed on September 19, 1857 a private two-wire electric telegraph extending from Liverpool to the lighthouse at Point Lynas on Anglesey, which would become the new ship reporting station and on to Holyhead. It was planned in three short inshore underwater sections: from Liverpool to Birkenhead across the River Mersey; from Hilbre Island off the Wirral peninsular to the Point of Air across the mouth of the River Dee; and from Great Orme's Head to Point Lynas, totalling 22½ miles of cable, connected across the Wirral, along the North Wales coast and across Anglesey by 56 miles of overhead land wires along the roads. The engineer was Lionel Gisborne and the cables were manufactured by Glass, Elliot & Company of Greenwich, and laid by them on July 9, 1859 by the chartered steamer *Resolute.* Twenty-five miles of cable were made with two No 16 gauge copper cores insulated to No 3 gauge with gutta-percha and armoured with twelve No 6 gauge iron wires. It weighed 3 tons 2 cwt per mile. This was the first telegraph in Britain made with public (albeit municipal) funding. It duplicated the Electric's long extant public circuit alongside of the coastal Chester & Holyhead Railway, so was essentially superfluous. Being inshore its underwater cables were easily damaged by ships' anchors and weather. The line between Great Orme's Head and Point Lynas soon ceased working and the cable taken up late in 1860, to be replaced by a land line across the Conway and Menai Straits road bridges. The Mersey cable was also repeatedly broken and an alternate inland circuit routed via Chester. A new cable was laid in 1862. In all the Harbour Board spent £16,290 between 1858 and 1862 on building, repairing and re-routing the cables and land lines between Liverpool and Holyhead.

The Harbour Board eventually retained only the rump of the Holyhead telegraph, the section from its Pierhead offices in Liverpool to Bidston Hill on the Wirral peninsular and, farther west, to Hilbre Island, at the entrance to the river Dee. It maintained lighthouses and telegraph stations at both these places for reporting shipping and "for signalling the lifeboat". In 1866 the Liverpool Observatory moved from the Harbour Board's Pierhead to Bidston. There were continued disputes between the Harbour Board and the Customs and the Coast Guard over use of these private wires in reporting wrecks; priority being given to informing the ship-owners and underwriters on the Liverpool Exchange.

The Mersey Docks & Harbour Board, after much consideration, sought tenders on June 24, 1859 for a public telegraph serving all of its dock property along the Liverpool or east shore of the Mersey, extending five miles from north to south. The Dock Telegraph was to have eleven stations, five owned by the Board. The *Dock Telegraph Company* had been pre-emptively promoted in 1858 by the Liverpool-based Magnetic Telegraph Company to work a similar line. The Harbour Board determined to keep independent control but still contracted for the Magnetic company to install their instruments along the new line, whose circuits cost them £343 to erect. A message rate of 6d for twenty words was fixed, with priority given to Harbour Board traffic. It was opened in April 1860.

John Sacheverell Gisborne was Telegraph Engineer to the Mersey Docks & Harbour Board in October 1862. He replaced his brother, Lionel Gisborne who had died in 1861, who also had been involved in engineering submarine cables in the Mediterranean and Red Seas since 1855 with another brother, Francis.

As the Harbour Board's docks in Birkenhead on the opposite side of the Mersey were not served by the Dock Telegraph, after many complaints in 1866, the competitive Electric Telegraph Company opened new offices convenient to the several dock entrances there.

Neither did the Dock Telegraph meet the urgent needs of the ship-owners and underwriters on Liverpool's Exchange; the Harbour Board was compelled to open up its dock property to the circuits of the Universal Private Telegraph Company in 1865. Private wires were then run from the individual docks and the Pierhead to business chambers in Liverpool.

The public circuits of the Board's Dock Telegraph were taken over by the Post Office in 1870; the cost of this unforeseen acquisition was never revealed.

The South of Ireland Cable

In early January 1862, the *London & South-of-Ireland Direct Telegraph Company*, with an authorised capital of £100,000, prepared to lay an underwater 62 mile four-core cable between Milford in Wales and Greenore Point, near Wexford in Ireland. The Chairman was Lord Fermoy, Lord Lieutenant of Cork, its Secretary was Lewis Cooke Hertslet and its engineer was Nathaniel J Holmes; the latter pair holding similar positions with the Universal Private Telegraph Company. Latterly the Secretary and Manager was William Alves Travers Cummins, a relative of the Cunard steam shipping family. From this initial project Holmes was to become engineer to many other domestic and international cable companies. This, the third route (and fourth cable) between Britain and Ireland, although with independent capital, was worked by the Electric Telegraph Company as part of its circuits, using the American telegraph. As its name implied it gave faster access from England to southern Ireland, especially to the proposed cable-head for America on Valentia Island in the south-west of the country and the important ports of Cork, Queenstown, Waterford and Wexford.

The Ireland Direct company's powers included a concession for a station at Roche's Point at the entrance to Cork Harbour where the pilots resided, enabling telegrams to be sent from the ocean steamers before the mail tender came out from Queenstown. For this line it used the Universal telegraph, which spelt out the alphabet and did not need knowledge of any code.

The four circuits of the South-of-Ireland company's cable were intended to be insulated with india-rubber by S W Silver & Company of Silvertown, London, who also provided their patent ebonite insulators for the associated two-wire overhead land line in Ireland.

In somewhat mysterious circumstances a competitor appeared on January 21, 1862, initially called the *St David's Head & Wexford Telegraph Company*, latterly known as the *London & Queenstown Direct Telegraph Company*, with a capital of £30,000. As it was to transpire the Queenstown company raised sufficient money to commission the Gutta Percha Company and Glass Elliot & Company to make and lay its own four-core gutta-percha insulated cable on the shorter route between Abermaw Bay in South Wales and Wexford on March 28, 1862. Glass Elliot, the contractors, were to guarantee the cable for eleven years of service. This left the South-of-Ireland company in possession only of land lines and cross-river cables in Ireland connecting Wexford with Cork.

The combined connection eventually comprised 454 miles of wire, these in 50 miles of land line between Cork, Waterford and Wexford in Ireland, in a short cable across the Blackwater river at Youghal, another across Cork Harbour and in the 62 mile underwater cable from Wexford to Abermawr where it connected at Milford with the Electric's existing circuits along the South Wales Railway to Cardiff and London.

Both the cable of the London & Queenstown Direct Telegraph Company and the Irish land lines of the London & South-of-Ireland Direct Telegraph Company were absorbed and worked as one by the Electric company from their completion in March 1862.

The South-Western of Ireland Telegraph Company

The South-Western of Ireland Telegraph Company joined Cork city with Crookhaven, a village on County Cork's far-southern coast, with an 85 mile landline in December 1863. It was built by Siemens Brothers as a marine telegraph to report Atlantic shipping arrivals, to forward private messages and, especially, to provide early news from civil war-torn America, as a promotion of Julius Reuter. The fast Cunard liners from New York to Liverpool carried a watertight container filled with telegraph messages from throughout America and Canada and, after crossing the Atlantic, dropped it off Crookhaven where the telegraph company's steam tender *Marseilles* picked it up. The messages were then brought ashore and retransmitted by the South-Western company's telegraph to Britain and Europe, a half-day before the Cunard liner reached Liverpool. In addition to Reuter in London the South-Western forwarded news for the Associated Press of New York, whose European offices were at 10 Exchange Street East, Liverpool. Although financially unviable, the Company's lines were bought by the Electric company in June 1864; the canisters of messages were still being picked up in 1872. While it was independent its secretary and manager was George Saward, of the Atlantic Telegraph Company. As a corporate relic it was acquired by Alexander Collie, a cotton-speculator, who anticipated selling its rights to the government in 1868.

The canister exchange imitated a similar service that had a steamer waiting off Cape Race, Newfoundland, to swap containers with inbound and outbound Cunard steamers in the early 1850s, working from the telegraph station at St John's, Nova Scotia.

The Magnetic Telegraph Company raced with Reuter to open a circuit from Cork though Skibbereen to Baltimore and a cable to Cape Clear on Clear Island, in the extreme west of County Cork. It opened in mid-November 1863. Crookhaven proved more convenient for the news traffic and Cape Clear was used as a meteorological station. The Magnetic had a similar station at Greencastle at the mouth of Lough Foyle in communication with Londonderry in Ulster that took containers from the Inman liners between Liverpool and New York and the Anchor Line steamers to Glasgow.

The West Highland Telegraph

Although established to lease-out private wires the Universal Private Telegraph Company erected and worked the *West Highland Telegraph,* a long line for public use, through some of the wildest parts of Scotland. It ran from its hub in Glasgow through industrial Dumbarton to Helensburgh, into the highlands to Inverary, Ardrishaig and Campbeltown on the isolated

Cantyre (Kintyre) peninsula, a distance of 130 miles. The line was completed throughout on September 4, 1865. The West Highland Telegraph went to the trouble of issuing telegraph stamps to encourage its public business. A further 18 miles of private line extended from Campbeltown to the lighthouse on the Mull of Cantyre for the Glasgow shipping interests.

In Scotland the Universal company also built public lines from Glasgow to Oban and Rothesay and opened a public circuit in its private lines to Greenock. It opened, too, public circuits on its private wires from Newcastle-on-Tyne to Blyth, Chester-le-Street and Sunderland in north-east England. Their history is explained later in the chapter on "The Universal Telegraph".

Independent Companies

A new Joint-Stock Limited Liability Companies Act of 1856 permitted the general formation of corporate concerns, this became even more liberal, regarding capital-raising powers, with the Companies Act 1862; in addition the Telegraph Act 1863 allowed all incorporated companies to make lines of telegraph for their own use or for public messaging. The Electric Telegraph Company encouraged local capitalists to use this to finance circuits that it felt were otherwise unviable. It then put them in circuit with its own lines.

The *Gloucester & Sharpness Electric Telegraph Company* was promoted during 1858 with a capital of £500 in 50 shares to make and work a 16 mile line alongside of the Gloucester & Berkeley Canal in the rural west of England. It actually raised £640, including money borrowed from local bankers and the canal company. The circuit cost £520 to construct. It primarily recorded ship-canal traffic, managing 500 messages per year and paid an annual dividend of 3% to its shareholders in 1859. It had offices at Commercial Road, Gloucester, supervised by Henry Waddy, the secretary.

The *Poole, Bournemouth & South Coast Printing Telegraph Company* was formed in 1859 with capital of £500. It was promoted by William Mate, owner of the 'Poole & South-Western Herald', and ran from the paper's office in High Street, Poole to the office of James Rebbeck, a property developer, in Southbourne Terrace, Bournemouth in the West of England. Of its capital only £312 12s 7d was expended and its message rate of 6d for ten words produced an income of £517 17s against costs of £441 12s 5d in the four year period from 1860 to July 1864; leaving enough for an annual dividend of 6% (£7 19s!). Messages had to be carried from Poole to the Electric company's circuit at Hamworthy on the South Western railway.

The *Bodmin, Wadebridge, Padstow, St Columb & New Quay Telegraph Company* worked a small network on the isolated north coast of Cornwall, totalling 36 miles of roadside overhead wires from about 1865. It connected with the London & South-Western Railway's circuits at Wadebridge.

Other "independent" lines established after the new Companies Act of 1862 included the *Portadown & Gilford Telegraph Company*, a private circuit owned by Dunbar, McMaster & Company, proprietors of a major flax spinning mill in Ulster; the *Whitworth Telegraph Company*, owned by Joseph Whitworth, the steel master, to serve his works in Manchester; the *Abergavenny & Crickhowell Telegraph Company* of six miles in South Wales; and the *Yarmouth & Kingston Telegraph Company*, a fifteen mile long marine line, primarily for reporting ship movements, terminating at St Catherine's Point on the Isle of Wight.

The *Coast Telegraph Company* was promoted by Charles West, a telegraph engineer, to form a series of marine telegraphs on Britain's shore. In June 1862 it constructed a signal station on Capstone Point at Ilfracombe in Devon, overlooking the Bristol Channel. From there merchants, ship-owners and mariners could send messages by flag from their vessels to the coast station and hence to any station in the world using the circuits and tariffs of the Electric & International Telegraph Company. A charge of 1s 0d was made for signalling messages to or from ships in the Channel. Only one such station was built by the Company.

The smallest of all firms appropriated by the government in 1868 appears to be the *Tavistock, Princetown & Dartmoor Telegraph Company.* It worked eight miles of road-side single wire from Her Majesty's Convict Prison Dartmoor to the London & South-Western railway station at Tavistock in Devon, in the far west of England, from 1862 and cost just £400.

There were several other very small un-incorporated lines in Britain and Ireland, including the *Roche's Point Telegraph* serving the lighthouse that marked the entry to Cork Harbour, and *Lady Londonderry's Telegraph*, in County Durham serving the coalfields. All were taken over by the government, paid for by the public purse.

The "Lady Londonderry" above mentioned was Frances Anne Vane, Marchioness of Londonderry, of Seaham Hall, Seaham Harbour, County Durham, who lived from 1800 until 1865. The Marquis of Londonderry having died in 1854, she, as his widow was left to manage his vast coal property in the County, comprising the immense Seaham Colliery, opened in 1846, the coal port at Seaham Harbour and the seven-mile private railway between Seaham and Sunderland, as well as coal royalties from other pits. *Lady Londonderry's Telegraph* had been in existence for some years, at least since 1861, as one of the first private networks provided by the Universal Private Telegraph Company. The 'Murray's Guide for Travellers in Durham and Northumberland' of 1864 describes it thus: "The numerous telegraph-wires which are to be seen traversing the coal country in all directions, have their terminus in an apartment at Seaham Hall, by which means the Marchioness is kept *au courant* of all that is going on in all the different collieries on her property." Her Ladyship's telegraph system was of sufficient competence to be in circuit not just with the Electric Telegraph Company at Sunderland but to send and receive messages to and from the Continent of Europe in 1861. There were in total five separate lines at Seaham.

Table 23

The Final Reckoning
Telegraphs in 1868
The Companies and the Railways

Company	*Line Miles*	*%*	*Wire Miles*	*%*
Electric	10,007	59.93	50,065	62.39
British & Irish	4,696	28.12	19,235	23.97
United Kingdom	1,692	10.13	10,001	12.46
London District	163	00.98	545	00.68
Universal	139	00.83	400	00.50
Total	*16,697*	*100*	*80,246*	*100*
Companies	16,697	77.45	80,246	87.92
Railways	4,871	22.58	11,022	12.08
Grand Total	*21,568*	*100*	*91,268*	*100*
Company	*Messages Inland*	*%*	*Messages Foreign*	*%*
Electric	3,137,478	55.47	539,188	68.92
British & Irish	1,530,961	27.07	212,764	27.19
United Kingdom	776,714	13.73	30,441	03.89
London District	183,304	03.42	-	-
Universal	27,542	00.49	-	-
Total	*5,655,999*	*100*	*782,393*	*100*
Railway	*Messages Inland*	*%*	*Messages Foreign*	*%*
South Eastern	103,386	28.64	-	-
Chatham	88,418	24.50	-	-
Brighton	86,937	24.09	-	-
North British	51,023	14.14	-	-
Caledonian	16,261	04.50	-	-
Others	14,899	04.13	-	-
Total	*360,924*	*100*	-	-
Companies	5,655,999	94.00	782,393	13.83
Railways	360,924	06.00	-	-
Grand Total	*6,016,913*	*100*	*782,393*	*13.00*

In 1868 the telegraph companies possessed 2,155 stations in 1,882 cities and towns, the railway companies had a further 1,226 offices (The South Eastern Railway possessing 113, the Brighton 104 and the Chatham 50); a national total for Britain and Ireland of 3,381 public telegraph stations.

These statistics, from the Returns of the Railway and Telegraph Companies to the Board of Trade, not the Post Office, show the relative position of the several public service providers. The London District company sent 316,000 messages in 1865 before it adopted an increased tariff. The Universal company's figures are for their public lines.

The nature of the Post Office administration was such that, in 1880, it claimed that in 1868 there were just 5,651 miles of line, 48,990 miles of wire, 2,488 stations and 2,200 (sic) instruments. Then in 1895 it stated that in 1868 there were 14,776 miles of line, 59,430 miles of wire, 2,932 stations and 4,045 instruments.

The *Jersey & Guernsey Telegraph Company* was the last public telegraph company formed for domestic traffic. It was actually formally registered on February 4, 1870 on the eve of the government's appropriation of the telegraphs. The Company's aim was to replace the failed cables of the Channel Islands Telegraph Company connecting England with Alderney, Guernsey and Jersey. It was promoted as a simple joint stock concern with a capital of £30,000 in £2 shares by a local islands' magnate, William Henry LeFeuvre, under the Companies Act 1867. It intended to lay a long cable from Start Point near Dartmouth in Devon to Guernsey, with shorter lengths between the islands. The Post Office complicated the project in its granting of landing rights and this led to some cables being laid by W T Henley's Telegraph Works Company, some by the India Rubber, Gutta-Percha and Telegraph Works Company, and the land works being made by W Warden & Company of Birmingham. Despite this the whole length was completed on November 8, 1870 and it was opened to the public between the Channel Islands and England on December 21, 1870. It opened seven offices on the islands, using the American telegraph on the inter-island circuits and Wheatstone's automatic telegraph on the English circuit. It engineer was W H Preece, apparently combining the work for a public company with his job at the Post Office Telegraph Department without too much difficulty. The Jersey & Guernsey company was taken over by the government in August 1872.

During their relatively brief, twenty-year existence the public telegraph companies raised £2,496,744 in paid-up share and loan capital to build and operate their competing national and local systems. The Electric in the 1860s regularly paid 10% dividends, the Magnetic 8%, and even the United Kingdom company ultimately managed 5%.

In perspective this compares with the combined paid-up capital of their gigantic allies, the domestic railway companies in 1868, at £502,000,000, with their receipts of £39,500,000 and their operating expenses of £20,000,000. Railway investors in the 1850s and 1860s were lucky to get 4% on their money.

Colonial Telegraphs

A final novelty is the only colonial company formed in England in this period to work telegraphs:

The *Cape of Good Hope Telegraph Company* was established in Cape Province in April 1860. It opened its first line between Cape Town and Simon's Town on May 8, 1860, using Cooke & Wheatstone's needle instruments. The engineer and manager was Charlton Wollaston, the son of the engineer of the first cable across the Channel. In 1861 it opened a line between East London to King William's Town; another was completed in 1864 from Cape Town through Port Elizabeth to Graham's Town. Its last main line was built between Durban and Pietermaritzburg.

In April 1862 the Good Hope company was incorporated in London as a joint stock company with a capital of £62,000 in 12,500 shares of £5, all paid-up, to complete the long 610 mile line from Cape Town through Caledon, Swettendam, Riversdale, Mossel Bay, George, Uitenhage and Port Elizabeth to Graham's Town, and to acquire its several branches. John Read was its Secretary and Manager in London. It had a subsidy of the Cape Legislature of £1,500 per annum for fifteen years. Siemens, Halske & Company of London were then employed to renovate and complete its system and install their instruments. It brought its latest American inkers and "iron-clad" insulators in circuit. Their workmanships was so good that the 600 miles of No 6 BWG iron-wire between Cape Town to Graham's Town was worked with just fifteen Daniell sulphate cells.

In 1864 its charges for twenty words from Cape Town were to Graham's Town 12s 6d, Port Elizabeth 10s 0d, to Caledon 2s 6d, Swettendam 3s 0d, Riversdale 4s 0d, Mossel Bay 5s 0d, George 5s 6d and Uitenhage 8s 0d. The Good Hope company had an arrangement by which messages for its stations could be sent from any of the Electric company's offices in Britain and forwarded by steamer to the Cape. By 1867 it was paying a dividend of 6%. The Cape of Good Hope Telegraph Company was purchased by the provincial government on July 1, 1873 for £40,750. It then had 760 miles of line and sixteen stations.

Britain's other great dominions, Canada and Australia, were sufficiently independent to go their own way in regard to the electric telegraph. British North America was to organise many joint-stock telegraph companies with its own and with American capital. The individual states that then formed Australia all adopted the European bureaucratic model with wholly government-owned public circuits. Both countries used the American telegraph on their public wires.

In 1864 there were four self-governing colonies in Australia having public telegraphs:

Victoria	2,826.5 miles	63 stations
184,441 messages,	£29,121 receipts	
New South Wales	2,520 miles	53 stations
130,500 messages,	£28,678 receipts	
South Australia	1,074 miles	26 stations
106,874 messages,	£10,994 receipts	
Queensland	792 miles	18 stations

The wires in Victoria were worked at a substantial loss, the others were all profitable. A new tariff of 2s 0d for ten words put Victoria's telegraphs into profit by 1869.

Across the Tasman Sea, New Zealand was then just embarking on the building of a system, the Telegraph Department being established in 1863. By June 1869 it possessed 1,330 miles of line including a cable connecting the North and South Islands. It sent 156,157 messages in that year, an increase of 60% over 1868; giving receipts of £31,080. The tariff was 2s 6d for ten words.

However, as in British India, the railways in Australia, in the hands of domestic public companies, initially adopted the Cooke & Wheatstone needle telegraph for safety and for messaging, influenced by their iron cousins in Britain.

4.] **THE UNIVERSAL TELEGRAPH**

Introduction

If little has been written about public telegraphy in Britain, then scarcely anything is recorded about private telegraphy; connecting individuals or houses by a wire for their sole use. This is all the more surprising given that one-fifth of all telegraph instruments in 1868 were in private circuits.

Before dealing with the history of the *Universal Private Telegraph Company*, which revolutionised telegraphy in Britain, some context is necessary. This entire section is particularly elaborate as none of the detail has been previously recorded in one place.

On the same day, June 2, 1858, as he obtained his patent for the *automatic telegraph* which was to revolutionise public telegraphy Charles Wheatstone acquired a patent for the components of what he was to call the *Universal telegraph*, a device he uncharacteristically promoted on a personal level. The instrument, with two compact dials, the communicator and the indicator, did not require galvanic batteries and, as it indicated individual letters and numbers by means of a rotating needle, could be worked by anyone who could read in perfect safety. Two instruments in circuit was the most effective arrangement, but using up to four was possible on short lines.

In this patent he gave careful credit to W F Cooke as his co-devisor of the earlier galvanic dial or index telegraphs that inspired the Universal telegraph.

The Complete Letter Writer
Mr Punch predicts…

"Since the electric telegraph is being extended everywhere, we think it might be laid down, like the water and the assessed taxes, to every house. By these means a merchant would be able to correspond with his factors at sea-towns - a lawyer would communicate with his agents in the country - and a doctor would be able to consult with his patients without leaving his fireside."

"What a revolution, too, it would create in the polite circles! Mrs. Smith, when she was giving an evening party, would 'request the pleasure' of her hundred guests by pulling the electric telegraph, and the 'regrets' and 'much pleasures' would be sent to Mrs. Smith in the same way."

"This plan of correspondence would have one inestimable blessing - all ladies' letters would be limited to five lines, and no opening afterwards for a postscript. If this plan of electric telegraphs for the million should be carried out, the Post Office will become a sinecure, as all letter-writing would be henceforth nothing more than a dead letter. In that case it might be turned into a central terminus for all the wires; and any one found bagging a letter by means of false wires should be taken up for poaching."

From 'Punch, or The London Charivari', December 5, 1846

The first galvanic dial telegraph using as a receiver a disc rotated by clockwork, regulated by an electrically-controlled escapement, contained in a clock-like mahogany case, and as a sender a small capstan making and breaking a circuit was patented by Cooke and Wheatstone as far back as January 21, 1840. Cooke gave entire credit to Wheatstone for its invention, and was, unfortunately, dismissive of its commercial potential.

The same patent of 1840 also included an improved dial telegraph, entirely replacing the capstan and galvanic battery with a metallic wheel or dial working a magneto device. Gently turning the wheel generated pulses of electricity that allowed the disc to turn step-by-step to each letter or number.

This *electro-magnetic telegraph*, as it was then called, was first used on the short line by the side of the Great Western Railway between Paddington and Slough, alternately with the original two-needle apparatus in 1843 until 1845, and on the London to Portsmouth line for a short period in 1845. It was also adopted by the *Chemin de fer Paris à Versailles* in 1845 and used on its line until the late 1850s. The Electric Telegraph Company allowed Wheatstone access to its circuits to further his development of the dial telegraph in 1846. It was widely copied and improved in Britain and abroad but was brought to perfection in Wheatstone's Universal telegraph of 1858.

The *Universal Telegraph*, the name he carefully chose, able to connect private individuals, ordinary citizens rather than technicians, was to be Charles Wheatstone's main preoccupation for a decade.

Wheatstone had introduced the galvanic dial telegraph to the public in 1840 and the magneto dial telegraph in 1842. It had been his intention even from that early date to create an instrument that ordinary people might use with facility and safety. In his arrangement with W F Cooke in April 1843 Wheatstone specifically retained to himself the rights for telegraphs with circuits of one mile or less in length, for a "district establishment" and for "domestic and other purposes". The rights expired without formal use along with the 1840 patent in 1854.

It is not known who acquired the first private telegraph circuit in Britain. What is known is that, apart from the Admiralty's dedicated line from Whitehall to Portsmouth of 1844, the Royal Household in Buckingham Palace had a two-needle circuit installed in 1851. This was contained in an underground iron conduit along the Mall to Trafalgar Square and the Electric company's Charing Cross office. A similar circuit was carried from that station to the Metropolitan Police Office in New Scotland Yard, Whitehall. These required the employment of a telegraph clerk skilled in the two-needle code to work the instrument and to maintain the batteries of cells, which contained, among other chemicals, sulphuric acid. Unsurprisingly, Lewis Ricardo, the Electric company's chairman, had a private wire to his London house in Lowndes Square. The telegraph superintendent of the South Eastern Railway Company, C V Walker, had a circuit for a double-needle telegraph installed between his residence and the telegraph station at Tunbridge Wells in Kent before 1852. It is likely that others in the industry had similar arrangements.

It might be noted that the Royal Navy's messages from Somerset House and the Admiralty carried to its yards and docks at Portsmouth and Plymouth in the west by the Electric company and to Deptford, Woolwich, Chatham, Sheerness, Deal and Dover in the east by the Magnetic's circuits were on leased circuits and were worked by the telegraph companies' clerks not navy personnel. Most of these official messages were in numeric cipher and the clerks were deliberately kept ignorant of the key used. The instruments used were "locked" for security.

One of the earliest private telegraph networks was that created for the collieries of the Earl of Crawford & Balcarres at Haigh and Aspull, near Wigan, in Lancashire in 1851. By January 1852 there were nine instruments in circuit at Haigh, managing the coal traffic from the pits down four inclined tramways, one being 1½ miles in length, to the near-by canal and railways. The code used allowed the signalling of different qualities of coals for different destinations, and had been developed by the Earl himself. The colliery telegraph was just then being extended with new circuits from Haigh to the Earl's Upholland Colliery at Rainford, nine miles distant, and from Haigh and Upholland to Wigan, alongside of public railways and private tramways. The system was installed by W T Henley and used a single-needle version of his magneto-electric apparatus and gutta-percha insulated subterranean copper wires. It did not extend underground into the pits.

The Haigh Colliery was an advanced enterprise. As well as its extensive tramways and the telegraph, its engineer, William Peace, was to introduce the mechanical coal-cutter, an endless-chain driven by compressed air, in December 1853, to supplement men and picks.

On July 30, 1862 George Warren, then age 23, was appointed *Court Telegraphist*, a new title recognising the duties of the travelling clerk attached by the Electric Telegraph Company to the Royal Household. He replaced James Hookey, telegraph clerk to the Queen, who had been promoted to Inspector of Works in the West Midlands. Warren had joined the Company in May 1855 and had been first appointed to the Court Telegraph Office in 1861. He travelled with the Queen between Buckingham Palace in London, Windsor Castle in Berkshire, Osborne House on the Isle of Wight and Balmoral Castle in Scotland, working the Royal Household's private wires in those places leased of the telegraph company, and followed her overseas, having to be "experienced in telegraphing in French and German as well as the English language." Although board and lodging were provided wherever the monarch was staying Warren, a native of Wareham, Dorset, had a house at Cowes on the Isle of Wight. He received a salary of £154 a year with allowances for travel and board, paid by the Electric company's South Western District in Southampton, then by the Post Office. When George Warren died in 1896 the Queen had a monument placed on his grave "as a mark of regard for faithful and zealous service" after 34 years service as her private telegraph clerk.

The Royal Italian Opera House in the Haymarket, a place of popular fashionable resort in London during the 1850s, had its own telegraph in the lobby of the Grand Tier from May 18, 1853; connected to the Electric's Charing Cross office in the Strand. The telegraph company's clerk received and posted important Parliamentary news for the Opera's patrons and was able to send messages out to the provinces. It is difficult to think of this as anything other than a publicity exercise, but it was still in use in 1867.

The Crystal Palace exhibition hall in Hyde Park in 1851 had its own telegraph between its many galleries and its entrances put in by the Electric Telegraph Company.

In May 1852 the Bank of England in the City of London installed a complex internal electric telegraph system between the Governor's Room and the chief accountant, chief cashier, secretary, engineer and other officers using G E Dering's patent single-needle instruments.

To give some idea of period thoughts on implementing private telegraphy the original prospectus of the United Kingdom Electric Telegraph Company in April 1853 "offered private wires for government departments, public companies or private mercantile establishments at an annual rent of from £2 to £3 per mile per annum, a single wire giving perfect secrecy at one-half the cost of regular bills". The company intended to lay an extra fifty wires for this purpose between the main cities. The plan was never carried out.

Waterlow & Sons, a large firm of law stationers, letterpress and lithographic printers with government contracts, had the first commercial private line constructed between 24 Birchin Lane and their works at 66 London Wall in the City of London in September 1857. It was engineered by Owen Rowland, of 5 Suffolk Lane, City, EC, one of W F Cooke's earliest collaborators, using single-needle galvanic instruments, alarm bells and a single roof-top iron wire in one 1,500 foot long span for just £35. The alternative of an underground circuit was costed at £1,200.

Owen Rowland had conducted trials of both steel and iron telegraph wires on Hackney Marshes to determine their strength and durability in 1858. He used tough steel wires protected by a coating of paint, "peculiarly adapted for the purpose", on the over-house circuit for Waterlow and also for the first private wire created using Wheatstone's Universal telegraph, for Spottiswoode the Queen's Printer, which he also engineered.

In the following year Waterlow's had the telegraph contractor, W T Henley, extend their little system and erect a 2¼ mile long private circuit from their Birchin Lane premises to their office at 49 Parliament Street, Westminster, near the Houses of Parliament. The new circuit consisted of two overhead iron wires (one being spare) in twelve 1,000 foot long spans running along the river Thames, and crossing it twice. The short wooden poles carrying two insulators were mounted in specially-designed iron saddles secured on the ridge of the fourteen roofs by six substantial screws, and held in place by guy wires. The No 14 gauge line-wire was manufactured of steel and covered with four coats of paint as protection against the elements. The single-needle instruments used in Waterlow's system each cost £5, and the bell alarms £4 4s. The eleven intermediate posts were all fixed on the roofs of business premises, warehouses and breweries. The new line cost £160.

Until there was an alternative to the code-worked needle instruments and the need for liquid batteries the application of telegraphy to private use was restricted. It was not until Wheatstone and Siemens Brothers introduced their dial telegraphs using magnetos rather than cells, in 1858 and 1859 respectively, that private telegraphy became commercially viable.

The Universal Telegraph

"The wire of one friend may be placed in communication with that of another, or in fact with any person who rents a wire. It may be that the friend may dwell in another part of the kingdom, in which case before sending a message, it would be necessary to have his wire placed in connection with a public railway telegraph, and this again at its terminus with the friend's wire."

"By combining beforehand different lines in this manner, two different persons may converse together across the island, sitting in their own drawing rooms; nay, only by extending the connection of these lines with the submarine cables across the seas, a person may converse with his friend travelling day by day at the other end of the globe, provided only that he keeps on some telegraphic line that is continuous with the main electric trunk-lines of the world."

"This may appear to be an idle dream, but that it will certainly come to pass we have no manner of doubt whatever."

Andrew Wynter, MD,
'The Nervous System of the Metropolis',
in 'Our Social Bees', 1861

At the suggestion of the Waterlow family, who were involved in local government and had been lobbying for a fire and police telegraph for the capital since December 1857, the City of London Police Office at 26 Old Jewry was connected by electric telegraph with its six stations at Moor Lane, Fore Street; Smithfield West; Fleet Street, St Bride's Church; Bow Lane, south end; Seething Lane, Tower Street; and Bishopsgate Churchyard in 1859. The City police used Wheatstone's Universal telegraph and a system of single, overhead, rooftop iron wires, all suspended from the spires and towers of the city churches. The work was done under licence of Charles Wheatstone by Reid Brothers, the telegraph contractors, of University Street, who also undertook subsequent maintenance of the wires, and it cost the City Corporation £800.

The City of London Police, responsible for the small central district, should not to be confused with the Metropolitan Police that enforced law and order in the rest of the capital, whose chief office in Scotland Yard had been connected to the Electric's national circuits with a private wire for a short period between 1851 and 1852. It was not until 1866 that the Metropolitan Police commenced their own network.

In Bristol, the large tobacco and snuff manufacturing firm of W D & H O Wills installed the first private telegraph line in the provinces, between their premises at 33 Mary-le-port Street and 112 Redcliff Street, during February 1859.

Seeing the opportunity that private wires offered, the London District Telegraph Company, on its promotion in January 1859, specifically wrote into its prospectus that it would provide them for individual and businesses in addition to its public circuits.

The iron ship-building yard of John Scott-Russell & Company at Millwall on the Thames in London engaged S W Silver & Company to construct a unique private telegraph to co-ordinate the installation of the machinery and the final fitting-out for sea of the mighty *Great Eastern*, the largest ship in the world, between February and September 1859. Using Wheatstone's Universal telegraph instruments it consisted of an underwater india-rubber insulated cable running from the hull of the great ship, floating off Deptford after her launching in January 1858, across the river Thames to Scott-Russell's works, along the length of the riverfront shipyard, then underground to the separate engine-building shops and to the management and drawing offices on the Isle of Dogs. It is notable, at least to those of a sentimental disposition, that, given her epic contribution to intercontinental cable-laying, an umbilical submarine telegraph cable was facilitating the birth of the *Great Eastern*.

The Universal Private Telegraph Company

The Universal Private Telegraph Company was projected on September 20, 1860 to acquire Charles Wheatstone's patent of 1858 for his perfected magneto-electric dial apparatus, the easily-operated *Universal telegraph*, a small, neat instrument, to "carry out a system by which banks, merchants, public bodies and other parties may have the means of establishing a telegraph for their own private purposes from their houses to their offices, manufactories or other places".

Its initial incarnation was as "The Universal Private Telegraph Company, Limited", incorporated under the new Joint Stock Limited Liability Act of 1857. It then sought a capital of £50,000 in 500 shares of £100 during October 1860, and had just two directors, Professor Charles Wheatstone and William Fairbairn, CE, the Manchester ironmaster. The Company's officials were Thomas Page, engineer, Lewis Hertslet, secretary and Nathaniel Holmes, electrician. It was almost immediately found that parliamentary powers were needed to facilitate its laying of wires over public roads, in addition to negotiating with parochial authorities in towns and cities for access and wayleaves, and that a broader capital base was required to ensure its viability.

Despite this the Limited Company was immediately active in marketing itself in Glasgow, rather than London. The first announcement of its services appeared there on April 10, 1860, in a very long descriptive article written for the 'Glasgow Herald' by Nathaniel Holmes. This was followed up by another on October 11, and by the publication of the prospectus for the Limited Company on October 17, 1860. Holmes was then living in Carrick's Royal Hotel on George Square in the city.

However, Holmes and the Universal company had already been busy in London as the second Scottish article, on October 11, revealed that both Julius Reuter and the City of London Police had networks of private circuits working by then.

It announced on October 17, 1860 that "The main object of this Company is to enable the Government Offices, Police Stations, Fire Stations, Banks, Docks, Manufactories, Merchants' Offices, and other important Public and Private Establishments to have a private system of communication with their own Establishments and Manufactories at distances, either from their offices or residences, by means of Professors Wheatstone's new and valuable Patents, which combine such simplicity that anyone who can read and spell can work them without difficulty, thus affording each establishment a distinct wire and private means of communication exclusively their own. The Company will either erect and maintain such Telegraphic communication at a fixed annual rental, or charge a specific sum for each contract for a term of years, as may be agreed upon."

"It is intended to extend this system of private Telegraphic communication beyond the limits of the Metropolis to other important cities, as Glasgow, Manchester, Liverpool, Birmingham, Preston, Bristol, Hull, Edinburgh, Nottingham, Plymouth, &c., additional capital being added from time to time for such purposes."

Even before this Nathaniel Holmes had been to War on behalf of the Universal telegraph. The 'Illustrated London News' of July 21, 1860 carried a long report on "Professor Wheatstone's Universal and Military Telegraph":

"This beautiful telegraphic apparatus, invented and patent by Professor Wheatstone, possesses great advantages over the many existing telegraphs from its extreme simplicity, portability and adaptability to all the various purposes for which communication may be required. The necessary qualifications for a complete telegraph were fully demonstrated by its arrangement upon the field under Mr N J Holmes, the electrician, at the volunteer sham fight at Camden Park, last Saturday [July 14, 1860]. Insulated lines of wire, payed off from portable drums, were extended over the ground from the central station in front of the grand stand to the divisions severally under the command of Lord Ranelagh and Colonel Hicks, forming terminal stations, which were afterwards moved over the ground as the volunteer forces shifted their positions, conveying intelligence of their movements from one division to the other, the whole of the evolutions being known to the central station at the grand stand. The instruments work with a single wire insulated by a coating of india rubber and covered with braided hemp as a further protection from injury and abrasion by the tramping of men and horses over it upon the ground, the earth connection being formed by the insertion of an iron spade or trowel attached to the wire into the ground and shifted as required."

"The telegraph consists of two distinct portions – the transmitter, or communicator, for sending; and the receiver, or dial, whereon the message is read. The communicator is a small box about one foot long by six inches deep by eight wide, upon which the twenty-six letters of the alphabet are engraved, together with the points of punctuation, and the cross or signal for the termination of words and messages. Opposite to these thirty spaces corresponding buttons are placed round the dial, each button representing the letter or sign annexed to it, so that messages are spelt out by generally depressing in succession the requisite buttons or letters composing the word, each separate word being marked by the depression of the cross. A pointer at the centre of the dial, when the telegraph is in action, revolves, and stops at the depressed button, the action of which will be presently explained. The interior of the box contains a permanent magnet, from which an induced current of magneto-electricity is obtained when required by the revolution of a small soft-iron armature and helix placed before the poles of the magnet, in close proximity, but not in contact. This armature by induction becomes itself a magnet in certain positions, and during its revolutions is continually parting with its charges and receiving fresh supplies, the several currents generated in this way being transmitted through the communicator and keys to the distant station along the wire. The revolving motion is communicated to the armature by the exterior handle and hand of the operator. The second or receiving portion consists simply of a small round barrel or dial, upon the face of which similar letters are engraved, to correspond with those of the transmitter; a hand or pointer on the dial, set in motion by the direct action of the current from the distant station points out the letter to be read off by stopping for an instant before it passes on to the next in succession composing the word. So rapidly are these indications received that over one hundred letters a minute may be read off with ease."

"The action of the instrument may be briefly explained as follows: Any letter, as H, being depressed upon the communicator, a certain number of distinct magneto-currents will be transmitted down the line to the distant station by the revolution of the soft-iron armature, each of which will register an advance of the pointer a letter upon the dial at that station. Now, as there are eight spaces between the cross or starting-point and the letter H, there will be eight currents, or eight advances of the index, which will stop at H, the current from the magneto machine being cut off from the line, and passed into the earth by the hand coming into contact with the depressed button. When another button is depressed the former key is raised and the currents again pass down the line until cut off by the hand as before, the index upon the distant station advancing as before, and so on, until the message is completed."

The Volunteer Sham Fight took place at Camden Park, Bromley, Kent, on Saturday, July 14, 1860. It was intended as a mass field exercise for the newly formed Rifle Volunteer Corps in the metropolitan boroughs. To give some idea of its size there were, according to the 'Daily News', an estimated 25,000 spectators in the grandstand and on the park grounds. The troops comprise two "attacking" brigades and a defence, nearly 6,000 men in all: the first brigade, 1,300 strong, composed of three battalions, drawn from the Rifle Volunteer Corps in Middlesex, Surrey and Tower Hamlets, the second brigade, although also of three battalions, was even larger, from Kent and Middlesex. The defenders came from Corps raised in the City of London, Middlesex and Kent.

The South Eastern and West End of London & Crystal Palace Railway companies offered the volunteers a bargain return fare of 8d from the London Bridge and Pimlico termini in London to Southborough Road for Bromley. James Wyld, the Queen's geographer, prepared maps of the ground and of the anticipated military evolutions for visitors.

The public assembled by 3 o'clock in the afternoon; although intended to commence at 5 o'clock it was not until 7 o'clock that the battle got underway, lasting two hours. By 10 o'clock the volunteers were marching out of the ground. The railway was still carrying off volunteers and visitors at 2 o'clock the following morning.

The 'Daily News' enthusiastically reported the use of "Professor Wheatstone's field telegraph" and Holmes' presence by the grandstand. It mentioned that Lord Ranelagh had used the telegraph in the delay to summon "Herr Schallehn with his accomplished artists of the South Middlesex band" from the front line to amuse the lady spectators.

The government, which was hostile to the Volunteer Rifle movement, had promised provisions and cooking stoves, but provided none. This meant that many of the volunteers went for fourteen hours without food in travelling to and from and engaging in the sham fight.

Napoleon III, Emperor of the French, had already created a *télégraphe volant* or "Flying Telegraph" to accompany his army when it expelled the Austrians from Savoy in northern Italy during June and July 1859. The field cables, laid from horseback, were bought from the Gutta Percha Company and Wheatstone's new instruments from the Universal Private Telegraph Company in London.

The next campaign on behalf of the Universal telegraph was led by a promotional visit for journalists to Julius Reuter's premises in the City of London on the morning of Friday, December 21, 1860, conducted by Holmes. The major London morning papers published detailed, favourable reports of the new Universal apparatus, its overhead cables and its costs. These reports were copied over the next week by the main provincial daily and weekly journals.

It was not until April 8, 1861 that the first paid advertisements in the 'Times', the 'Daily News' and the other London morning papers appeared, promoting its terms of £4 per mile of wire and the option to buy or rent instruments. These coincided with a demonstration of "Professor Wheatstone's Universal telegraph" at the Royal Polytechnic Institution at 309 Regent Street in London's West End during that month.

The Company obtained a Special Act of Parliament for its statutory incorporation on June 7, 1861, with a capital of £100,000 in 4,000 shares of £25, half of which was called-up, and to acquire powers to erect and maintain private telegraph wires at a fixed annual rental and provide the instruments necessary to work them. The promoters modestly anticipated a minimum net dividend of 10% per annum. The new Statutory Company was launched on November 18, 1861; as Wheatstone's Universal telegraph had been introduced in 1858 there were already a large number of private circuits in use in London and in Glasgow.

Initially 2,000 shares were issued and taken up, mainly in London; eventually calls were made for £20 on each of these from 1861 through to the end of 1862. This would provide a working capital of £40,000 to finance and extend its first circuits in London and Glasgow.

The Universal company initially took rooms for its secretary and its clerks at *The Estate Market*, 3 Hanover Square, London W, a newly redeveloped building, formerly a hotel, with offices and chambers, as well as a board room, to let. Lewis Cooke Hertslet, the Company's secretary was also Manager to the Estate Market, owned by Mark Markwick, a property auctioneer. It was not there long, and had moved to 448 Strand, in rooms above the Electric Telegraph Company's Charing Cross station, by December 1861.

By June 6, 1861 there was already an aerial cable in operation between Finsbury Square and the Royal Exchange, containing 24 miles of wire, and another from the Royal Exchange along Fleet Street and the Strand to Waterloo Place, with 158 miles of wire, each wire ready to be connected to a private subscriber. In progress were lines from Charing Cross to the Houses of Parliament, 42 miles of wire, and from Waterloo Place to Camden Town, the Goods Depot of the London & North Western Railway, containing 45½ miles of wire.

The Universal company had a Board of eight directors; chaired by David Salomons, chairman of the London & Westminster Bank, the country's largest financial concern, among whose directors was J Lewis Ricardo. The Board had, too, at its table, Charles Wheatstone – his only directorship and by far the largest shareholder. It also had the remarkable scientific weight of his friends and colleagues, Joseph Carey, William Fairbairn, and Edward Frankland. Latterly the active directors were: Frederick C Gaussen, Robert O'Brien Jameson and C Wheatstone. Its Secretary was Lewis Cooke Hertslet, a professional manager, and its electrical engineer the ubiquitous Nathaniel J Holmes, who was also active in canvassing support among the scientific community at Wheatstone's behest. Holmes had been the original London station manager of the Electric Telegraph Company in 1846, working with Wheatstone in the 1850s and became engineer to cables and land lines in Europe and Asia.

Among the largest of the shareholders in the earliest days were S W and H A Silver, the manufacturers of india-rubber cable insulation, and William Reid, the second largest shareholder, principal of Reid Brothers, the telegraphic engineers and contractors, long associated with Charles Wheatstone in making his instruments. The Reid family retained their considerable interest until the end in 1870 when there were six, men and women, holding shares. Holmes had one share in the Company.

The initial shareholders were David Salomons (30 shares), S W Silver (40), H A Silver (40), C Wheatstone (44), Edward Frankland (26), Sam Mendel (10), William Reid Jnr (10), William Reid Snr (60), William Fairbairn (30) and "Glasgow" (200 shares). Together they contributed the first £18,000 in capital.

The prospectus noted that its bankers, where deposits for shares ought to be made, were the Union Bank of London, Temple Bar branch, the Manchester & County Bank and the National Bank of Scotland.

The eminent civil engineer, Thomas Page of Middle Scotland Yard, Whitehall, responsible for many major bridges, docks and sewerage works, was appointed consultant to the Company in 1860. He was not much troubled by his appointment. Page had lent his name to the alternative transatlantic telegraph cable promoted by James Wyld MP, by way of Scotland, Iceland and Greenland to Canada, in 1859, and did so again in 1866.

One of the first acts of the Board was to engage in an Agreement with the Electric Telegraph Company, with its immense network of public circuits; this complex seven-year arrangement was signed on September 3, 1861. Its clauses stated the strategic ambitions of the two companies; 1] the Universal was to operate private wires in cities and towns, it would not allow the wires of any other company on its premises, and it was to transcribe messages from its private lines to the public system only through the Electric's circuits. 2] In return the Electric would accommodate the Universal's clerks and instruments on its premises but would not be responsible for any costs. Messages would be transcribed at the Electric's current rate and all such income would be retained by the larger company; equally all revenues from private lines and instruments would go to the Universal company. 3] Unless the Electric agreed otherwise the Universal would not engage in public telegraphy or in third party agreements for service; in return the Electric would not engage in private telegraphy other than for government service which it was obliged to do under its Acts. 4] The Electric undertook to match the rate for any foreign messages transcribed from the Universal's circuits to the lowest available.

Private subscribers were only able to specify another company's foreign route if were to be quicker to the destination. However, foreign press despatches and newspaper messages could be sent by any route or company. 5] The Electric Telegraph Company agreed "to support and assist the Universal Private Telegraph Company, other than by pecuniary means".

The two companies clearly demarcated their spheres of work, and anticipated transcription traffic from private to public circuits, co-operating to achieve this. There was to be no revenue-sharing or inter-company discounting. The early importance of private press messages was highlighted in concessions.

The Company opened its chief office at Charing Cross, the geographical centre of London, initially within, then as it expanded to offices next door to, the Electric Telegraph Company's West End station, at 448 Strand, so that private messages could be transcribed from private to public circuits and *vice versa* by the hub station. Instruments in offices and houses were hence able to connect with the entire domestic and foreign telegraph system. It paid the Electric company £100 per year rent for "an office".

Eventually the Universal Private Telegraph Company was to have its principal office at 4 Adelaide Street, West Strand, housing the secretary, the engineer and three or four clerks. Its District offices were at 15, later at 11, St Vincent Place, Glasgow; at Hartford Chambers, St Ann's Square, Manchester, and then, from 1864, at 52 Brown Street, Manchester; and at Printing Court Buildings, Akenside Hill, Newcastle, each managed by a Local Secretary and two or three clerks. With such a small workforce the firm relied heavily on contractors for originating all of its services, whether constructing its lines or providing instruments, for maintenance and for storing materials. The prime role of its few clerks was in billing and accounting. The only other staff members were the Engineer, the Assistant Engineer and two local "line assistants".

It was reported that each of the three District offices in the provinces had "stores" for instruments and apparatus. No record of such premises has been found, so they are likely to have been in the nature of a "cupboard."

In 1864 it also advertised offices in its own name at Dundee in Scotland and Belfast in Ireland. These were actually the premises of its sales agents, George Lowden, instrument maker, of 25 Union Street, Dundee, and P L Munster & Sons, merchants, of 6 Corporation Street, Belfast.

It laid Wheatstone's patent 'aerial cables' at roof-level along discrete side streets in cities from which subscribers' wires were led off. Access to a circuit was leased at £4 per mile of line; the dial instruments could be purchased for £36 each with a £1 1s a year maintenance agreement or a pair leased over several years at £1 per month, "including keeping the instruments in perfect working order".

The Company's works throughout its existence were in the hands of a small number of suppliers: Reid Brothers were contractors for all overhead and road works in London, Glasgow, Manchester, and Newcastle. The Company used Reid Brothers' stores at 12 Wharf Road, City Road, London N, as their depot for materials. The Company paid Reids £80 per annum for "a storehouse". S W Silver & Company manufactured the india-rubber insulated aerial cables. Where it needed wooden poles the Company bought them from the Electric company's depot at Gloucester Road, Camden, or, for the north of the country, from Thomas Robinson & Son, Oldham Road, Rochdale, timber merchants.

Other major suppliers included Barwell Brothers & Smith of Hockley for iron swivels and bolts; Binks Brothers of Millwall for copper wire; W T Henley of North Woolwich for copper wire and coils; R Johnson & Nephew of Manchester for coils; and R S Newall & Company of Gateshead for copper-cable lightning conductors.

The principal manager was the Company's Engineer, a fact of some novelty; for most of its life this was Nathaniel Holmes, with an annual salary of £600. When he became involved with other work in the mid-1860s his assistant and eventual replacement in 1866, Colin Brodie, became equally active in promoting the Company's telegraphs and dealing with the Board. Lewis Hertslet, with a salary of £300, remained as Secretary in London from 1861 until 1864 when William Brettargh, one of the Company's longest serving clerks, took over and remained in that position until 1868.

Each of the three provincial districts had a Local Committee of directors or major shareholders of five or six members that managed the business. As with the Board in London these were assisted by a Local Secretary. In Manchester this was Basil Holmes, the brother of Nathaniel Holmes, then Frederick Evan Evans; with Robert J Symington in Glasgow and Arthur Heaviside, Wheatstone's nephew, in Newcastle. The Local Secretaries had a salary of £200 per annum. Their clerks were each paid £52 a year.

Holmes was originally supported in 1861 by two "line assistants", Eugene George Bartholomew (£200 a year) and Colin Brodie (£150 a year). Bartholomew, who had previously been telegraph superintendent of the London, Brighton & South Coast Railway and superintendent at the Valentia station of the Atlantic Telegraph Company left in 1864. Brodie then became Assistant Engineer at £300 a year, and was finally to replace Holmes in 1866.

As regards the apparatus on private premises, maintenance and repair was placed in the hands of "Inspectors of Instruments", effectively sub-contracted, self-employed clock, chronometer and watch makers in the cities in which the Company had district offices. None of these individuals were employees of the Company and there were probably less than a half-dozen. The instruments, by all accounts, were remarkably reliable.

The Universal Private Telegraph Company, even from its first years, was not just a provider of communications - as its presence at the International Exhibition of

1862 at South Kensington shows. The influence of Charles Wheatstone was overwhelming; of course the Company displayed to the audience two of Wheatstone's Universal telegraphs, but it also included and offered for sale examples of immensely advanced technology; his automatic printing telegraph – which it claimed could print 500 code-characters a minute; his magnetic clock connected with several other small clocks; alarm and "exploding" bells worked by electricity; and a magnetic register or telemeter, showing the number of persons passing through the doors and turnstiles of the exhibition.

The "exploding" bells were actually Wheatstone's patent *magnetic exploder* for detonating explosive charges. It had been advertised by the Company in June 1861, and was widely demonstrated indoors and outdoors during the 1860s by remotely letting-off small fireworks and flares. The exploder was adopted by the British Army for demolitions in 1861.

Commencing in 1863 the Universal Private Telegraph Company installed a series of 'time guns' in Newcastle, Glasgow and Belfast. These sounded the hour at one o'clock each day based on an electric time signal from the Observatory at Edinburgh, Scotland.

On January 11, 1865 Nathaniel Holmes wrote to Captain Matthew Maury from the Company's office that he was negotiating with General Sir John Burgoyne, inspector-general of fortifications, in regard to electrical torpedoes that they and Wheatstone had been developing. "Tact and delicacy" were required in proceeding to avoid revealing anything to the Americans, with whom Maury's country was at war.

In 1868 the Company was also selling cipher machines or "cryptographs", another of Wheatstone's inventions, to monarchs, governments and the police.

Developing the Business

Unlike in public telegraphy where Miles of Line are important in securing particular profitable routes and Miles of Wire are less so as they address capacity and to some extent are adjustable to suit demand – in private telegraphy Miles of Wire are the determining factor in the model. The more Miles of Wire that it rented out to private subscribers the greater its income will be; the private wire company must determine the optimum number of wires for any district that it intends to serve and ensure maximum uptake of those wires. The use of multi-strand cables was the key to effectiveness in this, rather than the multiple use of single iron wires.

The original costs for private telegraphy were similar to public telegraphs: in negotiating rights-of-way, paying wayleaves, and in constructing the lines.

The Universal Private Telegraph Company initiated two income streams; rentals from private wires and rental and sales of instruments. During 1861 and 1862 it had constructed ten aerial cables in London, each carrying from fifty to thirty circuits or "strands", its marketing effort was in finding renters for each of these circuits. It planned to buy or lease houses at triangulation points across London to form secure places for the attachment of its aerial cables on their roof-tops and then let the premises to businesses or residents conditional on access to their circuits.

Even before the Company's creation the Universal telegraph instruments had been installed on internal circuits at newspapers in London, by Reuter in his foreign news agency and by the City Police.

The Company's initial twelve page prospectus, issued in 1860 from Hanover Square, revealed that the first Universal telegraph circuit had been made in the autumn of 1858 between the Houses of Parliament in Westminster and the Queen's Printers, Eyre & Spottiswoode, in Shoe Lane, Fleet Street in the City of London.

It also said that in 1860 the London Dock Company had nine instruments in operation, between its Dock House, their chief office, in Princes Street in the City of London, to the Superintendent's office at their docks at Ratcliff Highway, to the Commercial Sale Rooms in Mincing Lane and to several warehouses. The Surrey Dock Company had joined their Dock House in St Helen's Place, Bishopsgate, City with their docks in Rotherhithe, and the Commercial Dock Company their Dock House in Fenchurch Street, City, and to the other great docks at Rotherhithe, both with two instruments. The City of London Police then had nine instruments; Julius Reuter had six, connecting his offices in Waterloo Place, the Houses of Parliament, Royal Exchange Buildings and Finsbury Square; the 'Daily Telegraph' newspaper, most appropriately, also had two, between its offices in Fleet Street and the Houses of Parliament. De la Rue & Company, banknote and stamp printers, had four, connecting Bunhill Row, Cannon Street, and the Government offices in Somerset House, Strand; Glass, Elliot & Company, the telegraph cable makers, had two, from Cannon Street to their works in Greenwich; the North London Railway had an experimental line with two instruments between its stations at Hampstead Road and Camden Road (the latter being opposite the site of Wheatstone's first line of telegraph in 1837).

Alfred Waterhouse, the proprietor of the large tea-dealing firm of Dakin & Company, was to have his home at 44 Russell Square, Bloomsbury, his City office and shop at 1 St Paul's Churchyard, City, and his West End outlet at 119 Oxford Street, linked by telegraph, acquiring four instruments.

Outside of London, in 1860, Platt Brothers, textile machinery makers of Oldham, Lancashire, had three Universal telegraphs to connect their several workshops. The Forth & Clyde Canal Company in Scotland had two to communicate between their lock gate stations. Lord Kinnaird installed two, between his house at Rossie Priory and his factor's office in the City of Dundee, twelve miles distant.

There were, in addition, thirty-one commercial and industrial concerns in the City of Glasgow that were awaiting completion of the Company's first private circuits in Scotland's other capital.

South Australian Railways had also bought fifty-two sets of Universal telegraph apparatus "capable of working over a distance of 150 miles" in 1860.

The earliest additional subscribers for rental of a private wire in London included, in April 1861, S W Silver & Company, Bishopsgate to Silvertown; Ravenhill & Salkeld, engineers and shipbuilders, Ratcliffe to Blackwall; the 'Daily Telegraph', Fleet Street to Russell Square (the owner's residence) and the Thames Graving Dock Company, Silvertown; in September 1861, Pickford & Company and Chaplin & Horne, the carriers, and Bass & Company, the brewers, from their City premises to Camden Town railway goods depot; in March 1862, J Reuter, Royal Exchange Buildings to the offices of 'The Times', 'Daily Telegraph' and 'Morning Star' newspapers; and in July 1862, the Zoological Society of London, from its premises in Regent's Park to its offices in Hanover Square, Middlesex Water Works and Price's Patent Candle Company. The famous photographic artist, Antoine Claudet, had a private telegraph connecting his house in Chester Square with his studio at 107 Regent Street in that month.

It also listed John Penn, the ships' engine builder, and Elkington & Company, the electroplaters, as clients in its first year, as well as other manufacturing and engineering firms in London.

The Universal Private Telegraph Company and Mr Julius Reuter's Establishments

The 'Glasgow Daily Herald', Saturday, August 10, 1861

"The eye is arrested at the corner of Threadneedle Street by a singular tripod erection upon the roof of Mr Alderman Moon's [bookselling] premises, Royal Exchange Buildings. In appearance this resembles one of those iron river beacons placed to warn mariners off some dangerous shoal, with the exception that sundry ropes, supported by iron wires, appear to diverge from the top, and spread out in different directions. These rope-like appendages enclose the electric conductors of fine copper wire, fifty or one hundred being combined together according to the requirements of the district through which the "telegraphic main" is carried. Each separate wire of this bundle of conductors is carefully secured from contact with adjacent ones by insulation with Messrs Silver's patent india-rubber process, and further protected to resist mechanical injury and the effects of atmospheric exposure by coatings of prepared tape and hemp. The rope thus constructed is suspended between the poles, in lengths of about 200 yards, to the two iron wires by means of hooks drawn with it over the wires. The ends of each length of rope are carried down the pole into a box, the several wires separated and passed through little canals of ebonite arranged in a disc, and numbered consecutively, to correspond with those of the wires. By these means a communication with the "main" can be opened as any point along the line, and private wires carried down from the nearest post to the house or premises required to be placed in communication. If any accident happens to any particular wire, it can be discovered where the fault lies by testing from post to post."

"Passing onwards from the Royal Exchange, the "telegraphic main" traces its path down Birchin Lane, across the tower of St Clement's Church, to Cannon Street, where it enters another tripod, and meets the lines coming in from Whitechapel, Bermondsey, and North Woolwich. These tripods are placed wherever several lines meet or fall into one another, and are intended as stations for combining the wires coming in one direction with those entering from another. The ends of these cables are carried down the post into the connecting box. The box consists of a sheet-iron frame fitted with a lid, and about three feet long by two broad, and four inches in depth. The interior is furnished with insulating slips of ebonite, corresponding in umber to that of the cables entering the box. Each ebonite slip is furnished with a series of small screw terminals, numbered consecutively 1, 2, 3, 4, &c, to correspond with those of the discs along the line, and receive the several insulated wires of the rope which it represents. These wires are severally attached to the screws of each lip, and by means of cross-connection, can therefore be combined together in any desired direction. Entire command is thus given over the whole of the lines."

"By means of one of these boxes, at Waterloo Place, the various foreign ambassadors having private wires carried into that office, can, at will, be thrown in to communication with one another, the correspondence, though passing through Mr Reuter's establishment, remaining entirely secret. The various telegraph companies each having a private wire carried into Waterloo Place, any ambassador may likewise, by means of this box, at once be placed in direct communication between his own residence in London and his government abroad through the agency of the International or Submarine company's Continental system."

"Following the rope at a considerable elevation along Cannon Street, St Pauls' Churchyard, and Ludgate Hill, the line enters another tripod, at the corner of Bridge Street, Blackfriars, meeting the Holborn and Southwark "mains". Leaving this, the wires purse their zig-zig course along Fleet Street, and the Strand, the 'Illustrated London News', and Somerset House, to Hungerford Market, where they are lost to the eye. Here, by permission of his Grace the Duke of Northumberland, the cable passes along the roof of Northumberland House, descending into the street at Messrs Prater's [army clothiers], from whence is passes underground to Mr West's, the optician, of Cockspur Street, and, reappearing again at his roof, is carried across Pall Mall to Waterloo Place, where, for the purposes of the present description, we will leave it to worm its tortuous and various windings up Regent Street, Oxford Street, Tottenham Court Road to Euston Square, and the goods station, Camden Town. At Messrs Prater's, [No 2] Charing Cross, the "telegraph main" diverges in the direction of Whitehall and the Houses of Parliament; and by permission of the First Commissioner of Works, also passes almost the entire distance along the cornices of the Government Buildings, entering the Houses of Parliament, at the Clock Tower, and under the basements to the lobby of the House and the Reporters' Gallery."

"At Mr Reuter's telegraph office, 9 Waterloo Place, the wires descend into the house; and there we propose to examine more minutely the system. On entering this establishment we proceed up a staircase, and find ourselves in a suite of handsome apartments, used for the transaction of important business."

"Ascending the stairs, we enter the signal room on the right round which, ranged on shelves, are the call-bells, twelve or thirteen in number, each furnished with a tell-tale, and numbered 1,2, 3, &c. From these bells wires proceed into the instrument room, and can be placed when required in communication with the corresponding instrument, to give notice that a "telegram" is about to be sent. As soon as any bell rings, a boy in the alarm room calls out the number to the instrument clerk, who immediately prepares for the message. Passing from here, we enter the instrument room, into which thirty wires descend from the telegraphic "main" on the roof. Eighteen of these wires branch off into a box fitted with terminable screws placed in the instrument room, the remaining twelve being carried into a similar box in the ambassadors' room. At these boxes the ends of the wires are all numbered to correspond with those in the "main". From these boxes, also, another series of wires proceed to the various instruments ranged round the room, by which means the ends of a wire, at any particular instrument, can at any moment be thrown into communication with any of the thirty wires leading into the "main". Standing in the centre of the room, we have time to examine more closely the details of this wonderful arrangement; and the first thing that strikes us is, that each of the instruments has a plate attached to indicate to which direction of the metropolis it is in communication. On one we can read 'Times', Printing House Square; on others 'Times', Houses of Parliament; 'Daily Telegraph', Houses of Parliament; &c., other tables enumerate the 'Daily News', 'Morning Post,' 'Morning Herald', 'Morning Star', 'Morning Chronicle', 'Morning Advertiser', each of the various newspapers having its own private representative, and distinct channel of news. Other series of tables and instruments point out fresh sources of intelligence – wings of thought by which the genius of the house, Mr Reuter, carries on his business. Here we read Reuter's Cornhill, Reuter's Houses of Parliament, Reuter's Finsbury Square. Then again there is the representative from the International Telegraph Company, standing in the room ready for the instantaneous receipt of the Continental Service "telegrams"; messages can be received here simultaneously with their despatch from the Continent. Here, indeed, the mind seems bewildered at the comprehensiveness of the arrangements and system, which can, at a grasp, place an individual not only in complete command of the Continent, but also of the metropolis, and almost every important town and sea port in the United Kingdom."

"The power and resources of this little room are almost fabulous. Presently one of the alarms rings in the next room, and without further preparations, beyond shifting a handle to throw the telegraph into connection with the "main", the little index in front of the operator revolves with marvellous rapidity, and the words, "Paris, July 29, evening. It appears that the king of…" just catch our eye as we retire, amazed to think that the quiet house in Waterloo Place is in exclusive possession of intelligence that only a few moments before was whispered in Paris."

This extract is quoted in such length as it describes the remarkably sophisticated private electric communications system that the Universal company and Julius Reuter had together developed in 1861!

Reuter's offices at Lothbury and Finsbury Place were said to be equally complex in their arrangements.

Nathaniel Holmes, the Company's engineer, provided access to Reuter's Waterloo Place hub, and was the guide during the tour. He may have written this revealing, indiscrete article

---

From its commencement the Company had a strong interest from Glasgow; almost simultaneously with the cables in London a series of circuits were established in Scotland's commercial and engineering capital.

The first contract for a private telegraph outside of London was agreed with Reid & Ewing, muslin and calico printers, of Maryhill, Glasgow, on October 23, 1860, to connect with their city office in George Street.

In September 1861 the City of Glasgow Police; Loch Katrine Waterworks; the Glasgow Gas Light Company; the City & Suburban Gas Company; the Forth & Clyde Canal; Dalglish, Falconer & Company, calico printers; Henry Monteith & Company, dyers; G & J Burns, steamboat owners and engineers; A & A Galbraith, spinners and cloth manufacturers; Charles Tennant & Company, chemical manufacturers, David Hutcheson & Company, steamboat owners; Yates, Brown & Howat, muslin manufacturers; and many other mercantile, shipping and engineering firms were already subscribers. Whilst most acquired two instruments to connect their city office with their works, the ship-owners, G & J Burns required six, and David Hutcheson, four Universal telegraphs to cover all their premises.

William Mackenzie, a "letterpress printer, stereotype founder, engraver, lithographer, bookseller and publisher" of 45 & 47 Howard Street, Glasgow, had a private circuit installed between his office and works. He also engaged to print the Universal company's initial prospectus, and went on to produce the firm's stationery and instrument manuals for most of its existence.

In October 1861 the Company was canvassing for private wire customers in Manchester, the centre of the cotton trade and manufacturing in Britain and was engaged in building its first aerial cables there. It appointed an Agent to solicit business on commission, Wheatley Kirk & Company, of Albert Street, St Mary's, Manchester, a firm of surveyors, valuers and auctioneers of factories, plant and machinery. Kirk, who styled himself "District Engineer & Agent" for Manchester, Lancashire, Yorkshire, Cheshire and the Midland Counties, was to be found exhibiting the telegraph to trade associations in Manchester during 1861.

Nathaniel Holmes, the Company's engineer, was the driving force in the initial development of the Universal company; he was to be found soliciting shareholders from the scientific and mercantile communities, touring the country in this role as well in engineering and managing its works. In 1862 he was travelling between London, Bristol, Newcastle, Birmingham, Glasgow and Liverpool and ran up £907 in costs and expenses.

Looking for major users, during 1861 Holmes provided a costing to the government for private circuits in Whitehall to serve fifteen cabinet ministers; 19 instruments, 11 extra bells and 4 switches, totalling £337. In the same year he quoted the Metropolitan Police for circuits connecting Scotland Yard with the seventeen divisional chief offices and to the City Police; 21 instruments, 13 bells and 4 switches, at £335. Both of these projects were to be adopted in subsequent years in slightly modified forms.

However, the Company's activities were producing results, orders for private lines in June 1862 were: in Glasgow 37; in Manchester 54; in Liverpool 15 and new lines in London 20.

In this year a substantial network was commenced for the Marchioness of Londonderry connecting her residence at Seaham Hall, Durham, with several of her collieries and the harbour at Seaham. This grew to five separate circuits by 1868, and connected with the Electric Telegraph Company at Sunderland.

The Year 1862

After a year's construction activity the Company had achieved in September 26, 1862, in miles of wire constructed in cables, with the number of strands (circuits available) and those miles of wire that it had found renters for:

London District 1862

Line A – Finsbury, 30 strands, 1 mile length, 30 miles wire , 9 ½ miles rented
Line B – Strand, 50 strands, 3.2 miles length, 160 miles wire, 51 miles rented
Line C – Whitehall, 50 strands, 1,200 yards length, 35 miles wire, 6 ½ miles rented
Line D – Camden, 30, 20 and 15 strands, 1,430 yards length, 76 miles wire, 17 miles rented
Line E - Oxford Street, 30 strands, 660 yards length, 16 miles wire, 4 miles rented
Line F – Pimlico, single wire, 7 miles, 6 miles rented
Line G - Victoria Docks, 30, 20 and 15 strands, 124 miles wire, 10 miles rented
Line H - Southwark ,30 and 19 strands, 13 miles wire, 3 ½ miles rented
Line J – Lambeth, a single wire, 6 miles, 2 ½ miles rented
Line K – Wapping, 30 strands, 59 miles wire, 4 miles rented

This totalled 526 miles available in London. It then had 412 miles of spare capacity in London, but 35½ miles had applications from potential customers.

The District was also advertising heavily and canvassing for subscribers in industrial Birmingham in the English Midlands during December 1862.

Glasgow District 1862

Line A – 20 and 15 strands, 29 miles of wire
Line B – 20 and 15 strands, 17 miles
Line C – 30, 20, 15 and 10 strands, 38 miles
Line D – 20 and 19 strands, 10 miles
Line E - Govan and Renfrew in progress
Line F – 20 and 15 strands, 14 miles
Line G – 30 and 15 strands, 69 miles

This totalled 177 miles of wire available in Glasgow.

In October 1862 the Universal company listed the following thirty firms as having private wires in Glasgow; Dalglish, Falconer & Co., calico printers, Glasgow to Campsie, Robert Napier & Sons, engineers and iron founders, Lancefield to Govan, Parkhead Forge Company, Vulcan Foundry of James Napier, Henry Monteith & Co., calico and silk printers, G & J Burns, shipowners, Handysides & Henderson, ship-owners, William Sloan & Co., steamship agents, Charles Tennant & Co., manufacturing chemists, W & J Blackie & Co., printers and publishers, W & J Fleming & Co., linen works, A & A Galbraith, spinners and cloth manufacturers, David Hutcheson & Co., steamship agents, William Holmes & Brothers, shawl manufacturers, Murdoch & Doddrell, sugar refiners, Glasgow Iron Company, City & Suburban Gas Co., William Miller & Sons, turkey red dyers and calico printers, Strang & Hamilton, "twisters", Mitchell & Whytlaw, cloth manufacturers, Muir, Brown & Co., calico and silk printers, Robert Laidlaw & Son, ironmongers and iron merchants, Wylie & Lochhead, house furnishers, Edinburgh & Glasgow Railway Company, P & W McClellan, ironmongers and iron merchants, Greenock Foundry Company, J & A Allen's United States Steamship Office, George Miller & Co., manufacturing chemists and oil refiners, Bulloch, Lade & Co., spirit merchants, Lancefield Forge Company, among others.

It was to extend its lines in the autumn to the Vale of Leven, Barrhead, Thornliebank, Busby, Hurlet, Paisley, Greenock and Wemyss Bay. A plan was already in hand to link the Cumbrae, Pladda and Kintyre lighthouses to Glasgow city to provide information on shipping movements in the Clyde river.

Manchester District 1862

There were problems in developing the Manchester business. On September 26, 1862 there were no multi-strand aerial cables in use, but 20 miles were "suspended", along with a single open wire.

A long report to the Board of Directors in August 1862 noted that Bonelli's Electric Telegraph Company and the Globe Telegraph Company were active in "tapping" its business. Their agent, Wheatley Kirk, had been dismissed but retained a stock of instruments and the books. Basil Holmes, the engineer's brother, was appointed Local Secretary in his place. In response to the competition Holmes proposed, after negotiations with George Edward Preece, the Electric Telegraph Company's District Superintendent, that extensions be immediately carried out using the Electric's rights-of-way on existing overhead pole lines at 1s a mile wayleave, and through rental of wires where they were already up on an annual payment. These would consist of circuits 1] Manchester to Liverpool (6 wires); 2] Liverpool to Northwich (3 wires); 3] Manchester to Warrington (2 wires); 4] Manchester to Patricroft (4 wires); 5] Manchester to Bolton (4 wires), and 6] Manchester to Ashton and Stalybridge (2 wires). He also wished to acquire rights-of-way from Manchester to Stockport, Bolton to Bury and Rochdale, and Rochdale to Oldham and Ashton. This would rapidly extend the Company's coverage of Manchester and Liverpool, which he felt could be quickly rented to private subscribers.

The remarkably competitive situation in Manchester was such that Holmes identified seven firms active in private telegraphy: Bonelli's, W T Henley, Clyatt Morgan, Henry Wilde (the Globe Telegraph Company), John Faulkner & Company, Lundy Brothers and Wheatley Kirk & Company, their late agent. This came about, at least in part, through the policy of the Corporation of Manchester of freely granting permission for the carrying of open wires across and along public streets, which most local authorities refused.

Basil Holmes left the Company's service in Manchester after a couple of years and returned to his previous profession of artist, painting landscapes and sculpting, in Exeter, Devon. He was replaced by Frederick Evan Evans, who proved more determined and subsequently joined the Post Office Telegraphs.

The Company sought to lay its own cable across the Mersey connecting Liverpool and Birkenhead on November 7, 1861. The Docks and Harbour Board rejected the application.

The international mercantile cotton brokers of the port of Liverpool and the huge textile manufacturing industry based on cotton in Manchester were to prove some of the most enthusiastic adopters of private telegraphy. This was true even in the depths of the cotton famine brought on by the start of the latest internecine American war in 1861.

In March 1862 the Universal company proposed to erect a shipping telegraph between Cork and Queenstown in Ireland on the vital sea route to America, to report maritime traffic through a proposed new cable to South Wales and England. The Electric Telegraph Company invoked its agreement of September 1861 prohibiting any connection with other circuits. This dispute initially went to court but the suit was abandoned when the Electric bought out the cable company and agreed to the Universal's participation.

On September 15, 1862 Reid Brothers agreed to erect the "Coal Line" for the use of William Cory & Company, the coal factors. It was a roadside circuit leading from North Woolwich, 14 miles to Purfleet on the Thames estuary, to give early notice of colliers arriving in the river. The long private line cost £364. Cory handled a million tons of coal a year and was famous in the 1860s for the monster coal derrick, *Atlas*, moored on the river for mechanically unloading the firm's colliers.

S W Silver & Company had manufactured 534 yards of 60 strand cable, 416 yards of 50 strand, 8,079 yards of 30 strand, 8,769 yards of 20 strand, 5,902 yards of 15 strand and 5,125 yards of 10 strand by the end of 1862.

It was not all business. The Company was always ready to promote itself to the public in social events. A *soirée musicale, artistique et scientifique* was held by the London Cambrian Society at the London Coffee House, Ludgate Hill, on the evening of November 9, 1862. The principal event was a concert with two fine singers and a harpist from the Welsh community in London. Even so, as part of the *scientifique* element, Professor Wheatstone was there with his Universal telegraph, which was personally tried out by many of the visitors. He was not alone in the telegraph interest; the Submarine and London District Telegraph companies laid on wires to connect with their systems; Thomas Allen showed his "light cable" to span the oceans, Cromwell Varley had his new "fault finder" on display, Owen Rowland, some cables, Messrs Silver, some of their india rubber insulated wires, as did Messrs Hall & Wells, and, on a lighter note, Francis Pulvermacher, the medical electrician, demonstrated his batteries and other electrical apparatus, to "cure, without pain, trouble, or any other medicine, all kinds of rheumatic, neuralgic, epileptic, paralytic, & nervous complaints, indigestion, spasms & a host of others."

Extension in 1863

On January 9, 1863 Reid Brothers completed the connection of private wires between the head office of the London & Westminster Bank at 41 Lothbury, City, and its two major branches in London in the West End at 1 St James's Square, and in the "Borough" (Southwark) at 3 Wellington Street. David Salomons, chairman of the Universal Private Telegraph Company, was also chairman of the London & Westminster Bank.

When the Pneumatic Despatch Company opened its underground tube railway between the arrivals platform at the Euston Square station and the North-Western District Post Office in Eversholt Street, London, during January 1863 Reid Brothers installed the Universal telegraph to signal the arrival and departure of its novel carriages loaded with letters and parcels. The Pneumatic Despatch was a development of the Electric Telegraph Company's air circuits carrying messages between its offices in the City of London. Its cast-iron tubes were scaled up from 1½ inches in diameter to 30 inches, to contain close-fitting, four-wheeled railway waggons propelled by a vacuum. It was similar in operation to the "atmospheric" system worked on the London & Croydon and South Devon Railways, whose air pumps were controlled by Cooke & Wheatstone's newly-patented electric telegraph 20 years previously, in the 1840s. The 580 yard long tube line opened for service on January 15, 1863 and worked thirteen miniature trains a day carrying mail for the Post Office.

Nathaniel Holmes presented a series of maps to the Board of Directors in March 31, 1863 illustrating the aerial cables that the Company had already erected in Manchester and Glasgow, and his future plans:

- Manchester to Hyde, Stalybridge and Glossop
- Manchester to Oldham
- Manchester to Middleton, Bury, Haslingden, Accrington, Blackburn and Preston
- Bury to Wigan and Blackburn

Cables in the Manchester district were planned from Middleton to Rochdale and from Manchester to Stockport.

- Glasgow to Partick
- Glasgow to Campsie Junction and Kirkintilloch and Lennoxtown
- Glasgow to Leven
- Glasgow to Pollockshaws and Thornliebank with branches to Barrhead and Busby
- Thornliebank to Paisley, Port Glasgow and Greenock, and to Paisley and Dalry

A long aerial cable was planned in the Glasgow district to connect with Edinburgh and Leith.

The five lines of aerial cable operating in the Manchester District during most of 1863 were designated:

Line A – Pendlebury
Line B – Halmer
Line C –
Line D – Oldham
Line E – Victoria Station

On December 8, 1863 the first subscribers and the first private wires were created in Belfast, Ulster, in Ireland. William Ewart & Son, flax spinners, linen manufacturers and bleachers, connected their office at 11 Donegall Place with their works at the Crumlin Road Mills; William Girdwood & Company, Old Park Print Works were joined to their offices at 16 Donegall Place; and Johnston & Carlisle, of Brookfield flax spinning mills in Crumlin Road had a line to 30 & 34 Donegall Street in Belfast city.

Virtual Office 1863

On May 1, 1863 the Universal company announced in Glasgow that "The large Saloon on the ground floor, 15 St Vincent Place, is to be fitted up into small counting rooms for the accommodation of those firms in the suburbs and neighbouring towns who have no offices in the city, and who may wish to have private telegraph communication betwixt their works at a distance and Glasgow. The premises are in close proximity to the Exchange. By this arrangement a person whilst transacting business in the city can consult or be consulted by those at the works as easily as if in the next room. They will be let at £10 per annum."

An inclusive rate for telegraph and office was offered, an example of which was £34 per annum for a three mile line, inclusive of all maintenance. There was a "smaller rate per mile" for longer distances. As well as the City centre Pollockshaws, Barrhead, Hurlet, Nitshill, Paisley, Port Glasgow, Greenock, Springburn, Kirkintilloch, Campsie, Maryhill, Dalmuir, Kilpatrick, Bowling, Dumbarton, Dalreoch, Renton, Alexandria and Balloch were all then in private circuit.

Newcastle 1863

In January 1863, Basil Holmes in Manchester began advertising for private wire clients in a new market: Newcastle-upon-Tyne, the major centre for the coal-trade and for heavy engineering in north-east England. This canvass was immediately successful, leading to the establishment of a separate Newcastle District office. In March 31, 1863 it planned three cables:

- Newcastle to Elswick and Scotswood
- Newcastle to St Anthony, Willington, North Shields and Tynemouth
- Newcastle to Gateshead, Friarsgoose, Jarrow and South Shields

In Newcastle the commonest aerial cable was one of seven strands; however a nineteen strand cable was run 440 yards across the river Tyne near Robert Stephenson's famous High Level Bridge.

In that District the earthenware insulators on its roadside open-wire circuits near colliery villages became a regular target for young vandals.

In January 1863 the Company began renting wires in Dundee through an agent, George Lowden of Union Street, in that Scottish city, initially to the Royal Exchange building.

The board of directors, on June 12, 1863, anticipating substantial expansion and expenditure in the next few years, decided to increase its authorised capital. It would then amount to £190,000 in 7,600 ordinary shares of £25, all except £5 per share to be paid-up. The balance of 5,600 shares, not yet with the public, was then offered for sale. Not all of this was taken up, but it did cause a considerable change in shareholding, with provincial participants overtaking London capitalists.

The Universal company was able throughout its life to avoid the use of preference shares and the need for any loan or debenture issues, such was its strength in the capital markets.

Mr Holmes' Artillery

One day, a coalminer from some distant part of Durham, who had never heard of such things as time-guns, was passing across Newcastle Bridge, when he was startled by the sudden roar of the gun just above him. Amazed, he asked a passenger "what that was," who replied that it was "one o'clock." "One o'clock!" exclaimed the miner; "I'm very glad I were not here at twelve."

Mechanics' Magazine 1864

Time Guns

In Newcastle, from August 17, 1863, the Universal Private Telegraph Company, at the instance of Nathaniel Holmes, took a time-signal from Royal Observatory, Edinburgh in Scotland, off the Magnetic Telegraph Company's circuits and used Wheatstone's magnetic exploders, rather than galvanic batteries, in its office at one o'clock each day to ignite the charges of "time-guns" at the Old Castle in the city and at Barrack Hill several miles away in North Shields, signalling the precise hour of the day as a public service.

The process was described in 1865: "Mr N J Holmes... arranged a time-gun at Newcastle, 120 miles distant [from Edinburgh], to be fired by means of Wheatstone's magneto-exploder and Abel's magneto fuse; and on a fair day the current sent off along the telegraph wire discharged the gun with no sensible hesitation or 'hang fire;' but on a foggy day the highly intense magneto current was in too great a degree dissipated and lost. A practical system was finally devised, by causing a large signal-sending clock to discharge along the line of telegraph wire, at the due moment, a galvanic current of low intensity; this, on reaching Newcastle, was made to liberate in the proper apparatus there the more intense magnetic current, which had then only a few hundred yards to travel to the gun."

Prof Piazzi-Smyth, the Astronomer-Royal for Scotland, who introduced the very first electrically-controlled time-gun in Edinburgh in 1861, stated in November 1864 that his Observatory "looked on (Holmes) as the inventor of the distant time gun system".

The Company provided three more time-guns in Scotland: at St Vincent Place, Glasgow on October 29, at Broomielaw, Glasgow on November 10, and at Greenock on the Clyde on November 21, 1863. However all of these were abandoned in November 1864 at the insistence of the Electric Telegraph Company who objected to the use of the Magnetic's circuits, and who wanted to install its own time-balls regulated from Greenwich.

Not all Glaswegians appreciated the time-gun. Nathaniel Holmes was summonsed at the Police Court on a charge of discharging a cannon from the roof of No 15 Vincent Square to the inconvenience or danger of passers-by on November 16, 1863. Holmes' defence was that proper notice had been given. He also pointed out that, two years previously, when the first time-gun had been commenced in Edinburgh all the complaints came from a single individual who adopted a multiplicity of names in writing to the Police there. The justices dismissed the summons.

A temporary time-gun was set up by the Company in the yard of the Orphan Asylum in Sunderland on August 26, 1863 to fire off at one o'clock each day in celebration of the annual meeting of the *British Association for the Advancement of Science* in that city. The reaction of the orphans is not recorded.

The Company established a time-gun at the entrance to the basin in Dundee harbour in Scotland on December 23, 1863 for a short period.

By December 1863, it had, or anticipated, working remote electric time-guns at Aberdeen, Dundee, Glasgow, Birmingham, Coventry, Hull, Dover and Tilbury, as well as those in Newcastle and North Shields.

Its last time-gun was introduced in Belfast in Ireland at the invitation of the Chamber of Commerce in 1865. It, too, was connected by a circuit to Edinburgh Observatory and was installed by the Company at the Harbour Office. The gun fired daily at 1 o'clock *Greenwich* time as part of the Chamber's campaign to have time uniformity with Britain.

When the Electric Telegraph Company took over the management of the Newcastle time-guns on November 17, 1863 things went seriously wrong. With the original system of the Universal company, for the thirty-one days between October 17, 1863 and November 17, 1863 there were; Correct guns fired 30, No guns fired 1 and Incorrect time 0. Under the Electric between December 14, 1863 and January 14, 1864, also 31 days, the performance was; Correct guns fired 12, No guns fired 18 and Incorrect time 1. The Electric also abandoned their promised new gun at Sunderland. There was a public row in the newspapers between the City fathers and the Tyne River Commissioners, who had insisted on the change, over the poor service.

More Innovations 1863

The "Confidential Message System" was marketed by the Company, allowing subscribers with distant premises but without city offices to place terminal instruments in its hub station. The terms were the usual rental for wire and instruments, but with an additional sum for use of the Universal's office and clerks. There were three such contracts in Newcastle and one in Glasgow. A further three in Bradford terminated in the Electric Telegraph Company's office in that city.

One of the Company's most enthusiastic subscribers was to be Sir William Armstrong. The 'king of cannon' had a private wire from the office at his Elswick Ordnance Works to the Universal's hub in Newcastle which handled his messages on and off the Electric company's national circuits to an "enormous extent".

The great Museum at South Kensington had each of its many departments and its entrances connected by Universal telegraph in 1863. This was intended to protect its public and private exhibits; the doors being instantly shut upon any loss being signalled.

A new, very small Universal type-printing receiver of Wheatstone's design was offered in 1863 in place of the dial indicating instrument. The ordinary magneto-electric communicator was used with this device, which printed the message in alphabetic type on a tape. An "inkless" foil tape was originally used but was soon replaced by an inker and paper. As its mechanism was driven by clockwork the Universal type-printer was far less popular than the self-powered dial indicator.

It was described thus, in April 1863: "Wheatstone's New Printing Telegraph - A self-recording letter printing telegraph exhibited for the first time here (in Glasgow). By this apparatus, the message can be read by the receiver, if present, or recorded in legible type for his perusal during his absence. It consists of a small box divided into three compartments, the first of which contains, wound continuously on a wheel, several thousand feet of the slip on which the message is to be printed. The second compartment, about four inches square, contains the recording machine, capable of being worked either as a reading or printing telegraph, at the will of the operator, according as a small handle, placed in front of the dial, is turned to "read" or "print". This machine stops and starts itself without the assistance of any attendant, hitherto so necessary with former similar apparatus. The last compartment is an empty space, into which the message is received on leaving the machine. The box can be locked at pleasure, thus ensuring complete privacy in the transmission and receipt of intelligence."

Wheatstone's "miniature" printer worked by the Universal sender although revealed in 1863 was only patented, in concert with Augustus Stroh, in August 1871.

The Company's aerial cables had 50, 30, 20 or 15 copper strands or cores dependent on the potential of the district through which they were to run. There were also single india-rubber insulated wires, and "open wires", ordinary iron wire overhead circuits on earthenware insulators. Open wires were used primarily in their provincial lines.

The iron wires caused problems for the Company: in a year of electrical storms throughout the country large numbers of instruments were "thrown out-of-order" and one clerk rendered senseless by lightning in Glasgow during February 4, 1863. The use of *paratonnerres* or lightning protectors was obviously not obligatory in the private circuits.

It was working three private wires for marine telegraphs by the end of the year. One from Roche's Point to Cork in Ireland for the London & South-of-Ireland Direct Telegraph Company reported the movements of the trans-Atlantic steamers of the Cunard line for relaying to Liverpool and London. The others were both for the coal-owners; on the Tyne reporting the arrival of empty colliers to Newcastle, and then along the north bank of the Thames reporting the arrivals to the Coal Exchange in London and to the Victoria Dock where the colliers from the north-east of England unloaded.

The long marine telegraph reporting the arrival of colliers to the Coal Exchange from the mouth of the Thames, a single wire on wooden poles, was worked on the Company's "timber" between London and Rainham in Essex, then on that of the Electric Telegraph Company from Rainham to Tilbury, forty miles in all.

Having previously sold fifty-two instruments to the South Australian Railways, on April 3, 1863 the Company appointed Rattray & Matheson, solicitors, of Queen Street, Auckland, New Zealand, as agents for the Universal telegraph in all the Australian states and New Zealand. John Matheson advertised instruments for sale on September, 30, 1863.

The 'Argus' newspaper in Melbourne was to have a private wire using the Universal telegraph between its office in Collins Street and the reporters' gallery at the Parliament House in the Australian State of Victoria for several years.

Extensions in 1864

The Company opened 63 new private lines in 1864; new clients included Tupper & Company, iron wire makers; William Cory & Son, coal factors and merchants; South Kensington Museum; Victoria Dock Company; Odams Chemical Manure Company; Land Securities, a mortgage bank; Bryant & May, matchmakers; the Government's India Stores; Kennard & Hankey, bankers; St Katharine's Dock; Waterlow & Sons, printers; London Dock Company and the Chartered Gaslight & Coke Company. Reid Brothers, the Company's principal contractor, rented a wire between their City office and their works at Wharf Road, Islington.

A private line was opened in 1864 to Professor Wheatstone's home in Portland Place, off the aerial line to Finsbury. "It was his delight to startle a visitor or friend by sending a message to and receiving a reply from connexions or friends in distant parts of the country or abroad".

Names from the telegraphic past with private wires included Henry Brett, the gin and brandy distiller and early telegraph investor, and C W Tupper, the maker of the first iron wire circuits used in telegraphy by W F Cooke. The general manager of Price's Patent Candle Company, W H Hatcher, had a wire installed between their oil mill at Battersea and their factory at Vauxhall in South London. In 1846 Hatcher had been the first engineer of the Electric Telegraph Company.

In this year the Company began replacing its india-rubber insulation with gutta-percha, changing their suppliers from S W Silver & Company to the Gutta-Percha Company. A fire at Silvertown on May 26, 1864 destroyed a large mileage of the Company's newly-manufactured aerial cable.

The Universal Private Telegraph Company took a twenty-one year lease of No 4 Adelaide Street, Charing Cross, London, in July 1864, for its head offices. It inherited these premises from the *Westminster Society for Insurance on Lives and Survivorships, and Granting Annuities*, when the society's business was transferred to another concern.

The London lines had cost by December 1864 £16,574 to erect; the 596 miles of aerial cable at £19 3s 10d per mile of wire, the 135 miles of conventional "open wire" circuits cost £31 11s 2d per mile of wire.

In Manchester Robert Dodwell, the former District Manager of the Magnetic Telegraph Company, was employed as commission agent to acquire new renters in July 1864. He managed to gain over thirty new customers in the rest of that year from Manchester and Yorkshire. He had previously acted as agent for W T Henley's unsuccessful magneto dial telegraph and as engineer to Bonelli's Electric Telegraph Company in Manchester.

The Company looked at acquiring the long six-wire circuit constructed by Dodwell for Bonelli's company between Manchester and Liverpool after that concern ceased trading in 1864. Although this line was on a prime commercial axis, with clear potential for private wire rental, and it experimented with transmissions on the circuit, terms could not be agreed.

The Newcastle District at the end of 1864 had 303 miles of wire, 138 in aerial cables and 165 miles of "open wire". It had eleven lines: for Gosforth, North Shields, a Loop at North Shields, South Shields, the River Tyne, Northumberland Docks, Birtley and Chester-le-Street, Blyth, Low Walker, Whittledean and Sunderland.

In that year the Company introduced the first switching or, as it came to be called, *exchange* between subscribers in Newcastle. Initially three renters of instruments were able to communicate with each other through a Swiss Commutator or *Umschalter*, a small switch-board, at the Akenside Hill hub. By 1868 the network had increased to eight intercommunicating subscribers. Colin Brodie, the Company's assistant engineer, devised this, the very first, private exchange system.

In a radical change in its business model circuits in the lines at Blyth and Chester-le-Street were opened for *public traffic* to the District office in Newcastle on December 14, 1864. The cost for a local twenty-five word message, including addresses of sender and recipient, was 6d; this was different from the standard twenty word message base of the national companies. These circuits also retransmitted messages to the Electric Telegraph Company's national lines when required.

The Company appointed an agency in Ireland to market private telegraphy during 1864; P L Munster & Sons, commission merchants, 6 Corporation Street, Belfast, in the industrial north of the island.

Jonathan Mellor, a cotton magnate from Manchester and a director of the South-Eastern Railway, joined the board of directors on February 24, 1864 and became chairman. Of more interest, Mellor was also a director of the India Rubber, Gutta-Percha & Telegraph Works Company, the joint-stock successor to S W Silver & Company, the principal supplier of the Universal's multi-core "aerial cables". Behind this appointment is the back story of the brothers Silver who, as well as being suppliers, were large shareholders and at the same time in litigation with the Company over their patent insulation. Mellor replaced David Salomons, the powerful chairman of the London & Westminster Bank, who withdrew from the board for health reasons.

Unsurprisingly the Company, on Mellor's election, reverted to having the India Rubber, Gutta-Percha & Telegraph Works supply its multi-core aerial cables. However it also bought some stock from Wells & Hall, telegraph wire makers, of Mansfield Street, Borough Road, Southwark, in November 1864 using their patent india-rubber insulated cores. Arthur Wells and Walter Hall had already contracted with the government to manufacture standard telegraph wire for the army and navy, a No 18 BWG tinned copper wire insulated with india-rubber to a quarter inch diameter, weighing 90lbs per mile. This field cable had been successfully tested underwater for four years at the ordnance testing grounds at Shoeburyness on the Thames estuary.

In June 1864, at Mellor's suggestion, the Company's shareholders voted for the board of directors to share equally an annual honorarium of £600. Previously the directors had received no fees.

The Year 1865

New clients in 1865 totalled thirty-one in London and five in Newcastle, as well as others in Manchester. These included the Manchester Steel Company (owned by Joseph Whitworth), the Corporation of Salford (a local government authority), Shaw, Savill & Company (ship-owners), the 'Daily Telegraph' (two more wires), the Birmingham Police, the Birmingham Gas Company and the 'Newcastle Daily Chronicle'.

Losses in wire renters in the later 1860s averaged at about ten a year.

The year 1865 also saw the completion of the Company's major venture into public telegraphy which it called its Cantyre (Kintyre) Line, from Glasgow to Campbeltown on the Mull of Cantyre, to Oban, and to Rothesay in Scotland. Reid Brothers completed the 130 miles of pole telegraph for £6,244, as well as five miles of submarine cables across the lochs.

The *Glasgow District Telegraph Company*, a message-forwarding concern, also began to use the Universal's circuits in November 1865, continuing to do so until 1868. It seems to have been a trading style of the Universal company, as it shared its premises at 11 St Vincent Place, with a network of Agents in shops that fed messages to its public telegraph offices by messenger, at a cost of 6d for a twenty word message, delivered free within a radius of a half-mile.

The Glasgow to Greenock public wire by way of Paisley and Port Glasgow was worked under an agreement with the Electric Telegraph Company in that messages were not to be transmitted off the Universal's circuits, in competition with the older concern.

The Forth & Clyde Canal Company gave the Universal company free rights of way for all its circuits along its waterway so long as it needed its own private wire between Glasgow and Grangemouth, a distance of 27 miles, for which it paid £60 per annum.

The Company began a dispute with Reid's over their costs in this year. It had relied implicitly on its major suppliers for all of its supplies and services; its four offices each employed only four clerks who worked exceptionally long hours in keeping the books up to date. Colin Brodie began a test of direct labour and costed the processes involved in construction of its lines, and showed Reid's charges to be excessive.

It was not all utilitarian business. On the evening of April 27, 1865 a Sunday Schools' *Soirée* was held at Warlter's Road School, Holloway, for 250 young scholars and their teachers. "The wires of the electric telegraph were conveyed across the room, and two gentlemen from the offices of the Universal Private Telegraph Company were in attendance to explain the instruments in operation at each end of the room".

At the end of 1865 the Company had a total of 366 subscribers, of which 47 were new business drawn from 108 miles of new circuits. It had also let or sold 95 sets of Universal instruments.

The Electrical Torpedo
The Universal Private Telegraph Company was drawn in 1865 into the War between the Confederate and United States in America. During the summer and autumn of 1864 it had provided its magnetic exploders, insulated wire and magnet fuses to agents of the Confederate States Navy. At this time Nathaniel Holmes and Matthew Maury, a Confederate naval officer and renowned scientist, had begun developing a system of coast, harbour and river defence based on electrical torpedoes or submarine mines.

On June 20, 1864 Stephen Russell Mallory, Secretary of the Navy in the Confederate States, on the advice of Commander Maury, instructed that 5,000 pounds of the nitro-cellulose explosive, gun-cotton, ten miles of gutta-percha insulated copper wire and twelve "Wheatstone Batteries" with necessary wires and primers be shipped from Europe. The new device had already come to the notice of Confederate agents in England; a previous order from the navy department for 25 miles of insulated copper wire and 1,000 pounds of gun-cotton, dated April 11, 1864, was despatched from Liverpool to the southern states in July with the gratuitous addition of a Wheatstone Magnetic Exploder and 100 Magnet Fuses. These advanced materials were all to be used in making electrical torpedoes.

In Britain Holmes approached Sir John Burgoyne, the general in charge of fortifications at the War Office in London, in January 1865 informing him of the experiments with electrical torpedoes that he, Wheatstone, Maury and the Dutch naval officer Marin Jansen had been carrying out independently. Holmes sought government support for their work. Burgoyne apparently was positive, but it had to be carried out discretely to keep it secret from the abolitionist minister in London.

On April 20, 1865 Maury, just about to leave for Mexico, and Holmes, writing from the Company's offices, came to a secret agreement to market the electrical torpedo to national governments, dividing the income equally. Its ignition was based on the magnetic exploder with the addition of a mechanism for accurate cross-bearing by two operators to ensure that a vessel was over the torpedo, an electrical gauge to safely test the circuits and the igniting fuse, and plans for planting torpedoes in deep water and in water with strong currents. The torpedo was based on the experiments in Europe and, more importantly, on Confederate experience in submarine demolitions in America. Its use was to be offered preferentially to Russia, Holland and Mexico.

Nathaniel Holmes and Matthew Maury obtained a patent for the electrical torpedo on December 8, 1865.

The Year 1866
By April 1866 the Company's Miles of Wire in aerial cables and wires had expanded:

London District 1866
Line A - Finsbury, 42 miles of wire
Line B - Strand, 127 miles
Line C - Whitehall, 27 miles
Line D - Camden, 65 miles
Line E - Oxford Street, 111 miles
Line F - Pimlico, 15 miles
Line G - Victoria Docks, 200 miles
Line H - Southwark, 60 miles
Line I - Lambeth, 11 miles
Line K - Wapping, 91 miles

The London District included Birmingham, with 15 miles of wire, and Derby, Coventry, Bristol, Kendal and Dublin, 12 miles.

In 1866 the Company's London District totalled 776 miles of wire; 629 miles in aerial cable and 146 miles in "open wire".

The medical profession was much taken with the Universal telegraph. Two eminent practitioners, Morell Mackenzie at the Throat Hospital, 5 King Street, Regent Street, and Charles Brooke at the Westminster Hospital, Broad Sanctuary, had the Company provide them with private wires between hospital and house. In December 1866 two lesser surgeons, Louis Little and John Couper, had a three-mile long private wire and instruments to connect their rooms in Brook Street and Park Street in the West End with the 445-bed London Hospital on Whitechapel Road in the depths of the East End. The doctors and surgeons paid for these facilities themselves that they might be immediately summoned for emergency duties at their hospitals.

In March 1866 the Board of Directors reported that the company had 366 renters. Expansion in the previous half-year had been considerable; with 108 miles of new line wire costing £2,145, 47 new renters earning £1,303 per annum and 95 new instruments rented or sold. A dividend of 6% was declared.

The principal increase in business in 1866 came with the acceptance by the Metropolitan Police of the Company's tender to connect Scotland Yard with twenty-one of its Divisional Stations in October. The work was finally completed on September 30, 1867. Commissioner of Police for the Metropolis, Sir Richard Mayne, and the Assistant Commissioners, Captain William Harris and Captain Douglas Labourdiniere, were then also provided with personal lines to their residences, at Chester Square, Porchester Square and South Audley Street, respectively.

Surprisingly, in a year that was to see the collapse of the financial system in Britain, the Bank of London, the London Joint Stock Bank, the National Bank, the Union Bank of London, the Manchester & County Bank and the National Bank of Scotland all subscribed for new private wire circuits from the Company.

In 1866 the Company laid a new 30 strand cable in London, alongside of the South Eastern Railway from Cannon Street station to St Saviour's Church, Deptford. It already had 15 renters lined up, including the Surrey Commercial Dock Company, Peter Rolt, a major timber dealer, G & J Rennie, engineers, the Metropolitan Police and Peek Frean, the famous biscuit makers.

Despite continued expansion the Company was to have a poor year in 1866: the Great Storm in January 1866 caused £2,092 worth of damage to its "open wire" circuits. This, and the expense of expanding in a year of financial crisis, especially the construction of the Cantyre line, wiped out its annual dividend. The provincial shareholders complained that Charles Wheatstone, still the principal proprietor, continued to receive a royalty on new instrument rentals and on every new mile of aerial cable in these hard times. However, a tighter rein on spending had the shareholders' rewarded once again in the next financial year.

The stationhouses of the Liverpool Fire Police were connected by Universal telegraph in October 1866. The Mersey Docks & Harbour Board also opened its immense property either side of the river in Liverpool and Birkenhead to the Company's private wires for the use of merchants and brokers.

The Year 1867
At the end of the following year the Engineer's report in December 1867 consisted of:

London District 1867
Line A – Finsbury [Birchin Lane, Founders' Court, Moorgate Street, King Street, Wharf Road, Highbury]
Line B – Strand [Birchin Lane, Lombard Street, Bedford Street, Tavistock Street, Adelaide Street]
Line C – Whitehall [Parliament Street, Bridge Street, Clock Tower, House of Commons]
Line D – Camden [Oxford Street, Goodge Street, Euston Station, Camden Station & Piccadilly Circus to Conduit Street]
Line E – Oxford Street [Founders' Court, Baker Street, Russell Square, Guildford Street]
Line F – Pimlico [Victoria Street, Grosvenor Place, Halkin Street, Grafton Street, Chartered Gas Works, Thames Bank]
Line G – Victoria Dock [Birchin Lane, Hayden Square, Mile End Gate, West India Dock, East India Dock, Orchard Street, Victoria Dock, Silvertown, Purfleet, Chartered Gas Works, Bow, Hackney Wick]
Line H – Southwark [Hibernia Wharf, Hay's Wharf, Free School Road, Dockhead, Wade Street, Spa Road, Deptford, China Hall, Rolt's Yard]
Line I – Lambeth [Belvedere Road]
Line K – Wapping [King William Street, Adelaide Place, Nicholson's Wharf, Wapping Basin, St Bede's Wharf; and Custom House, Mincing Lane, London Road; and Minories, St Katharine's Wharf, Broad Street, Ratcliffe]

Outside of the capital itself the Company's London District in 1868 managed private lines in Birmingham, 27 miles of wire, Derby, 1 mile, Coventry, 1 mile and Bristol, 1 mile, as well as 39 miles of Metropolitan Police wires.

Newcastle District 1867
Line A - Gosforth, 29 miles of wire
Line B – Tynemouth, 96 miles
Line C – Jarrow, 60 miles
Line D – Whittle, 29 miles
Line E – Malhead, 13 miles
Line F – Willington, 70 miles
Line G – Percy Main, 3 miles
Line H – Northumberland Dock, 5 miles
Line I – Gateshead, 5 miles
Line J - Town, 1 mile
Line K - Durham, 54 miles
Line L – Sunderland, 8 miles
Line M – Chester-le-Street, 18 miles
Line N – South Hetton, 28 miles
Line O – Riddick House, 8 miles
Line P – Miscellaneous, 7 miles
Line Q – Stella Staith, 5 miles

Manchester District 1867
Line A – Wear Lane, 54 miles of wire
Line B – Studdart Bridge, 17 miles
Line C – Blackburn, 129 miles
Line D – Brealey, 13 miles
Line E - Patricroft
Line F – Beckton Hall, 5 miles
Line G – Ashton, 52 miles
Line H – Stockport, 12 miles
Line I – Wanting, 17 miles
Line J – Pendleton, 31 miles
Line K – Jackson's Row, 4 miles
Line L – Miscellaneous, 4 miles
Line M – Bradford, 7 miles
Line N – Kendal, 3 miles

Liverpool Sub-District 1867
Line A – Vauxhall Road, 23 miles of wire
Line B – Christian Street, 9 miles
Line C – Prince's Dock, 20 miles
Line D – Canada Dock, 72 miles
Line E – Sandy Lane, 3 miles

In September 1867 the Company noted the range of people that were working its instruments: "the Universal telegraph is used by Reuter's Telegram Company for the transmission of news to 'The Times' and other newspapers; between newspaper offices and the Reporters' Gallery of the House of Commons; by police constables and firemen and by all classes of commercial employee, as well as by butlers and housemaids; and, on the Cantyre line, by country shopkeepers, most of whom are postmasters and postmistresses."

By 1867 the Universal telegraph was adapted for use on the Royal Navy's new ironclad warships with very large dials that signalled the commander's orders from the vessels' armoured conning tower to the engine room and to the helm. It was planned to install a new version in the House of Commons with large dial indicators and replaceable paper inserts that showed the business in progress and yet to be transacted for the members throughout Parliament.

Police Telegraph

One of the first adopters of the Universal telegraph had been the City of London Police in 1859, before the Company was organised. It had a web of circuits connecting its six stations with the chief office in Old Jewry. Its utility was described by its senior field officer, writing in March 1864:

"Captain Charles Hodgson, the Superintendent of the City of London Police force, speaking of the value of the telegraph for police purposes, states; by its means, information is immediately transmitted from the several divisions of the chief offices of all occurrences of an important character, of which particulars were, formerly, only supplied every twenty-four hours. So, likewise, any matter of which it is desirable to send notice speedily to the different stations, is now telegraphed, instead of being sent round in writing by a messenger – a course that formerly occupied about two hours. The telegraph is also found very convenient in promptly obtaining from a division any particulars required relating to matters under investigation at the chief office. On the occasion of fires or other unforeseen emergencies, the telegraph has been found especially useful, not only in conveying the information from station to station, but in enabling the officers to collect from all the stations the requisite number of men, without denuding the streets in the immediate neighbourhood of the occurrence of the constables in charge of beats. As an illustration of its value in this respect, I may instance the occasion of the great fire in Tooley Street, when London Bridge and the city side of the river were, for a considerable period, occupied by a vast and excited crowd, which required the greatest exertion of police authority to control and, through which, only be the greatest effort could the circulation of traffic be maintained. The large number of City Police so engaged were drawn from the several divisions by a series of telegraphic messages, as the increase of the fire, and the accumulation of spectators, made hourly additions to the strength of the police necessary. A further, and by no means unimportant, aid rendered by the police telegraph, is the general facility it affords to officers in charge of divisions of conferring with the chief office on matters presenting unusual difficulties, and of communicating with the superintendent at his residences, at any hour of the night. For these reasons I consider the telegraph most valuable to the force, in economising time, and giving to its officers more direct control over its resources."

Captain Charles George Hodgson, born in 1812 and late of the Grenadier Guards, had been appointed Superintendent of the City Police on its establishment in 1839. He remained as the force's operational chief until just before his death in 1869.

Regarding law enforcement in the rest of London, it was only in 1866 that the Executive Branch of the Commissioner's Office of the Metropolitan Police in Whitehall Place, London (better known as "Scotland Yard"), invited tenders for connecting twenty-one of its larger Divisional stations and three private residences of the senior officers with Scotland Yard by electric telegraph. The tenders were to be received by October 6, 1866. The specification required the use of Wheatstone's Universal telegraph. The contract had to include the maintenance of all instruments, apparatus and wires, which had to be ready for service by March 1, 1867 and was to run henceforward for a period of seven years. Two tenders were received.

The London District Telegraph Company quoted a rental of £900 per annum, with an alternative outright purchase price of £4,000, plus £50 a mile for any additional wires.

The Universal Private Telegraph Company quoted £786 per annum, a purchase price of £3,200 and £30 a mile for extensions. They were awarded the contract.

At each of the designated Divisional police stations and residences the Company provided one of its three-piece Universal dial telegraphs, comprising a communicator, an indicator and a bell. It also established a Telegraph Office at Scotland Yard, with four sets of Universal telegraph apparatus, twenty-four bells, one for each station, and four switches that each connected with six stations. Additional telegraphs were to be rented at £6 per year for a complete set, or £5 without bells.

Training in the use of the Universal telegraph was commenced early in November, 1866 for a senior police officer, usually an Inspector, from each Divisional station. The Commissioner and Assistant Commissioners each had a Clerk appointed to work the instrument at their private residences when they were at home. Only those formally trained were allowed to touch the apparatus. The Telegraph Office at Scotland Yard was under the charge of Superintendent Thomas Kittle, head of the Executive Branch. A sergeant and a constable were to work the apparatus in the Office in eight hour shifts throughout the day. Communications received by the Office and by all other stations were to be recorded in Telegraph Message Books.

On September 30, 1867 the Universal company's secretary, William Brettargh, wrote to the Commissioner of Police confirming that the entire network was completed, linking Scotland Yard with the Police Stations at Whitehall, Westminster, St James's, Marylebone, Holborn, Covent Garden, Finsbury, Whitechapel, Stepney, Lambeth, Southwark, Islington, Camberwell, Greenwich, Hampstead, Kensington, Wandsworth, Brixton, Paddington, Highgate and Wapping, as well as the private houses of the Commissioner of Police and the two Assistant Commissioners. Police Orders of the same day announced the telegraph's operational introduction on October 1, 1867.

The relationship between the Metropolitan Police and the Universal Private Telegraph Company proved to be a fruitful one. Extensions to the new network were soon authorised: in December 1867 the Commissioner's Office was connected with the Home Office in Whitehall at an additional annual rental of £32; in January 1868 the police office in the Houses of Parliament was added for an extra £36, and during 1868 the London Fire Brigade, the Horse Guards, headquarters of the Army, and the City Police were put in circuit with Scotland Yard, too. Eventually, on April 18, 1868, the Company was instructed to extend the police network to the majority of the 117 smaller stations (out of a total of 138) then without the telegraph, at an additional rental cost of £1,936. This final agreement was never completed as the Company was appropriated by the Post Office during that year.

Although the Post Office eventually agreed, in May 1871, to fulfil the Company's contract to complete the police network, by March 1873 only another 75 stations had been put in circuit. It also resisted applying the maintenance clauses in the Company's agreement whereby broken circuits had to be made good within three days and that Scotland Yard would decide the order in which circuits should be repaired.

Metropolitan Police rental to the Universal company for the telegraph was £786 in 1868, when 14,719 messages were sent, and £1,124 for the period 1869 to 1870, including £45 per annum each for the three personal wires, after which years the Post Office assumed the arrangements.

Thomas Kittle, born in Barrowby, Lincolnshire, in 1831, had a remarkable rise through the ranks of the Metropolitan Police. Joining in 1857, he was a Sergeant at Scotland Yard with the Executive or operational administration section of the Commissioner's Office by 1861, becoming Inspector with A Division, Westminster, in 1864, giving expert evidence as such before Parliament. In mid 1868 Kittle was appointed Superintendent in charge of the Executive Branch where he was responsible for introducing many technical improvements in police communications as well as for the adoption of the telegraph. He appears to have died in the early 1870s.

I must thank Superintendent John Bunker, late of the Metropolitan Police, for providing much of the information above, contained in his exceptionally detailed work on police communications, 'From Rattle to Radio'.

One the earliest users of the Universal telegraph outside of London was the City of Glasgow Police. The Municipal Police Committee negotiated a bargain rental of £100 a year, down from £180, on June 17, 1861 to connect the Central Police Office at South Albion Street, the District Police Stations, the Fire Engine Station and the Exchange. It was originally only a one year contract, but the system was found efficient and the agreement extended, eventually comprising twelve separate lines. The circuits, by October 1862, included the City Prison and the home of the chief of the detective police, Captain Alexander McCall, who "in his own bedroom, can be spoken with from any part of the city". McCall was to become the City's Chief Constable.

The Newcastle City Police connected the Central Police Station at the New Buildings with the Police Offices at Northumberland Street and Prudhoe Street on September 15, 1863. This was one of the first private circuits in north-east England.

The Birmingham Police possessed one central instrument and a four-way switch to connect to its four outstation circuits. These linked the Central Station at Moor Street and the District stations at Kenyon Street, Duke Street, Alcester Street and Ladywood. The system was completed on May 12, 1865.

On October 11, 1865, the Liverpool Fire Police authorised the Company to connect the Public Offices at Cornwallis Road, the Hotham Street waterworks, the five dock fire stations and the twelve town fire stations by Universal telegraph. The cost for this very extensive system was to be £230 per annum.

The Leeds Police united its Central Police Office at the Town Hall with its wide-spread stations at Duke Street, Kirkstall Road, Hunslet, Holbeck, New Wortley and Sheepscar, as well as the borough gaol at Armley on July 8, 1868. The system was to cost £550 a year.

In July 1868 the Newcastle City Police extended its single circuit dating from 1863 that was costing £65 a year, adding four more circuits, eventually renting 3 miles of wire, five Universal instrument sets and ten bells. The neighbouring Northumberland County Constabulary also acquired a single circuit in that year.

Telemetry

Wheatstone had developed several methods of recording distant operations, including the electric thermometer for use in mines and at high altitude, and had had installed experimental magnetic counters at the entrances of the Great Exhibition at the Crystal Palace, Hyde Park, in 1851 so that visitor numbers could be monitored minute by minute.

The Universal company introduced for sale Wheatstone's much improved '*Recording Instrument for Newspaper Offices and Public Buildings*', an adaptation of the Universal telegraph. It was operated by an electro-magnetic trip and required no galvanic batteries. This was first used in the London Exhibition of 1862 to count and record electrically on a dial everyone entering through the turnstiles. It was modified to count the copies of 'The Times' newspaper as they were printing on its rotary presses, indicating the performance on a dial on the editor's desk.

The Cryptograph

On March 29, 1856, 'Chambers's Journal' in London reported, "Mr Wheatstone has solved the problem of a method of secret correspondence, easy of application and undiscoverable. He has invented and patented an instrument – the *Cryptograph* – by means of which any two persons may intercommunicate without fear of betrayal. It is so simple, that the writer, as he sits at the table, turns the barrel with a finger of his left hand, while recording the symbols with his right. These he may send to his correspondent, who, provided with a similar instrument, makes the necessary movements, and reads off the despatch. Or the symbols may be transmitted as a telegraphic message, in full confidence that none but the receiver to whom it is addressed will get at the interpretation. No matter that it be intercepted by anyone having a similar instrument; none but the two who have agreed beforehand the key can find out what is meant. There are two or three forms of the instrument; and one is so contrived as to interpret its own signs at pleasure. We hear that the impossibility of detection by any third or unauthorised person is clearly demonstrable. So unhappy lovers may take heart once more, assured that Mr Wheatstone's cryptograph will enable them to correspond by cipher-advertisements in the *Times* to their heart's content, and without fear of discovery from the most lynx-eyed of guardians. The price of the instrument will be sufficiently moderate – in the advertisers' phrase – to bring it within the reach of all who may wish to use it."

'Scientific American' gave a more serious and precise description on May 18, 1867: "The importance of a secure cipher for commercial, military and other telegrams of a confidential nature, grows with every step in the extension of telegraphic correspondence, and has brought forth a most ingeniously simple and effective invention for the purpose mentioned, which has been adopted by the British War Office. The parties to a confidential correspondence by telegraph are each furnished with a little instrument consisting of a dial having the letters of the alphabet printed in regular order in a circle near the circumference, with one blank space, making 27 intervals. In a circle within this runs a flanged groove having room for just 26 letters, and in which the letters, printed on separate bit of card of the exact size, are arranged in any arbitrary order understood between the parties. A secure and convenient way to fix this arbitrary order in the mind without risking it on paper, is to agree upon any word easily remembered, and when a despatch is to be sent or deciphered, write down the letters of this word, and under them write the remaining letters of the alphabet in the proper order from right to left, one letter under each letter of the word, then beginning another line under this in the same way, and so on until the entire alphabet in arranged in both lines and columns, which are to be read vertically, and the letters in the inner circle of the dial are to be arranged in that order. After the despatch is sent or deciphered, as the case may be remove the letters, and the instrument is again uncommunicative."

"But the mode of communication remains to be described. The centre of the dial is penetrated, exactly like a clock, by a shaft or arbour passing through a hollow arbour, the former bearing a long and the latter a short index hand. Each of these arbours has also fixed on its spur wheel, gearing on a loose pinion common to both, so that turning the one turns the other. But the spur wheel of the short hand has twenty-six teeth and that of the long hand twenty-seven, answering respectively to the divisions of the inner and outer circles, so that at every revolution of the long hand, the short hand completes the circuit of the alphabet and one letter further, thus gaining one every time. Consequently, a message spelled out with the long hand, and written out in the letters simultaneously indicated by the short hand, would be in a constantly changing cipher, in which no letter would be represented twice by the same substitute, and no possible clue could be obtained without first obtaining the magic word upon which the inner circle of letters was arranged. The receiver of the message having properly arranged the arbitrary alphabet in the instrument, has only to turn the short hand to the letters of the despatch as received, in succession, and write off those indicated by the long hand. The instrument is, of course, only to be turned forward, or from left to right."

During February 1868 the Company sold four of the Cryptograph machines to the Metropolitan Police. These small, pocket-sized, nickel-silver devices, around four-inches in diameter, could render messages into an unbreakable cipher. Each cost £1 5s. It had been previously adopted by Queen's household and by that of the Emperor of the French.

Superintendant Thomas Kittle of the Metropolitan Police was responsible for introducing the Cryptograph to the Home Office in London, to the Irish Office in Dublin and to the police at Dublin, Manchester, Liverpool and Birmingham, as well as to the Lancashire Constabulary. These instruments were used to protect government and police messages related to the fight against Fenian terrorism. In October 1867 Kittle had been placed in charge of the police telegraphs in London leased of the Company. He spoke approvingly of the simplicity and ease-of-use of both the Universal telegraph and the Cryptograph, and of the absolute security of the latter instrument, to Parliament in 1868.

In appearance the Cryptograph was extraordinarily simple, being a disc of white metal with a shallow rim, grooved for outer and inner alphabet rings, about 3¾ inches diameter overall and ½ inch deep over the central knob. It was intended to be pinned to a table for one-handed use, all the sensitive information being easily removed from the disc or dial. The outer alphabet, on a fixed flat ring, and the separate inner alphabet letters were engraved on ivory, fitting into two grooves on the dial, the inner groove being pierced with holes to push out the letters. There were also removable cardboard inner rings, as well as the loose ivory letters, on which a cipher or even a sequence of symbols could be handwritten and kept separate for regular use. Donald W Davies described its manufacture thus in 'Cryptologia' in 1985: "The construction is very precise. It is hollow at the back, and a small case is attached to hold and cover the gears. The surfaces appear to be silver. The way in which the back surface conforms to the front suggests that it was made by electro-deposition onto a pattern... Three screws at the edge have pointed ends which protrude a little, to fix the device on a surface. It is carried in a felt-lined case together with the ivory peg and a few complete inner rings that can be used to hold alphabets for easy removal and replacement". The ivory peg was used to push out the individual letters on the inner groove.

The design and size of the Cryptograph remained constant, although the disc was also later made in brass and other materials. It always came, with accessories, in a hinged case or box, 4¾ inches by 4⅛ inches by 1 inch in size. Instrument serial numbers show that over two thousand were made between 1868 and 1890.

Wheatstone developed a larger, desk-top version of the pocket Cryptograph that printed, or rather embossed, the enciphered or deciphered text on a tape. "The dial had a handle and pointer with a spur wheel of 26 teeth, gearing with another of 27 teeth fixed on the axis of a frame round which the type is set. On striking the knob in the centre of the dial, the letter corresponding to the cipher indicated on the dial is embossed on a strip of paper, fed through by a ratchet and pawl, and received in locked receptacle."

The Cryptograph was seen at the *Exposition Universelle* in Paris in 1867, but little further was heard of it in the public press. It was rumoured to be still used, enciphering government secrets, at the end of the century. A variant was proposed for army field ciphering in 1914.

1868 The Last Year

In Leeds and Bradford, and many other towns in the north of England, including Middlesbrough, industrialists and coal-owners preferred to own their private wires outright, commissioning the Universal company to erect the line and provide the instruments, avoiding rentals, having only a maintenance agreement with regard to apparatus.

Examples of the contracts undertaken for private wire work are those with the extremely large mining firm of Bell Brothers of Middlesbrough, in 1868. Bell Brothers were owners of South Brancepeth and Tykedale collieries, the Normanton, Skelton, Kilton and Cliff ironstone mines, Wear ironworks and Clarence ironworks

Bell Brothers line from *Royal Exchange, Middlesbrough, to Port Clarence Ironworks*, comprised a half-mile of overhead line and three-quarters of a mile of roadside line:

- 250 yards, one No 8 iron wire and wooden standards, Exchange to Port Clarence Ferry
- 250 yards single-core submarine cable across the Tees, Middlesbrough to Port Clarence
- 200 yards, one No 8 iron wire and 30ft larch poles Port Clarence to North Eastern Railway
- 1,000 yards, one No 8 iron wire and 30ft larch poles North Eastern Railway to Port Clarence Ironworks

The cost of these works was £62 2s 6d, but the cost of the submarine cable across the Tees is not recorded, two sets of Universal instruments cost £50

Bell Brothers line from *Royal Exchange, Middlesbrough, to Normanby coal mines*, comprised one-quarter mile of over-house line and five-and-a-quarter miles of roadside line:

- 150 yards, one 3/16 iron wire, over-house, Royal Exchange to Middlesbrough railway station
- 1 mile 680 yards, one No 8 iron wire and one-third larch poles, 26ft and 30ft, Middlesbrough railway station to Cargo Fleet
- 3 miles 1,200 yards, one No 8 iron wire and whole larch poles, 26ft and 30ft, Cargo Fleet to Normanby mines

The cost of these works was £172. The costs of one set of Universal instruments was £25, of one tell-tale bell and one switch, £5 5s and of one short circuit piece, 12s 6d.

For the South Bank Iron Company, Middlesbrough, a line was built from *Royal Exchange, Middlesbrough, to Clay Lane Ironworks,* one-quarter mile over-house and two-and-half miles of roadside line:

- 150 yards, one 3/16 iron wire, over-house, Royal Exchange to Middlesbrough railway station
- 1 mile 680 yards, one No 8 iron wire and one-third larch poles, 26ft and 30ft
- 1 mile, one No 8 iron wire and whole larch poles, 26ft and 30ft

These works cost £87 and two sets of Universal instruments £50.

For Swann Coates & Company, ironmasters, of Middlesbrough, a private wire was made from *Royal Exchange Middlesbrough to Cargo Fleet ironworks*, two-and-a-half miles of roadside line:

- 150 yards, one 3/16 iron wire, over-house, Royal Exchange to Middlesbrough railway station
- 1 mile 680 yards, one No 8 iron wire and one-third larch poles, 26ft and 30ft
- 100 yards, one span No 8 wire, railway to their office

These works cost £54, the two sets of Universal instruments, £50.

The four private telegraph systems above were all construction contracts and not rental agreements. They, however, still demonstrate the Universal company's standard specification and costs for erecting and equipping their open-wire private circuits.

On December 31, 1868 the report to the Board of Directors showed that the Universal Private Telegraph Company possessed the following miles of wire:

	Built	*Building*	*Rented*
London	826	20	573
Manchester	579	8	467
Newcastle	432	44	384
Glasgow	603	29	510
Cantyre	479	0	402
Total	*2,919*	*101*	*2,336*

The Company continued to invest in additional mileage, driven by continual demand for private circuits. In 1868, the year in which it achieved its best dividend return, its spare capacity still varied from 30% in London to 20% in Manchester, 10% in Newcastle and 15% in Glasgow. This gave it a large margin for expansion; and the original Universal telegraph and aerial cable patents still had five years before they expired and competition could enter the market.

The Universal Private Telegraph Company on June 20, 1868 had 2,294 miles of wire, of which 629 miles was yet to be let, with 1,196 instruments on lease. The ongoing rental income for that year was £12,676, new renters contributed £2,086 and terminating renters £888, totalling £15,532 income.

In July 1868 a new 30 strand line, its last, was to be laid alongside of the South Eastern Railway from Cannon Street and St Saviour's Church to Spa Road, Jamaica Road, Neckinger Road and on to Greenwich.

In the last year the Company's directors were Jonathan Mellor, of Manchester, chairman, Frederick C Gaussen, London, deputy chairman, C H Bousfield, Glasgow, John Cameron, Glasgow, Joseph Cary, London, J G T Child, Manchester, Henry Kimber, London, Walter Mackenzie, Glasgow, Samuel Mendel, Manchester, James R Stewart, Glasgow, Alfred Watkin, Manchester and Charles Wheatstone. There were then 127 shareholders. The growing influence in the board of the regional shareholders is noticeable.

The liquidation of the assets of the Universal Private Telegraph Company took a remarkably long time; the last meeting of the proprietors to approve the final accounts and disbursements took place on May 25, 1878.

Instruments

From the beginning the Universal Private Telegraph Company classified its instruments as *Communicators* (transmitters), *Indicators* (receivers) and *Bells* (alarms). Each type had a separate number series in the Instrument Account. For most of its existence the Universal company referred to "stations" or "sets of instruments" which comprised a communicator, an indicator and an alarm bell. These were originally separate items, though by 1863 Augustus Stroh had combined the Communicator and Indicator into a single instrument with its own Bell. The functions continued to be accounted for individually as private users requested separated instruments, particularly more alarm bells.

Wheatstone's magnetic bells continued to be used to provide acoustic signals in mines and factories, as they had on the railways previously. The Company also provided switches to combine more than one circuit and tested relatively complex switchboards, designed by its engineer Colin Brodie, to interconnect multiple circuits.

October 1862	*Coms*	*Indics*	*Bells*
London	136	136	145
Glasgow	114	102	105
Total	*250*	*238*	*250*

September 1863	*Coms*	*Indics*	*Bells*
London	212	212	212
Manchester	99	100	106
Glasgow	200	206	208
Total	*511*	*518*	*526*

June 1864	*Coms*	*Indics*	*Bells*
London	337	337	373
Newcastle	131	131	155
Manchester	141	142	168
Glasgow	288	294	301
Total	*897*	*904*	*997*

December 1866	*Coms*	*Indics*	*Bells*
London	516	516	600
Newcastle	169	169	195
Manchester	229	236	296
Glasgow	372	378	390
Sales	117	117	127
Stock			12
Total	*1,403*	*1,416*	*1,620*

December 1868	*Coms*	*Indics*	*Bells*
London	526	526	645
Newcastle	161	161	209
Manchester	250	257	326
Glasgow	395	401	423
Sales	181	181	208
Total	*1,513*	*1,526*	*1,812*

Curiously, the Company rented twenty-four Universal instruments to the competitive London District Telegraph Company for use on its own private circuits. The District's contract with the Post Office, connecting its main sorting depots, was worked entirely with sixteen Universal telegraphs. Line rental was entirely separate from instrument rental, so users of a line could specify which type ought to be installed.

The Company had acquired the patent for the Universal telegraph outright in 1861. They bought all of their instruments, free-of-royalty, from Charles Wheatstone. Of the 1,500 instruments rented at the end of 1868 one third were to the original two-part design and the remainder to the unitary design of Augustus Stroh, on which they paid a royalty of one-eighth of the cost. Stroh manufactured all of the Company's instruments on behalf of Charles Wheatstone, at his workshops at 42a Hampstead Road, London NW.

The retail price of a Universal telegraph reduced considerably from its introduction when it was £36 for the two-part version. From 1865 to 1868 the one-piece telegraph varied in price between £25 for commercial customers to £20 for the War Office. As they cost £13 10s from the maker, Augustus Stroh, the gross margin on these was in the region of 50%. The separate magnets-and-bells sold for £5 5s, and cost about £3. Of course, only a tiny proportion of instruments were sold outright, the overwhelming number was rented out.

In comparison, Siemens 'Patent Alphabetical Dial Instrument', used in the London District Telegraph Company's private circuits, cost £18 18s in 1865; and, incidentally, Siemens competitive electrical machine for exploding charges in mines, the so-called "ebonite machine" using static electricity, cost £12. By mid-1864 Siemens had made and sold a total of 700 magneto-dial instruments in Britain and Prussia.

As Wheatstone used the Company as sales agent the difference in retail price and cost was divided equally between the two parties. Of more consequence in the long-term was the profit share that he received on all instrument rentals, £1 per instrument per annum. In November 1862 the Universal company was also marketing Wheatstone's "automatic printing telegraphs, alphabetical printing telegraphs, railway signal telegraphs and apparatus, mining telegraphs and exploding machines".

However, Wheatstone personally absorbed the costs of improving the instruments and for defending the patent rights; the latter was to amount to £3,000 by 1867.

The first two-part Universal telegraph communicators or transmitters were 6¼ inches high by 7½ inches wide by 11½ inches long, weighing 9¼ pounds; the companion "barrel" indicators, 7¼ inches high by 5¼ inches wide by 6¾ inches long, weighed 5½ pounds.

The single piece Universal telegraph was 12 inches high by 7⅝ inches wide by 13½ inches long, and weighed 16 pounds. Where separate, the alarum bell in its box was 7½ inches by 4¾ inches by 6¾ inches.

The Siemens device was 24¾ inches tall by 23½ inches wide by 17 inches long, and weighed 100 pounds (!).

The Company did not employ any mechanics. Instead local "Inspectors of Instruments" were appointed from ordinary clock and watchmakers. These worked as independent Agents of the Company, contracted to maintain subscriber's equipment as part of their own general repairing business as and when required.

The close, enduring and creative relationship that Wheatstone maintained with Augustus Stroh is entirely in keeping to that which the professor had with all of his mechanical suppliers, including the ill-tempered telegraph contractor William Reid, from 1836 and Louis Lachenal, the Swiss craftsman who manufactured and improved his patent concertinas, from 1845.

Construction

During the straitened year of 1866 Colin Brodie, the Company's engineer, at the instance of the Board, was able to enforce a marked reduction in construction and maintenance costs:

Cost of Aerial cable	*1862*	*1866*
Iron Pole	£11 10s	£7 0s
One span with insulation	£1 5s	£1 4s
Brackets	£1 0s	10s
Leading down and fixing gutta-percha wire	6d	2d
Suspending cables	£1 0 s	12s 0d
Suspending light cables	12s 0d	7s 6d

Cost of Road wire	*1862*	*1866*
Poles and one wire a mile	£30	£20
Extra wire a mile	£10	£8
Painting poles (two coats)	22s 6d	22s 6d

All of this work was undertaken by Reid Brothers of London, who also provided most of the materials.

Underground Cables

As well as its aerial cables by 1868 the Universal Private Telegraph Company possessed thirty cables of the common sort in London, several of which were submarine. These were manufactured by S W Silver & Company in a similar but more robust manner to the aerial cables. There were multiple copper cores, each of No 21 gauge insulated with india-rubber, felted and covered with two lays of hemp, occasionally with an intermediate layer of india-rubber under the hemp.

- Adelaide Street to Scotland Yard, 25 cores, 500 yards, laid 1867*
- Scotland Yard to King Street, Westminster, 20 cores, 730 yards, laid 1867*
- King Street to the Clock Tower, Parliament, 10 cores, 280 yards, laid 1867*
- Clock Tower to Westminster Bridge Road, 7 cores, 450 yards, laid 1867*
- Across Charing Cross [from Adelaide Street], 50 cores, 200 yards, laid 1861*
- Charing Cross to Admiralty, 50 cores, 180 yards, laid 1861*
- Downing Street to King Street, Westminster, 50 cores, 60 yards, laid 1861*
- Across entrance to Victoria Dock, 7 cores, 100 yards, laid 1862*
- Across entrance to Surrey Docks, 7 cores, 100 yards, laid 1866*
- Across entrance to Commercial Docks, 7 cores, 100 yards, laid 1866†
- Across entrances to West India Docks, 7 cores, 200 yards, laid 1867†
- Across entrance to Millwall Dock, 7 cores, 200 yards, laid 1868†
- Across Deptford Creek, 7 cores, 80 yards, 1867
- Across entrances to London Docks, 30 cores, 38 yards, laid 1862†
- On roof of Somerset House, 50 cores, 250 yards, laid 1860‡
- Admiralty to Downing Street, 30 cores, 560 yards, laid 1860‡
- Euston to Camden, 10 cores, 1,760 yards, laid 1861‡
- West India Docks, 25 cores, 880 yards, laid 1862‡§
- East India Docks, 25 cores, 700 yards, laid 1862‡§
- East India Docks, 20 cores, 880 yards, laid 1862‡§
- East India Docks, 10 cores, 600 yards, laid 1862‡
- London Dock wall, 30 cores, 1,400 yards, laid 1863
- Stepney railway station, 50 cores, 450 yards, laid 1867‡
- Stepney to Bow Bridge, 10 cores, 2,400 yards, laid 1864‡
- Cannon Street to St Saviour's, Southwark, 30 cores, 870 yards, laid 1866‡
- St Saviour's to Duke Street, Bermondsey, 19 cores, 350 yards, laid 1868‡
- Duke Street, Bermondsey, to Neckinger Road, 29 cores, 1,500 yards, laid 1866‡§
- Neckinger Road to Spa Road, 21 cores, 300 yards, laid 1866‡
- Spa Road to Blue Anchor Road, 14 cores, 1,150 yards, laid 1864‡
- Blue Anchor Road to Deptford Creek, 5 cores, 3,250 yards, laid 1868‡

[* in iron piping; † stapled to dock sill; ‡ stapled to wall; § two paired cables]

The Admiralty to Downing Street cable served all of the adjacent government offices, turning and twisting among the narrow streets.

Before the Phone Book

To illustrate the nature and extent of private telegraphy the following is a selection of the subscribers to the Universal Private Telegraph Company at its hand-over to the Post Office in October 1870. The vast majority of its clients were merchants and traders who relied on communication for their livelihood, whose names have long been forgotten. The list demonstrates the variety and economic bias of users; how printers and heavy engineers found the Universal telegraph of utility, as well as the press, the police and other organisations with a branch structure. Those marked with an asterisk * had been subscribers in the previous year.

LONDON District - including Birmingham, Bristol and Coventry, with 570 Universal instruments

Bank of London*
Birmingham Gas Company
Birmingham Police (3 circuits)
Henry Brett (distiller and publican) (3 circuits)
Bristol Police
Bryant & May (match-makers)
Joseph Causton (printers)
Chaplin & Horne (carriers) (2 circuits)
Chartered Gas Company
Chubb & Company (lock-makers)
City of London Union (local government)
Coal Factors Society (Coal Exchange to Victoria Dock)
William Cory (coal-factors) (4 circuits)
Cross & Blackwell (pickle-makers)
'Daily News' newspaper
'Daily Telegraph' newspaper
De La Rue & Company (printers)
'The Echo' newspaper
Eyre & Spottiswoode (the Queen's Printers)
Great Eastern Railway
Hay's Wharf (wharfingers)
India Rubber, Gutta-percha & Telegraph Works
Johnson & Matthey (precious metal refiners)*
Kennard & Hankey (bankers)*
Land Securities Company (mortgage bank)
Licensed Victuallers Tea Association
Lord Londesbury
London Joint Stock Bank (3 circuits)
London & St Katherine Dock Company (10 circuits)
London & South-Western Bank
London & Westminster Bank (7 circuits)
London Joint Stock Bank*
London, Windsor & Greenwich Hotel Company
James McHenry (financier)*
Morell Mackenzie MD, Throat Hospital (3 circuits)
Mappin & Webb (jewellers)
Marylebone Vestry (local government)
Metropolitan Police (24 circuits)
Midland Railway
Millwall Dock Company
Samuel Montagu & Company (bankers)*
'Morning Post' newspaper
National Bank (7 circuits)
Negretti & Zambra (instrument-makers) (3 circuits)
'Pall Mall Gazette' newspaper
Peek, Frean & Company (biscuit-makers)
Pickford & Company (carriers) (4 circuits)
Price's Patent Candle Company*
Ravenhill & Salkeld (engineers)
Regent's Canal Company (2 circuits)
Reid Brothers for the City Police (9 circuits)
Reid Brothers (telegraph contractors)*
J & G Rennie & Company (engineers)
Reuter's Telegram Company*
Salvage Association (ship-salvors)
Shaw, Savill & Company (ship-owners)
S W Silver & Company
South Kensington Museum (The V&A)*
Sovereign Life Assurance Company
Spottiswoode & Company (printers) (3 circuits)
'The Standard' newspaper
Surrey Commercial Dock Company
'The Times' newspaper
Trinity House (lighthouses)
Union Bank of London*
Victoria Dock Company*
Waterlow & Sons (printers)
Westminster Palace Hotel Company
Zoological Society of London (The Zoo)

MANCHESTER District - including Barnsley, Blackburn, Bradford, Hull, Kendal, Leeds, Liverpool, Oldham, Salford, Sheffield and Wigan with 287 Universal instruments

Liverpool Gas Company (4 circuits)
Liverpool, New York & Philadelphia Steam Ship Company (Inman Line)
Liverpool Police (22 circuits)
David McIver & Company (Cunard Line) (5 circuits)
Manchester & County Bank*
Manchester Police (10 circuits)
Manchester Steel Company*
Mersey Docks & Harbour Board (10 circuits)
National Steam Navigation Company
Oldham Corporation Gas Works
Salford Corporation (local government)
Salford Gas Company
Salford Police
West India & Pacific Steam Ship Company
Wigan Coal & Iron Company (5 circuits)

NEWCASTLE District - including Sunderland, with 160 instruments

W G Armstrong & Company (engineers) (2 circuits)
Backworth Coal Company (2 circuits)
Bedlington Coal Company (2 circuits)
Birtley Iron Company
Black Boy Coal Company
Burnhope Coal Company
Cramlington Coal Company
Earl of Durham (coal-owner)
Cowpen & North Seaton Coal Company (4 circuits)
Hetton Coal Company (2 circuits)
W Hunter (coal-owner) (4 circuits)
Jarrow Chemical Company
James Joicey & Company (coal-owners) (4 circuits)
C Mitchell & Company (shipbuilders)*
Newcastle City Police (5 circuits)

Newcastle & Gateshead Water Company
Newcastle Gas Company
North Hetton Coal Company
North Bitchburn Coal Company
Northumberland County Police*
J M Ogden (coal-owner) (3 circuits)
Ryhope Coal Company
Seaton Delaval Coal Company (3 circuits)
South Hetton Coal Company (3 circuits)
Stella Coal Company
W Stephenson & Sons (coal-owners) (3 circuits)
Tharsis Sulphur & Copper Company (copper smelters)
Thompson & Boyd, (engineers)*
Earl Vane† (coal-owner) (5 circuits)
Weardale Iron Company

(† a system known as Lady Londonderry's Telegraph)

GLASGOW District – including Edinburgh and Dundee, with 254 Universal instruments

Barclay, Curle & Company (engineers)
Barony Parochial Board (local government)
Blochairn Iron Company
G & J Burns (ship-owners) (2 circuits)
Caird & Company (engineers)
Clyde Shipping Company
Clyde Trustees (local government)
Duke Street Prison Board
Dundee Police
Edinburgh Police (5 circuits)
John Elder & Company (engineers) (4 circuits)
Forth & Clyde Canal Company (6 circuits)
Garnkirk Canal Company
Glasgow Corporation (local government)
Glasgow District Telegraph Company*
Glasgow Gas Commissioners
Glasgow Corporation Gas Company (3 circuits)
'Glasgow Daily Mail' newspaper
Glasgow Exchange Committee (stock market)
Glasgow Iron Company
Glasgow Jute Company (3 circuits)
Glasgow Police (12 circuits, including the Prison)
Glasgow Water Commissioners (3 circuits)
Glasgow & Greenock Shipping Company
Glasgow, Paisley & Ardrossen Shipping Company
Gourock Rope Works Company
Greenock Foundry Company
Handyside & Henderson (Anchor Line)
London & Glasgow Engineering Company
Robert Napier & Sons (engineers) (3 circuits)
National Bank of Scotland*
North British Railway (3 circuits)
'The Scotsman' newspaper
J & G Thomson (engineers)
Tod & McGregor (engineers) (2 circuits)
J E Walker (coach proprietor) (3 circuits)
Wylie & Lochhead (furniture makers) (3 circuits)
Young's Paraffin Oil Company (3 circuits)

IRELAND – managed from London, including Dublin and Belfast, with 55 Universal instruments

Alliance Gas Company, Dublin
Lagan Foundry
Guinness & Company (brewers) (2 circuits)
Melfort Spinning Company
Milewater Spinning Company
Ulster Spinning Company
White Abbey Spinning Company
White Abbey Bleaching Company
'Irish Times' newspaper

The Universal telegraph was adopted in public service by several of the British-owned cable companies that operated overseas. It was used on the land circuit between the cable's coastal shore-end station with its specialised apparatus and the public offices in foreign city centres. In addition the Electric Telegraph Company acquired several for its own use and for use on the private circuits that it worked.

Outside of London and other cities, the country houses of the political, mercantile and commercial classes were put in circuit with their nearest telegraph office. Lord Kinnaird had the Universal company install a private circuit from Rossie Castle in Forfarshire to the nearest city, Dundee, a distance of twelve miles, in 1860.

A minor court case in Manchester in April 1869 illustrated the trusting nature of the Company's working practices. James Warburton, age 34, was employed as assistant to F E Evans, the local secretary, to collect the £2,000 in annual rentals in the city. These he collected in cash every quarter, but was found to have embezzled the payments due in March from Isaac Storey & Company, £16, the Bridgewater Trustees, £20, and Coulshaw, Nicholl & Company, £16. He pleaded guilty. His wages were stated as being £1 a week.

Summary

The Universal Private Telegraph Company was a successful venture, continually expanding its mileage and rentals in the relatively small field of private telegraphy – eventually paying 8% dividends in 1868. In 1866 it had 6,340 shares on which £105,026 was paid-up; the largest shareholder was Charles Wheatstone with 566 shares, £13,080 paid. It should not have been acquired by the state in 1868 as, with odd exceptions, it did not offer a public service. However it was pointed out that, as the odd exceptions proved, unless it was taken into state ownership nothing could prevent it opening other public lines.

The dividends were 1863 - 5%; 1864 - 6%; 1865 - 6%; 1866 - 0%; 1867 - 4%; and 1868 - 8%. The costs of the Cantyre public circuit and the repairs needed after the Great Storm affected profits during 1866.

Income from its public circuits in Glasgow and Newcastle was about £600 a year. It also had a small revenue stream from "re-transmitting" messages onto the Electric Telegraph Company's national circuits.

The Universal Private Telegraph Company eventually had agreements with fourteen railway or canal companies or railway proprietors: the Caledonian (as owners of the Forth & Clyde Canal); Lord Egerton; Great Western; Lancashire & Yorkshire; London, Chatham & Dover; London & North Western; Manchester, Sheffield &

Lincolnshire; North British; North Eastern; North London; Regent's Canal; South Eastern; Stockton & Darlington; and West London Extension, mostly for short wayleaves and crossings. The costs in these varied wildly; £1 1s as an annual wayleave for crossing a railway, 10s per mile per wire per annum wayleave on the South Eastern (always a difficult negotiator), 1s per annum rent for each iron bracket mounted on the property of the Chatham and North Eastern lines, 5s 6d rent for the same on the North Western in Liverpool, and 2s per annum rent for each pole on the North Eastern.

The following tables show the gradual but continual expansion of the Universal Private Telegraph Company during its mature phase as compiled by its engineer Colin Brodie in 1871 for the administrators of its liquidation; they differ slightly from those produced earlier by Nathaniel Holmes. The figures are divided between the Company's districts, London, Manchester, Newcastle and Glasgow; these effectively covered the whole of Great Britain and Ireland.

Miles of Wire Rented

	Lon	Man	New	Glas	Total
1863	227	110	100	245	682
1864	364	228	191	358	821
1865	445	329	264	369	1,407
1866	504	380	309	448	1,641
1867	576	462	326	485	1,849
1868	598	441	379	490	1,908

Rental Income

£	Lon	Man	New	Glas	Total
1863	916	352	380	779	£2,427
1864	1,778	665	752	1,138	£4,333
1865	2,512	1,079	1,133	1,199	£5,923
1866	3,029	1,389	1,368	1,382	£7,168
1867	3,875	1,652	1,521	1,654	£8,702
1868	4,158	1,914	1,876	1,757	£9,705

Expended on Lines

£	Lon	Man	New	Glas	Total
1863	12,540	6,041	4,060	8,892	£31,533
1864	16,665	7,680	6,286	11,422	£42,053
1865	17,802	8,745	7,941	11,771	£46,259
1866	18,594	9,919	8,383	12,009	£48,905
1867	20,660	10,571	8,788	11,892	£51,911
1868	20,930	10,630	9,417	12,113	£53,090

In 1868 the Universal Private Telegraph Company had a total paid-up capital of £121,463 in ordinary shares, out of £190,000 authorised by Parliament. It had no fixed interest preference shares, nor any debt. The Company then employed 18 clerks and 6 messengers. Its public circuits in Scotland and North East England worked 27,542 inland messages.

The Post Office took over 1,196 miles of private wire and 400 miles of public wire (139 miles of public line), and 1,466 Universal instruments that the Company had provided to its subscribers; these figures are significantly lower than those recorded in the firm's books or returned to the Board of Trade in previous years.

The government acquired the patent for the Universal telegraph along with the other assets of the Company; it immediately renamed it the "ABC telegraph" to ensure that its true purpose was concealed.

In contrast with the Universal Private Telegraph Company's annual rental rate of £4 per mile, the Post Office private wire rental rate in 1871 was £8 a mile in London and £7 a mile outside of London. The cost of an instrument from the Company was £25 with £1 1s per annum for maintenance; from the government the first cost was identical, but a single-needle galvanic telegraph was also available at £7 10s and £2 10s annual maintenance. The government charged £5 5s a year on top of message costs for transcription to the public circuits, which service was provided without cost by the Company. It also added an extra 3d to each transcription message off private wires for delivery.

The Post Office, unlike the Company, required long, fixed term contracts of between three and five years for private wires, and demanded rental be paid annually in advance, whereas rent was paid quarterly to the Company, as in normal business practice.

In 1870, with the capital obtained from the government appropriation, Wheatstone established the *British Telegraph Manufactory* to make his telegraph instruments, clocks and exploders. For this he acquired the former premises of Cornelius Ward in Great Portland Street, London; a man who, like himself, had been a patentee and maker of musical instruments.

The West Highland Telegraph

The Universal company, with the permission of the Electric Telegraph Company, entered public telegraphy in 1865, with a series of wires from Glasgow to North-West Scotland which it called its "Cantyre Line", trading as the West Highland Telegraph. The area was a stronghold of the British & Irish Magnetic Telegraph Company and of railway-operated telegraphs worked in concert with the Magnetic. It inherited the rights of the abortive *Glasgow, Cantyre & General Telegraph Company* of 1864, established to connect several lighthouses on the Clyde river with Glasgow port through a local land network and eight submarine cables.

It was initially promoted at a public meeting at the Underwriters' Room at the Royal Exchange in Glasgow on February 16, 1864. Nathaniel Holmes, the company's engineer and leading organiser, proposed to the assembled shipping interests a private wire for their sole use from the Point of Cantyre and a parallel public wire connecting the towns on the north of the Clyde river with Glasgow. The private wire was intended as a marine telegraph reporting shipping movements, especially arrivals, for the underwriters, tug-boat owners and ship-owners, similar to those the Company worked on the Thames, on the Tyne and at Cork in Ireland. Such a wire, it was claimed, could save on average £20 in costs on each vessel docking in Glasgow. Both circuits would be built and maintained by the Universal company; in return he expected an annual subscription of between £1,000 and £1,500 for a minimum period of three years from the shipping interest to guarantee its viability. No capital would need to be provided.

The public wire was anticipated as serving the several resort towns along both shores of the Clyde, with message revenues mainly occurring in the summer months. Only a combination of public messages and a private subscription, Holmes claimed, could make the Cantyre line viable.

Wayleaves for access were seen as straightforward as the line would largely be built on land owned by a single noble individual – the Duke of Argyll.

The proposed dual private-public main line was to run from Glasgow through Dumbarton, Helensburgh, Gairlochhead, Kilmun, Dunoon, Innellen and Toward, crossing to Bute, passing hence to the Mull of Cantyre and running south to Campbeltown and the Light on the Point. A public branch was to run north to Tarbert and Ardrishaig, a second public branch was to cross to Arran to connect Lamlash and the light at Pladda in the Firth of Clyde, a third small public branch was to be made to Rothesay.

Holmes also tempted the audience with the prospect of a new underwater cable from Cantyre twelve miles to the coast of Ulster, and a wire hence to Belfast, Glasgow's principal companion in trade. Messages would be 2s 0d for twenty words, far cheaper than the current rate. He was reported in the press as saying the cable would be supported by and worked in concert with the United Kingdom Electric Telegraph Company, the only national company that lacked access to Ireland. Given the Universal company's connection with the dominant Electric Telegraph Company, who were also proposing a new Northern Irish cable at the time, this seems somewhat unlikely.

The audience asked after an eighteen mile cable from the coast at Ardrossan to Lamlash on the isle of Arran instead of the planned branch. The suggestion got short shrift from Holmes, who said that it would cost more than all the proposed land lines put together. In the event Arran was not to be connected all. There was then, in proper Scottish style, a general debate about the high cost of the subscription and how it might be equitably levied.

However the meeting gave its "hearty approval of the scheme", all the necessary consents were obtained and construction was announced on June 20, 1864.

The West Highland Telegraph eventually worked ten public circuits, all constructed by Reid Brothers of London for a total of £6,244, from its office at St Vincent Place, Glasgow, to:-

1 Campbeltown
2 Oban
3 Rothesay
4 Dunoon
5 Roseneath
6 Greenock
7 Partick
8 Hillhead
9 Govan
10 Bridge Street Station

The circuits were almost entirely "open wire", in the Company's terminology, consisting of iron wires on overhead poles; but they also included four short submarine cables across the lochs at Roseneath, Blairmore, West Craighead and Ardbeg. In length the circuits totalled 130 miles of line, of which 5 miles were underwater and a short length underground through Helensburgh. Its Cantyre lines ran from the centre of Glasgow along the north bank of the Clyde river to Helensburgh, Row, Roseneath, Cove, Blairmore, Cot House and East Craighead to West Craighead; West Craighead north along the road around Loch Awe to Inverary and Oban; West Craighead south down the Cantyre peninsular to Ardrishaig, Campbeltown and the Cantyre Light on the tip of the Mull; and from Cot House south past Holy Loch along the west bank of the Clyde to Dunoon, Toward, Ardrie Point, Ardbeg and Rothesay. To these dedicated lines it also applied wires in its private circuits to Barrhead and Greenock to public use.

The 130 mile long line from Glasgow to Campbeltown and the private wire on to the light house on the Mull marking the start of the shipping route into the Clyde was opened on September 4, 1865 in the presence of the Duke of Argyll and the Provost of Campbeltown on Cantyre and the Company's chairman in Glasgow. It had six intermediate stations, Dunoon, Rothesay, Toward, Inverary, Lochgilphead and Tarbert, other stations were promised in a few days.

A separate public line, using a circuit in its private wires, from Glasgow to Hillhead was opened on November 15, 1865. It ran from Mr Stenhouse's Shop, 9 Hamilton Place, Hillhead to the Company's hub office at 11 St Vincent Place, Glasgow. Twenty words could be sent for 6d, including delivery within a half mile.

There were four submarine cables:

- Kyle of Bute, 2,640 yards, 3 cores
- Loch Fine, 2,640 yards, 3 cores
- Loch Long, 3,520 yards, 6 cores
- Gare Loch, 1,320 yards, 6 wires

The cables were not particularly reliable as at least one of the cores in each had failed by 1868.

In the books of the company the Universal instruments were lent to the Cantyre line, and Wheatstone took no royalty on their manufacture. Its open wires were all to a very heavy No 4 gauge due to the exposed situation of its Highland circuits.

The marketing of the public service was limited and a little confused; it was advertised in Glasgow from 1865 until 1868 as the "West Coast Telegraph", although it was occasionally called the "West Coast & Highland Telegraph". The urban public lines were also publicised as the "Glasgow District Telegraph Company". In editorial articles in newspapers it was more often called the "West Highland Telegraph", by which title it was commonly known. In the Company's books it was always the "Cantyre Line". The title of the Universal Private Telegraph Company did not feature in any of these advertisements, although it opened a public office at its hub station at 11 St Vincent Place in Glasgow, open from 9am to 8pm daily. Robert Orr was clerk-in-charge there and received a salary of £107 a year.

The network of the West Highland Telegraph was a rural, even rustic, "self-help" operation, relying on the goodwill of the local inhabitants in providing access and services on a voluntary basis. There were twenty-six public offices, all run by Agents of the Universal company from their shops or homes, without charging rent or other expenses. Those with greater responsibility received a salary. Outside of the larger villages, their friends and children delivered messages. Its circuits were worked with the Universal telegraph by ordinary people with minimal training; they sent their takings weekly to Glasgow.

The location of the stations and their working Agents, with their salaries, in 1868 were: Ardrishaig – Mr McCulloch (£11 11s); Barrhead – Mr Watson, Post Office; Blairmore – Mr McLeish, grocer; Bowling – Mr Jeffrey (£9 13s); Campbeltown – Alex McEwing, stationer; Carradale – Mr Steel, forester (£15); Cove or Craigrownie – Mr Harris, Post Office; Dumbarton – Mr Blair, Post Office (£7 10s); Dunoon – Mr McLeod, Parochial Poor Inspector; Glasgow, 11 St Vincent Place; Glasgow, Bridge Street Station, newspaper stall; Glasgow, Charing Cross - Mr Littlejohn, wine merchant; Govan – Mr Harl, druggist; Greenock – Mr Kinloch, stationer; Helensburgh – Mr Bartrum, bookseller; Hillhead – Mr Stenhouse, Post Office; Innellen – Mr Sheare, Innellen Hotel; Inverary – Mr Rose, Post Office (£12 2s); Lochgilphead – Miss Miller, Post Office; Minard – Miss Smith (£15); Oban – John Hunter, apothecary (£25); Partick – Mr Kennedy, bookseller (£16 7s 5d); Roseneath – Robert Morrison, grocer; Rothesay – Mr McKinlay, Post Office; Tarbert – Mr McCalman, banker; and Toward – Mr Wright, carpenter.

There had been at least one other office, at the Post Office in Pollokshaws, between 1865 and 1867 on the line to Barrhead. The Bridge Street Station office was on the platform of the Glasgow & South-Western Railway's original terminus on the city's Southside.

The small tradesmen in Glasgow and the suburbs added 'Agent to the Universal Private Telegraph Company' to their listings in the street directory, along with the agencies of joint-stock banks, insurance companies and the post office that they had previously acquired.

The degree of self-help was such that a guarantee of £40 per annum was offered from April 1866 by John Pender (of the British & Irish Magnetic Telegraph Company) who had his country-house close-by at Minard Castle to support the office at Minard.

The revenues from the Cantyre lines grew gradually from around £75 a quarter year in the autumn of 1865 to £150 a quarter for the same period in 1867.

In the year previous to the opening of the West Highland Telegraph circuits in the Universal Private Telegraph Company's private lines from Blyth, Chester-le-Street and Sunderland to Newcastle in North-East England had also been opened for public use. As with its Cantyre Line these were worked by third-party Agents, not by Company employees, who remitted telegraph money to the District office in Newcastle.

As with the national telegraph companies the Universal company's agents sold *Telegraph Stamps*, in two denominations, 6d and 1s 0d, to encourage its public business in Scotland and the north of England. It seems that in Scotland the Company charged 6d for a twenty word message, and 6d for each subsequent ten words or less. In England in 1865 the cost was 6d for twenty-five words.

The London District Telegraph Company
Private Wires and Private Networks

There was only one serious competitor to the Universal Private Telegraph Company's business. It was on January 1, 1859 that the *London District Telegraph Company* was projected "to provide [along with public telegraphy] private wires for government, police and fire brigade stations, carriers, proprietors of factories, wholesale warehouses, dock, canal, banking and other companies, hotelkeepers, &c., for direct communication with their branch establishments or to the nearest station of the Company". It eventually contracted to connect with private circuits the premises of War Office, the General Post Office and the London Fire Engine Establishment. Its largest customer was to be the Metropolitan Board of Works, who, as well as supervising public building and highways, managed the Fire Brigade after 1865, with a total of fifty private wires.

The London District Telegraph Company was promoted to construct a public network in the metropolis to serve 100 closely-located message stations with a very cheap tariff. It anticipated delivering its public messages within a half-hour of their receipt. Its private wires and later private networks were subsidiary to this public business.

Uniquely, rather than having closed circuits between subscribers' premises the District, at first, connected its private wire customers to its central office to access or exchange to other circuits, local and national.

In its early months the Company tried several magneto-dial telegraph instruments before offering a private telegraph service, including those of Charles Wheatstone, Polidor Lippens, W T Henley and William Siemens. It initially offered customers Henley's apparatus, but that was quickly abandoned and to work its private circuits for the War Office, the London Fire Engine Establishment, the Metropolitan Board of Works, and others, it adopted Siemens magneto-dial telegraph. However, several of its clients, including the Post Office, insisted on having Wheatstone's Universal telegraph on their wires. The costly Siemens and Universal instruments were all hired by the Company from the manufacturers, not purchased outright.

Very little is recorded about the District's private wire business. It had considerable problems in making and maintaining its complex overhead-wire public circuits in London, as well in generating sufficient finance, and was only ever active in the capital. The District initially offered individual private wires that connected users with its head office where messages were transcribed for forwarding by the national and international public networks; the first "exchange" system. However, by the late 1860s it had effectively abandoned this model and concentrated on constructing large closed networks for the clients noted above and point-to-point private circuits similar to those of the Universal company.

The first "private telegraphs" it installed were noted at the August 1860 shareholders' meeting. The printing firm of De la Rue of Bunhill Fields, City, and Samuel Plimsoll, of the Great Northern Railway Coal Depot at King's Cross, had wires to the Company's central station. Later in the year, "several new private telegraphs" had been installed.

In the following July, the Board reported that revenue from private wires for the half-year to December 1860 was £84, whilst to the half-year ending June 1861 it was £180. Eight new private telegraphs had been rented in the previous six months. Based on this performance an income of £600 a year was thought achievable.

The District company reported at its shareholders' meeting of January 31, 1862 that it had nineteen private telegraphs in operation, anticipating £1,000 in rentals per annum. This level of income seems to have been maintained over the years. These lines were worked on term contracts, using spare capacity in its existing network, short overhead branch circuits being made to connect to unused wires in its public network. There had been such a demand for private wires that the Board felt that it needed to invest in dedicated private circuits, a sum of £3,000 was recommended.

In December 1862 the Company mentioned that it dealt with the gentlemen's clubs in St James's as well as large business houses, "at a very slight cost per mile", connecting them to their central station in Cannon Street. "From hence all messages will be at once repeated over the wires of the London system, or further yet, along the numerous English and continental lines." It further claimed that "numerous special contracts had been entered into by leading London firms", especially those with interests in Europe, enabling them to telegraph orders from their own counting house to their correspondents overseas. More importantly, in 1862, it had commenced connecting the stations of the *London Fire Engine Establishment* as a trial. This was to be its first large-scale private network, and was completed by December 1863.

During 1863 Captain Eyre Massey Shaw in charge of the *London Fire Engine Establishment*, the body that managed the insurance companies' fire service in London, described how its seventeen stations were connected by electric telegraph. The stations were spread across the metropolis at 107 Broad Street, Ratcliff; Wellclose Square, Ratcliff; 23 Bishopsgate Street Without; 64 Whitecross Street, Finsbury; 66-69 Watling Street, Cheapside; 27½ Farringdon Street, Blackfriars; 254 High Holborn; 44 Chandos Street, St Martin's Lane; George Yard, Crown Street, St Giles's; 76 Wells Street, Oxford Street; 33 King Street, Baker Street; 39 King Street, Golden Square; Horseferry Road, Westminster; 84 Waterloo Bridge Road; 2 Southwark Bridge Road; 165 Tooley Street, London Bridge; and the floating station at Lucas Street, Rotherhithe. Their engines responded to all calls by the public not just those for insured property. The London District Telegraph Company contracted to install and maintain the circuits; Siemens, Halske & Company provided their magneto-dial instruments. The chief fire engine station in Watling Street in the City of London was initially put in circuit with each of the so-called foreman's stations, with two or more appliances. Subsequently the remaining district stations with single engines were connected to the foreman's stations, with switching so arranged at the latter that Watling Street could communicate directly to every station, "even the most remote" at Ratcliff, Baker Street, Westminster and Rotherhithe. The system was "of the simplest possible kind, each line complete in itself with a dial instrument at each end". The fire telegraph was regarded as better than the American system of remote street alarms in avoiding abuse and errors in response. The cost benefits were stated to be excellent, replacing messengers on foot, allowing a concentrated response to large fires, reducing the number of engines called-out to minor incidents and to false alarms, as well as reducing the fees charged to the insurance companies and individuals.

By special arrangement the British Museum was connected by the District company to the London Fire Engine Establishment's station at Holborn.

At the end of its last year of working before being taken over by the Metropolitan Board of Works in 1865, the London Fire Engine Establishment had 17 stations and 131 black-clad firemen, with two floating steam pumps, two large horse-drawn steam pumps, six small horse-drawn steam pumps and thirty-three small horse-drawn manual pumps. The budget for renting the private telegraphs was £500 per annum.

In addition, it should be said, there were the 85 fire escape stations, each with a wheeled ladder and a "conductor", operated by the *Society for the Protection of Life from Fire*, a charitable institution, which the state also was to absorb.

The contract with the Fire Engine Establishment was continued when it was taken into state control in 1865. By January 1, 1869 the new *Metropolitan Fire Brigade* had 49 stations, with 47 private telegraph circuits consisting of 71 miles of wire, and 90 fire escape stations. In that year the Company billed the brigade through the Metropolitan Board of Works for £1,052 in line and instrument rental.

On losing their fire engines to the state, the fire insurance companies formed on December 22, 1865 the *London Salvage Corps,* tasked with rescuing insured goods and protecting them from damage by water, rather than fighting fire, duties that the 'old order' had also undertaken but which the state refused to take on. Becoming operational in March 1866 under William Swanton, formerly chief officer of the Western Division of the

Fire Engine Establishment and its acting deputy superintendent, it took premises for its vehicles and 64 men, mostly former fire-fighters at 31 Watling Street in the City of London, close to the Fire Brigade headquarters, and at four other stations on the Commercial Road, Hackney; Southwark Bridge Road, Southwark; Shaftesbury Avenue, in the West End; and Upper Street, Islington. During the spring of 1866 these were connected by private telegraph wires by the District company.

Although they co-operated closely there was some competition between the Fire Brigade and the Salvage Corps. The Corps proved somewhat quicker in responding to telegraphed alarms and used its old skills to extinguish small fires before the Brigade turned up.

The District released very little information about its private wires subsequently. However, as can be seen, its early model was clearly quite different from that of the Universal company; routing circuits through its central office. As has been said, it later, successfully, dwelt on making large private telegraph networks.

At the shareholder's meeting of August 1865 it was said that the £3,000 invested in private telegraphs was "almost a fixed source of revenue". The contracts were far less subject to fluctuation than public messaging. A new tender had been submitted for making a private network for the General Post Office, linking its headquarters in St Martin's-le-Grand with the new District Post Offices that undertook letter-sorting in London. This tender was accepted, but required additional capital, which strained the District's limited resources.

The Post Office network covered their premises at St Martin's-le-Grand (the General Post Office and East Central or EC District), 126 High Holborn (West Central or WC District), Packington Street, Islington (Northern or N District), Nassau Place, Commercial Road (Eastern or E District), 9 Blackman Street, Borough (South Eastern or SE District), 8 Buckingham Gate (South Western or SW District), 3 Vere Street, Oxford Street (Western or W District) and 28 Eversholt Street, Oakley Square (North Western or NW District).

The District announced that by June 1866 it had completed construction of new private telegraph networks for the Metropolitan Board of Works, the London Salvage Corps and the General Post Office. This went only a small way to counter-balance the destruction of its overhead public circuits in the Great Storm earlier in that year. It was still "paying for the hire of instruments when no rental was being received" from damaged private circuits yet to be repaired. A new, higher, tariff for private telegraphs was proposed; despite this several new contracts were said to be pending.

Even in the year that the government appropriated the business, the London District Telegraph Company was able to increase its private telegraph business. The Fire Brigade required further circuits, and the War Office at the Horse Guards in Whitehall was connected to the eight army barracks of London; for the foot guards and infantry at the Wellington in Bird Cage Walk, Portman in Portman Street, St George's in Trafalgar Square, Kensington in Kensington Church Street, and the Tower of London, for the artillery at St John's Wood, for the cavalry at Knightsbridge and Regent's Park, during 1868, giving an increase in revenue of £800.

The District company also provided a private wire with Siemens dial telegraphs for the Speaker of the House of Commons, connecting his rooms in Palace Yard with the stables in adjacent Millbank Street.

The Siemens magneto-dial telegraph that it commonly used was patented in Britain in 1859. It was a relatively large apparatus with a brass sending dial and a receiving dial with a rotating pointer. The Siemens transmitter "had a dial of 26 characters; the handle is connected, by helical spur gearing in the ratio of 13 : 1, with a shuttle armature revolving between the poles of six horseshoe permanent magnets. The current was sent to the receiver every time the handle was moved through the space between two symbols. The pointer hand of the receiver is on the same axis as a small ratchet wheel which vibrates between the poles of an electro-magnet; two fixed pawls cause its rotation one tooth for every current."

The following sixteen individuals and organisations are the known private wire clients of the London District Telegraph Company between 1860 and 1868. There were obviously many more, mostly foreign merchants, shop-owners and small firms, connected to the central station in Cannon Street, perhaps as many as twenty at any one time for short periods. It is known that some later became public offices.

British Museum (1 circuit)
City of London Club (1 circuit)
De la Rue & Company, printers (1 circuit)
General Post Office (10 circuits)
Great Central Gas Consumers Company (1 circuit)
Junior Carlton Club (1 circuit)
London Fire Engine Establishment (18 circuits, 1864)
London Fire Brigade (47 circuits, 1868)
London Salvage Corps (5 circuits)
Metropolitan Board of Works (5 circuits plus those of the Fire Brigade)
Samuel Plimsoll, coal dealer (1 circuit)
Speaker of the House of Commons (1 circuit)
Telegraph Construction & Maintenance Company (1 circuit)
George Walker & Co., wine merchants (2 circuits)
War Office, connecting barracks in London (8 circuits)
William Wright, sporting publisher (1 circuit)

In 1870 the District company was renting 118 Siemens magneto-dial telegraphs and 24 Universal telegraph instruments, which would make 71 individual private circuits in all. The Universal instrument was then used on the wires that the District provided for the Junior Carlton Club, the Great Central Gas Consumers Company, the General Post Office and some of those for the Metropolitan Board of Works. There was also at least one Universal instrument at its Cannon Street offices.

The London District Telegraph Company did not publish any list of its private wire clients, nor any details of its pricing structure. It is obvious that there was a relatively high turnover in its private telegraph customers until it began to engage in constructing private networks in 1864. Of about 71 private telegraphs that it managed in London in 1870, 67 were in closed networks for just three organisations.

Other Companies' Private Circuits

As well the Universal firm, private telegraphy between offices and individuals was offered by all of the other telegraph companies; to the extent of 1,329 miles of private wire with 307 instruments in 1868. In addition there were leased-lines provided for newspapers in Scotland and the north of England to transmit copy from London during the night, but these were worked between the telegraph companies' offices.

The *Economic Telegraph Company* was "prepared to construct and maintain private telegraph wires for merchants and others, between their mills, warehouses and private residences" in Manchester in August 1863 with the Breguet galvanic dial telegraph. Whilst the Universal company charged £4 per mile per year in line rental, the Economic asked for £2. Each of its Breguet instruments were rented at just £2 a year, versus the Universal magneto telegraphs rented individually at £6, but the latter did not need batteries and chemicals.

In the next four years the Economic company constructed a network of 127 miles of private wire in Manchester, Liverpool, Oldham, Stockport, Buxton and Bolton, with around 40 instruments. Its customers included Blood, Wolfe & Company, brewers, Liverpool; Chadwick & Sons, ropemakers, Liverpool; Thomas Milner & Son, Phœnix Safe Works, Manchester; and Hamilton's Windsor Ironworks of Garston.

The Economic company obtained an Act of Parliament in July 1866 to secure its existence. It was moderately successful in its geographic market and the business was bought by the government in 1868.

The *General Private Telegraph Company* was formed as a contracting firm during mid-1866 to provide private wires in Manchester using the Breguet device. It was a trading title of Thomas Brown, a maker of lightning conductors, and offered to erect and work a single private wire at £9 a year for the first mile and £3 for every additional mile. The Breguet galvanic alphabetical telegraphs for private lines were sold by the firm for £10 10s each; it also provided Breguet's domestic electric bells, from its Depôt at 4 Blue Boar Court, Manchester. By April 1867 the General company had leased telegraph circuits along the Manchester, South Junction & Altrincham Railway, and offered access for private wire clients to and from the city centre to Stretford (£12 per annum), Sale (£15), Timperley (£20), Altrincham (£24), Bowdon (£30) and Lymm (£40). It had ceased trading by the time of the government appropriation.

Robert Dodwell, late District Superintendent of the British & Irish Magnetic Telegraph Company, also had an office at 4 Blue Boar Court in April 1865 when practising as a consulting telegraph engineer and almost certainly had an interest in the General Private Telegraph Company; he may have created the firm.

The *Liverpool District Telegraph Company* of Islington, Liverpool, advertised briefly in November 1866 as a promotion of G & W Peet, ironmongers, and C F Clyatt, telegraph engineer, late manager of the Economic Telegraph Company. It had an "improved system" of private telegraphs and "Peet's Patent Bell Service". The bells were installed in an extensive system in Liverpool's new Town Hall at Dale Street during 1867. Its offer to connect Seacombe, Egremont and New Brighton in July 1866, on the opposite side of the Mersey from Liverpool, for £30 per annum had been rejected as too expensive. The association of Peet and Clyatt ended in litigation during the summer of 1868.

A curiosity of the private wire business in Manchester was the number of individuals and partnerships, rather than joint stock concerns, which entered telegraphy:

- William Bate, telegraph engineer, 9 Bexley Street, Salford (1863)
- Thomas Brown, telegraph engineer, 4 Blue Boar Court, Market Place (1863-68)
- Cyrus Dunderdale, telegraph engineer, Micker Brook Terrace, Rushford Park, Levenshulme (1863-65)
- Clyatt, Morgan & Company, telegraph engineers and contractors, 29 Corporation Street, Manchester (1860-1863)
- Robert Dodwell, consulting telegraph engineer, 95 Dale Street, Manchester, at the shop of Isaac Wolf, watchmaker (1861-1863) and at 4 Blue Boar Court, Manchester (1865-1866)
- John Faulkner, manufacturer of private telegraphs, call bells and lightning conductors, 86 Percival Street, Collyhurst, then 13 Great Ducie Street, Strangeways, Manchester (1855-1930s)
- John Lavender, telegraph constructor, 17 Garnett Street, Waterloo Road (1859-1868)
- Robinson & Company, telegraph engineers, 37 Cross Street, Manchester (1862-66) (see below)
- Henry Wilde, manufacturer of lightning conductors and telegraph engineer, 2 St Ann's Churchyard, Manchester (1861-1868)

In 1862 the partnership of Lundy Brothers, of 8 Marlborough Terrace, Rusholme, Manchester, Charles William Lundy and Thomas Evans Lundy, were also to provide private wires in the city for a short period. C W Lundy joined the Magnetic Telegraph Company in Manchester, and was to have a long career working, then managing, American and India cables. T E Lundy moved to London as a telegraph engineer, opened a telegraph school and attempted to introduce electric sewing machines but was bankrupt in 1870.

Manchester was remarkable in freely allowing overhead and over-house wires to be erected along and across its thoroughfares by concerns working without Parliamentary powers.

In addition, outside of Manchester, in the north of England there were:

- Thomas Robinson & Son, timber merchants and sawmill engineers, Railway Works, Oldham Road, Rochdale, with an office at 84 Cannon Street, London EC, who constructed many miles of pole telegraphs for private, and some public, circuits in Manchester and Liverpool.
- George Frederic Smeeton, ironmonger (sic), Crown Street, Halifax, Yorkshire, sole agent for Crossley & Breguet's dial telegraph instrument.

In October 1864 E G Bartholomew, late of the Universal company, was to be found installing a private circuit for the great railway locomotive and marine engine builders, Robert & William Hawthorn. The apparatus used, after trying a dial instrument of his own design, was the Universal telegraph and connected the works of Hawthorn & Company, their Scottish subsidiary, at Great Junction Street, Leith, with the engineering shops of a railway company at Granton.

The creation of the Post Office Telegraph monopoly in 1868 ended independent telegraph enterprise in Manchester. Most of the individuals cited above turned to other work, reverting in many instances to their original trade of installing copper-rope lightning conductors on the hundreds of factory chimneys in Lancashire. One of the oldest of such firms, that of John Faulkner, who commenced business in 1855 and who advertised his *Private Telegraph Manufacturing & Erecting Company,* "telegraph wires fixed to church steeples and high chimneys without scaffolding" (using a kite to drop a rope on the top of the structure and using that to haul up a pulley and a "bosun's chair"), in 1863, survived as an electric bell manufacturer.

At the end of its existence the *Electric Telegraph Company* worked the following circuits on behalf of individuals and public bodies. These principally divide into government work, the transmission of time, leased lines for the press and private contracts ante-dating the formation of the Universal company.

Admiralty (4 circuits)
Astronomer Royal (time signal)
Duke of Beaufort
J Bennett, London (time signal)
Blair, London (time signal)
Cammell & Company, Sheffield (steelworks, 3 circuits)
Clay Cross Colliery Company (3 circuits)
House of Commons to Lothbury
Copper Miners Company
E Dent, London (time signal)
East India Docks Company
Falmouth, Gibraltar & Malta Telegraph Company
Glamorgan County Gaol
'Glasgow Daily Mail' newspaper
'Glasgow Herald' newspaper
Great Eastern Railway
Great Northern Railway
Hill & Price, Bristol (time signal)
A Johannsen, London (time signal)
London, Chatham & Dover Railway (time signal)
London & St Katherine's Dock Company (3 circuits, and others with the Universal company)
Lord Chamberlain (2 circuits, Windsor Castle and Buckingham Palace)
Military Storekeeper to Woolwich Arsenal
J Pool, London (time signal)
Steer, Derby (time signal)
Lords of the Treasury (5 circuits, Balmoral Castle, Somerset House, Buckingham Palace, Foreign Office and Downing Street)
Prince of Wales, Sandringham
Vickers & Sons (engineers)
War Office to Woolwich Arsenal
Weichert, Cardiff (time signal)
Wigan Coal & Iron Company (7 circuits and others with the Universal company)
E A Williams, Cardiff (time signal)

The telegraph instruments that worked the Electric Telegraph Company's private government circuits at its Founders' Court and Charing Cross offices were fitted with locks to prevent unauthorised access. Those the Electric provided for the Admiralty between Portsmouth, Gosport, Devonport and St Ann's Head, Milford Haven; at Somerset House; for the War Department; and for the Houses of Parliament were American telegraphs printing the "European Code" of dots and dashes and not dial equipment.

Regarding the other national companies: the *British & Irish Magnetic Telegraph Company* worked a very small number of private wires for the Admiralty, in the mining district of North-West England and in Dublin, Ireland. The *United Kingdom Electric Telegraph Company* also provided the Bridgwater Navigation and other canal companies with eighteen instruments for nine private circuits. These two concerns had only a small number of private wires on their books by 1868.

There were several "non-starters" in private telegraphy inspired by the success of the Universal telegraph, particularly in Manchester, the country's immensely wealthy textile capital.

W T Henley, the electrical engineer, manufacturer and contractor who had originated the magneto-needle apparatus in 1848, began advertising his own newly-patented "Magneto-Electric Alphabetical Dial Telegraph, the cheapest and simplest in construction", in Manchester, Leeds and Bradford during 1861. Despite working in concert with the *British & Irish Magnetic Telegraph Company* and R V Dodwell, its enthusiastic district manager in Manchester, as well as offering prices "half the cost of any other dial telegraph" and a five year warranty with every instrument, Henley was unsuccessful in the private wire market during the 1860s. Despite this he continued to offer it to collieries and private firms during the subsequent decade. It was tried on the private wires of the London District Telegraph Company, a subsidiary of the Magnetic company, in 1861, but quickly abandoned.

As part of its promotion Henley's magneto-dial was shown at a Telegraphic *Soirée* in Manchester during the evening of September 7, 1861, connecting through the Magnetic's circuits to Liverpool. The ladies present were able to send their own messages using the dial instrument and receive replies over the thirty-five miles between the two cities.

The Magnetic Telegraph Company offered its private wires to manufacturers, other businesses and local authorities for a flat rate of £50 a mile, including two of Henley's magneto-dial telegraph instruments, plus £6 per annum for maintenance. This was computed as costing over the life of a circuit, including the cost of money, just £8 10s a year! The stations of the City of Dublin Fire Brigade were connected under this arrangement, one of few contracts the Magnetic obtained.

Henley's magneto-electric dial telegraph was introduced into use by two subscribers in Kingston-upon-Hull during August 1862. For fire-fighting purposes the Hull central police station was connected with the waterworks at Stoneferry. Colonel Woodford, the inspector of police, recommended that the private wire be extended to the reservoirs at Springhead. In addition, Zachariah Charles Pearson, a shipowner and Mayor of Hull, had a private wire led from his residence to his counting house at the harbour, being run through pipes under the Hull Docks. Z C Pearson, in financial difficulties, engaged in speculative blockade running during the American War, and became bankrupt in September 1862. The only other known being that entered into by Edward Ripley & Son, of Bradford, Yorkshire, a large firm of dyers, in 1861.

Henley's magneto-dial telegraph had been patented on March 23, 1861; it "had a dial plate with twenty-six symbols and the handle had on its axis a commutator of twenty-six bars so insulated and connected that each time the handle is turned through the space between two symbols a current was sent to the line reversed in direction to the previous one. The receiver contained an electro-magnet with semi-circular pole pieces, with which vibrated a magnetized needle which actuated the reversed escapement that moved the pointer. A projecting pin, at the side of the dial, stepped round the pointer to zero. It had an electrical bell which may be stopped by a switch at the front." Henley claimed in 1861 that his magneto-dial was able to transmit fifteen to twenty words a minute working over distances from 2 to 50 miles. The Army found after thorough tests in 1863 that his magneto-dial instrument, though simple, was unreliable – it proved difficult to keep the handle of the sending dial and the pointer of the receiving dial synchronised.

The *Globe Telegraph Company* proved to be a short-lived threat to the Universal telegraph. In 1861 Wheatstone had demonstrated the Universal telegraph to Henry Wilde of Manchester, a maker of patent lightning conductors, and sent him several samples. Wilde sought a license to market it in Manchester but was discovered by Nathaniel Holmes, the Universal company's engineer, selling his own 'Globe telegraph' later in that year. A law suit was commenced on December 19 1861.

The highlight of the patent suit was a demonstration of the Universal telegraph to the bench of the Court of Exchequer. Wheatstone's barrister, William Robert Grove, QC, FRS, a scientific colleague of his at King's College, and inventor of the Grove or nitric acid cell, as well as being a lawyer, worked the words "Find for the Plaintiff" on the instruments, "a message which caused a great deal of merriment". Despite this interlude Wilde's magneto-dial instrument was found sufficiently different to justify an original patent.

Wilde's magneto-dial telegraph used "a small magneto-electric machine, driven continuously by a treadle, and supplying a rectified current. The transmitter consisted of a vertical shaft rotated by a worm gear from a horizontal shaft driven by the treadle shaft; on this horizontal shaft was a commutator by which four reversed currents were transmitted to the line per revolution. Above the vertical shaft was a plate supporting the transmitting dial through which projected thirty spring-lifted keys. When a key was depressed it stopped an arm attached to the vertical shaft after the corresponding numbers of signals had been transmitted, the slipping of the driving cord permitting of the stoppage". The receiver consisted of an index spindle on which was an escape-wheel driven by pallets formed on an arm that was swung by a small magnet fixed between two vertical electro-magnets through which the line current passed. The lower part of the receiver contained a clockwork alarm which, unless switched out, rang when currents were being transmitted; the alarm was wound up by a button that projected from the lower portion of the globular case.

In 1861 Henry Wilde went into partnership with George Cliff Lowe, a silversmith, jeweller, chronometer and watch maker, and electroplater, to form the firm of Henry Wilde & Company with works at 37 Mill Street, Ancoats, Manchester to manufacture his dial telegraph.

Beginning in April 1862 the *Globe Telegraph Company*, a private partnership, began to seek clients for its "system of selling-out telegrams", a quaint way of describing private telegraphs, in Manchester. Although then without permission of Parliament to erect poles or lay cables it approached several local authorities for permission to erect wires over streets; Blackburn in May 1862, Bradford in June 1862, Derby in August 1863, Huddersfield in March 1864 and Liverpool in July 1864. Its Engineer, Cyrus Dunderdale, also made several proposals to municipal authorities; for the Derby Water Works Company a circuit was to be made from their office in Wardwick to their works at Long Eaton for the new fire brigade, at a cost of £180, considered on August 26, 1863. On March 2, 1864, a circuit was proposed to connect the police office in Huddersfield and the waterworks, also as a fire precaution, for £72. The Company tried to enter the property of the Mersey Docks & Harbour Board in Liverpool with a circuit for the West Indies & Pacific Steamship Company. The Harbour Board, having already entered into contracts with the Universal and Magnetic companies, rejected its approach on July 21, 1864. However the Borough Council did give permission for its overhead wires in other parts of the city on August 3, 1864.

Overhead wires, across housetops, Henry Wilde noted, were objected to in every city and were impossible in the suburbs. He proposed to overcome objections to overhead wires in 1864 and patented a novel system of subterranean telegraphy; varnished *iron* wires were placed within iron pipes supported and separated by perforated earthenware cylinders. To prevent the pipes from being flooded they were to be laid on an incline and drained by siphons. Wilde contrasted the cost of conventional post and wire circuits of £80 a mile, which lasted ten years, with his costs of £26 a mile, the expense of keeping the insulators in order being nominal.

An expensive Act of Parliament was necessary to continue its works affecting public highways, and a capital of £100,000 was authorised in the summer of 1864. Wilde was to receive a modest £1,300 in shares as the price of the patents for the Globe telegraph, so similar to Wheatstone's, and the subterranean conduit.

Once the Globe Telegraph Company obtained its Act of Parliament on June 30, 1864 it was able, it is said, to contract with around forty firms, including George Crossland & Sons, Huddersfield, Yorkshire, wool cloth manufacturers; William Jessop & Sons, Sheffield, Yorkshire, steel makers; Platt Brothers, Oldham, Lancashire, manufacturers of spinning and weaving machinery; Hopkins, Gilkes & Co., iron and engine works, Middlesbrough, Yorkshire; John Rylands, Manchester, Lancashire, cotton spinner; and W G & J Strutt, Belper, Derbyshire, cotton spinners, to use Wilde's instruments, tempted by a one-off charge of £80 per line for local construction and instruments. The firm, unable to raise more than £2,000 in capital, quickly failed in its competition with the Universal Private Telegraph Company and had ceased business by the end of 1865.

Henry Wilde appeared before the Telegraph Bill Committee of Parliament on July 21, 1869, after engaging in a letter-writing campaign for his patents and liabilities to be taken on by the Post Office, along with the other telegraph companies. Unlike the Post Office officials, who merely sought to establish a value for any telegraphic property offered, the Committee members cross-examined him and called engineering witnesses to disprove his evidence regarding his instruments and his subterranean circuits. The original patent was then nine years old, and Wilde had tried unsuccessfully for six years to sell his system. The opinion was that it was now worthless.

The telegraph companies collectively provided 1,773 instruments for private and government use in 1868. Other than the dial apparatus supplied by the Universal (which provided 80% of private equipment) and London District companies these were single-needle telegraphs, Cooke & Wheatstone's or Highton's, which required trained clerks for their working and batteries of acid-filled cells. No circuits working Henley or Wilde magneto-electric dial telegraphs were taken over by the Post Office in 1868, although a small number using the Breguet galvanic dial were permitted for a short period.

Separately from the public companies, telegraph contractors also offered to erect private wires for *internal* circuits in large factories, collieries and metal mines during the 1860s. The commonest instrument used in these indoor lines was Louis Breguet's galvanic dial telegraph of 1852, which, although large in size and requiring batteries, could be used by ordinary clerks as it indicated the common alphabet. It had the commercial advantage of not being patented in Britain.

An electrical alternative to internal private telegraphs was the use of a bell system. One of the earliest and most comprehensive was installed for the large works of Thomas De la Rue & Company, the printers of bank notes and stamps, in Bunhill Row, just north of the City, by Reid Brothers, telegraph engineers, to the plan of C V Walker, telegraph superintendent of the South Eastern Railway. When completed in June 1864 it comprised fifty-nine bells, thirty-eight ringing keys, several galvanometers and galvanic batteries. Based on Walker's railway signalling bells the network was used to summon workers, to announce commencement of work, meal breaks and leaving-off work. An electric clock connected to the Greenwich Observatory was also installed for De la Rue. One can only wonder at the reaction of De la Rue's workers to this regime...

On a much lighter note, the Ferry Hotel on Windermere in Westmorland, North West England, had Siemens, Halske & Company install a 600 yard long underwater cable across the great lake to the Nab. A lever or switch on the Nab set off the bell of a clockwork "patent railway alarm" in the ferry house of the hotel opposite to summon the boat. This submarine bell telegraph was engineered by Louis Crossley of Halifax and opened on April 5, 1864. Crossley, of the famous family of carpet manufacturers, was also agent for Breguet's dial telegraphs in Britain.

5.] **BAIN**

No history of electric telegraphy can ignore Alexander Bain, who lived from October 1811 until January 2, 1877. He was the son of John and Isabella Bain of Leanmore farm at Watten in Caithness in the far north of Scotland. His principal contributions to telegraphy were his improvements to the *electric clock* and to the *chemical telegraph*. Bain was a watchmaker by profession, being apprenticed initially, between 1829 and 1830 to John Sellar, a clockmaker in Wick, Caithness, and then in Edinburgh, and was a prolific inventor of electrical and other instruments active at the same time as Cooke and Wheatstone. By all accounts he was a difficult man to negotiate with and according to some a ferocious drunk. He was, unfortunately, intemperate to excess; contriving disputes with Wheatstone over electric clocks, with Bakewell over copying telegraphs and with Shepherd, another patentee of clocks, as well as with the Morse Syndicate in America. Bain died in relative poverty and is commonly portrayed as a Celtic martyr impoverished by class prejudice.

In truth Bain's principle character weakness was an inability to collaborate with his peers; a plain mechanic, he never had a scientific or technical mentor, nor an education that would have allowed him to appreciate the work of others. Moreover, he was unable to maintain any of the professional partnerships that he attempted with which to channel his ideas into consistent reality. He seems to have gone out of his way to give offence to potential allies.

The level of Bain's contrived ill-will may be judged by his continued antipathy to Wheatstone. Alone among the professor's many "mechanical" collaborators, who included William Reid, Louis Lachenal, Nathaniel Holmes, Augustus Stroh and Robert Sabine, Bain passed himself into posterity as a victim of his evil machinations. All the others co-operated and flourished alongside of Wheatstone for several decades.

Bain, as will be seen, created many ingenious devices in a great many fields; the electric clock and the chemical telegraph had lasting impacts on technology. Unfortunately his temperament was such that these achievements gave him little but sorrow and disappointment.

The Electric Clock
Bain's first accomplishment was his *electric clock*, which he patented on January 11, 1841 with the London watch- and clock-maker John Barwise, of 25 St Martin's Lane, Charing Cross. This used an electrically-regulated pendulum to propel the time-keeping movement, with a galvanic source made from metallic plates buried in damp soil. It was not the first galvanic clock; this had been devised by Carl August von Steinheil in Munich in 1839.

The partnership managed to produce sixty of Barwise & Bain's electric clocks, "working at the expense of 2d a week", for exhibition at the Royal Polytechnic Institution, 309 Regent Street, London, during July, August and September 1841. These were made at Alexander Bain's Electric Clock & Telegraph Manufactory, 11 Hanover Street, Edinburgh.

As well as devising several forms of electric pendulum or 'master' clock, which included a simplified mechanism for converting the swing action into rotary motion, Bain placed many much smaller 'companion', now known as 'slave', dials in the same circuit. Adjusting the master simultaneously corrected the companions which worked in precise synchronicity. More than that in 1848 he had a master clock in Edinburgh regulate a small companion forty-six miles away in Glasgow with a circuit along the railway between the two cities.

It proved to be the first of many missed opportunities in Bain's life; the partnership failed and Barwise went on to found the *British Watch Company* in 1843, the first attempt to factory-make timepieces in volume.

Bain was not alone in investigating the use of electricity to propel clock movements. As well as Steinheil in Munich, Charles Wheatstone had already determined the principles of what he called the *Magnetic Clock*. In 1840 he installed an electric master movement and six connected 'slave' dials at King's College, London. The master device and the small, neatly-cased Magnetic Clocks were made by the eminent clockmaker E J Dent of 82 Strand, almost adjacent to the College. Claiming that his, or more accurately Steinheil's, concept had been copied; Bain never forgave Wheatstone for 'stealing his thunder.' One of Wheatstone's clocks of 1840 still exists.

The Mechanical Telegraph
By August 1841 Bain had moved on and the electric clocks at the Polytechnic Institution were joined by the first display of Bain's *electro-magnetic printing telegraph*. It had been patented, along with other devices, on April 21, 1841. To finance this, the first of his many telegraphs, Bain secured the support of Lieutenant Thomas Wright, RN, living ashore at Chelsea in London. This was one of a number of mechanical signal and printing telegraphs, some of such complexity as to be best described as contraptions, devised by Bain before completing his chemical telegraph patent.

The mechanical telegraphs used galvanic electricity to manage power produced by clockwork. In Bain's first telegraph pulses of electricity created by rotating a dial over contact points were used to release and stop a type-wheel turned by weight-driven clockwork; a second clockwork mechanism rotated a drum covered with a sheet of paper and moved it slowly upwards so that the type-wheel printed its signals in a spiral. The critical issue was to have the sending and receiving elements working synchronously. Bain attempted to achieve this using centrifugal governors to closely regulate the speed of the clockwork.

In the same patent of 1841 Bain and Wright introduced the *electro-magnetic railway controller*, an apparatus intended to signal between two moving trains. A pilot engine ran a mile-and-a-half or so in front of another locomotive hauling a train. A current between the pilot engine and the train engine was carried by insulated conductors running along the centre of the railway, with a "leg" beneath the locomotives making the electrical connection. Should the pilot engine stop or the current between the pilot and the main engine be disrupted a visible signal was given on the footplate. If that was ignored a whistle, gong or other alarm was sounded, if this too were ignored the apparatus turned off the steam and applied the brakes of the locomotive.

A centrifugal governor linked to the wheels of the pilot engine by a belt was employed to break the current should engine stop, causing a needle on a telegraph dial on the following locomotive to indicate "dangerous" and also to set off clockwork that rang an alarm bell and then released a weighted lever to shut off the steam. The clockwork was wound automatically by the motion of the locomotive. It was only made as a table-top model.

On June 21 of the same year, 1841, Bain took out another patent, this time in association with the artist Paul Joseph Gauci, for "ink-stands and ink-holders". These were complex desk-top reservoirs for writing ink into which steel-nibbed pens, which replaced quills, were dipped. There were several sorts, including ones with miniature pumps and others with rotating bodies to prevent the elements of the ink separating. He returned several times over the years to improving these devices.

The Chemical Telegraph

As with the electric clock, Bain did not invent the principle of the *chemical telegraph*, in which paper or cloth is treated to make it sensitive to marking by an electric current; in England this originated with Edward Davy's patent of 1838, but Bain certainly made the principle, which he called 'electro-chemical decomposition', practical in his English patent of May 27, 1843. The original version was an adaptation of his complex mechanical telegraph of 1841, writing its dot and dash cipher in a spiral on a paper cylinder wrapped around a revolving brass drum.

The famous chemical engineer, Isham Baggs, had also patented a "method of printing colours by electricity" on January 23, 1841. This used electro-chemical decomposition to form images on both paper and cloth.

The perfected Bain *chemical telegraph* of 1843 consisted of a finger pedal or on-off key to make and break the circuit and a roll of electrically-sensitive paper fed by clockwork between a brass roller and a single metal feeler as part of the circuit. The current caused a mark to be made on the paper in a series of dots and dashes interpreted into the roman alphabet in so-called "Bain Code". In its essence it was remarkably simple, and also silent in operation, but Bain would not leave it alone in its simplicity.

A much more elaborate pattern of chemical telegraph also introduced in 1843 had identical mechanically-driven sending and receiving instruments. This had a rotary sender using punched tape, on the Jacquard principle, running under two metallic feelers to make and break the electrical circuit; to receive messages the punched paper tape roll was replaced by strips of chemically-sensitive paper, which had to be kept damp, running under the metal points to cause the marks. The need for precise synchronisation defeated this first effort at automatic telegraphy, despite the use of ever larger centrifugal governors on each instrument.

In the version utilised on the circuits of the Electric Telegraph Company "a strip of paper is drawn off a small gutta-percha bobbin placed inside a short brass cylinder, and over a drum whose surface is silvered; the latter is rotated by clockwork having a fan brake or governor. The clockwork is started or stopped by a small lever working between two stops and when in the running position makes contact with the earth terminal. A small wooden roller can be pushed into contact with the silvered drum to keep the paper stretched and at the same time bring the style down to the paper. The style is made from iron or steel and is connected with the line wire terminal, while the drum against which it is kept pressed is in connection with the earth terminal. The paper tape was soaked in a mixture of one volume of a saturated solution of potassium ferrocyanide, one volume of a saturated solution of ammonium nitrate, and two volumes of water; the latter salt being deliquescent served to keep the paper damp. When a current passes, the iron decomposes the electrolyte, uniting with the acid radical to form Prussian blue; other solutions, such as potassium iodide, can be used, the iodine liberated from which colours a starch solution. The Steinheil code, dots in two parallel lines, was originally used. A gutta-percha trough was used for damping the rolls of paper tape."

Bain also devised, in July 1843, a 'Voltaic Governor' to manage the current for electrotyping, the creation of precise copies of metallic illustrations and type. It used clockwork moderated by an electro-magnet to lower the plates into an electric cell to maintain a steady current and even thickness of metal deposit.

The I & V Telegraph

Bain created an ingeniously simple instrument in May 1843, the so-called *I & V telegraph*, using a single wire circuit, in direct competition with Cooke & Wheatstone. It was included as an afterthought to his patent for the chemical telegraph and its principle was to be widely used in Austria, as well as briefly in 1845 between Edinburgh and Glasgow. It was similar in appearance to the Cooke & Wheatstone single-needle telegraph, but with the needle on the dial of the "indicator" worked left (I) or right (V) by two vertical semi-circular electro-magnets, as the polarity of the current was altered by twin finger pedals or keys. The code for this device was based on numerical combinations of 1 and 5, the roman I and V.

It was described at the time as: "Mr. Bain's single-index telegraph, which was the instrument proposed by him for practical use, consisted of two hollow cylindrical coils of wire, placed horizontally a short distance apart, with their axes in the same line. Between them a small bar magnet was fixed across a delicate spring, which in front passed through the dial-plate of the instrument, and was turned up to form an index. The two coils were connected, so that an electric current entering from the line wire would pass through both. When this was the case, the bar magnet would be attracted towards one coil, while at the same time it would be repelled by the other. These actions tended to carry the magnet to the same side, as far as the spring to which it was attached and a fixed stop would allow of its moving. The reversal of the current inverted the effects of the coils, and the magnet would then pass to the other side. The combinations of these two movements represented the various letters and signals, being denoted to the observer by the index on the dial of the instrument. The movement of the index to the left denoting the letter I, and to the right the letter V, this instrument obtained the name of 'I and V Telegraph.'"

He simplified the I & V telegraph in his patent of 1845 by substituting a single drop-handled current-reversing commutator for the double-pedals or keys, and legally also protected the I & V code. This was the apparatus used on the Edinburgh & Glasgow Railway.

Bain completed his first line of electric telegraph alongside of the Edinburgh & Glasgow Railway in December

1845. It ran for forty-six miles as a single iron wire carried atop nine foot high larch poles on "porcelain knobs", the poles set 200 feet apart. There were seven telegraph stations, Edinburgh, Glasgow, Cowlairs, Kirkintilloch, Castlecary, Falkirk and Ratho, opened to the public from June 6, 1846. The circuit cost £50 a mile to construct, or in total £2,400 – including the galvanic batteries and eight Bain instruments. The apparatus was the I & V single-needle telegraph that worked two codes, one for commercial messages, the other for specialist railway traffic. On April 29, 1846 Bain used this single wire circuit to demonstrate the utility of his electric clocks, a master timepiece in Edinburgh was connected to a small companion dial over the forty-six miles and synchronised their timekeeping electrically. In December of that year he used the same two clocks for a public demonstration in Glasgow.

The I & V telegraph was also installed to manage traffic on the single-track 1,540 yard Shildon Tunnel of the Stockton & Darlington Railway. The railway agreed to pay Bain £50 to use his patent rights and for erecting wires, batteries, and so on, on August 4, 1846. They were installed in "cabins" at either end of the long tunnel. The Shildon telegraph was in use until 1868, and at least one of the two instruments still exists.

The Bain I & V Code used on the Edinburgh & Glasgow Railway was as follows: I – A; II - B; III - C; IIII - D; VI - E; VII - F; VIII - G; IVI - H; VVI - I; IVVI - L; VVII - M; VVVI - N; VIVI - O; IV - P; IIV - Q; IIIV - R; VIV - S; VV - T; IVIV - U; IVV - V; VVV - W; IVVV - X; VIVV - Y; VVIV - Z; V - (End); VIIV - (Stop); I - 1; II - 2; III - 3; IV - 4; V - 5; VI - 6; VII - 7; VIII - 8; VIV - 9; VV - 10.

On the Stockton & Darlington Railway in England there was a variant in use: I - A; II - B; III - C; IIII - D; V - E; VV - F; VVV - G; VVVV - H; IV - I; IIV - J; IIIV - K; VI - L; VII - M; VIII - N; IVI - O; IVII - P; IIVI - Q; VVI - R; IVV - S; VIV - T; VVVI - U; IVVV - V; VIVV - W; VVII - Y; VIVI - Z; IVIV - (Stop). This may have been adapted from the original I & V code over the years.

The Copying Telegraph

It is commonly averred that Bain invented the facsimile machine; one version of his chemical telegraph of 1843 was indeed enabled to copy solid metallic type by using a swinging arm carrying an electrical feeler, scarcely something for public or even commercial use. It was Frederick Bakewell, a writer and engineer, who patented the first copying telegraph in 1848 designed to transmit hand-writing or a drawing over distance and perfected it in 1851. It has to be said in Bain's defence that he had allowed Bakewell access to his workshops in 1847 and contemplated employing him to "prepare a full description of his electrical inventions". However when Bain was out of the country in the spring of 1848 Bakewell patented his simple copying telegraph using a single rotating drum and a metallic feeler to send and receive messages, the original message written in varnish on foil, replaced with electrically-sensitive paper to receive, and announced it loudly in the 'Spectator' magazine that he edited.

Bain, as usual, gave in to one of his rages and attacked Bakewell in the press over several years, going to the trouble of making his own, extremely complex, version of a copying telegraph in 1850. This had two drums and two electrical feelers, one for sending one for receiving, all driven by clockwork and held synchronous by a massive centrifugal governor. It seems that he eventually came to some sort of business arrangement with Bakewell; he acquired a one third share of a patent the latter obtained for a soda-water making machine for £200, and they had adjacent stands showing copying telegraphs at the Great Exhibition of 1851.

It has to be added, too, that the Electric Telegraph Company, by then the owners of the Bain telegraph and clock patents, notoriously litigious in protecting its rights, did not challenge the originality of the copying principle introduced by Bakewell in 1848, and, in fact, co-operated with him. On September 22, 1848 the Company allowed Bakewell to use a single wire circuit between its office at Seymour Street in London and the "Telegraph Cottage" in Slough to try his new "small instruments".

William Carpmael, the leading patent lawyer of the time, who was also a qualified engineer, stated to Bakewell in the summer of 1848 that "The copying of writing has never been attempted before - the field is quite open to you."

It was Bakewell who wrote, not unreasonably, that "Mr Bain has in several instances introduced complex mechanisms for effecting the simplest purposes"; an observation with which anyone reading these pages must undoubtedly agree.

The Navigator

On December 31, 1844 Bain patented a complex process for registering the direction and distance travelled by ocean-going ships, and for remote measurement of temperature and speed, the elements all using electricity. The patent was in five parts, 1) registering the direction of a ship's course over distance using a magnetic compass and a rotary log, 2) registering the direction of a ship's course over distance at certain intervals of time as in 1) by the addition of a chronometer 3) printing the direction of a ship's course and the distance travelled, 4) ascertaining the temperature in the holds of ships and 5) taking soundings at sea. In effect the "Bain Navigator" consisted of a magnetic compass, a chronometer and a speed and distance log, electrically monitored and recording data constantly on a paper disc moved by clockwork. One of Bain's most original, creative and potentially most useful concepts, it was, sadly, never perfected.

The Navigator aside; the electric clock and telegraph business was good: during April 1845 Bain had to advertise in Glasgow for instrument makers for his Edinburgh workshops, and again at the end of December for cabinet makers to case his telegraphs and clocks.

On September 25, 1845, on December 12, 1846 and again on February 19, 1847 Bain patented additional improvements to both his clocks and telegraphs.

Perspective, Highton on Bain

Edward Highton, an early telegraph engineer, published one of the first analyses of the industry in 1850. He treats Bain's innovations and his activities up to that year in the following manner:

"We will now pass on to the patents of Mr Alexander Bain.

"Mr Bain, in 1845, opposed the Bill of the old Electric Telegraph Company, when before Parliament. The result was a compromise between the parties, and the purchase by that Company of the patents of Mr Bain.

"The first [telegraphic] patent of Mr Bain was sealed December 21, 1841 [Patent 9,204]. This patent relates to a telegraph applicable to locomotive engines. With regard to that part which has more immediate reference to the electric telegraph, Mr Bain proposed to have the coil moveable, and the magnet stationary; Cooke and Wheatstone's plan being the reverse of this, viz., the coil being stationary, and the magnet moveable.

"Mr Bain proposed to apply this mode of obtaining motion both to ordinary telegraphs as well as to a new form of printing telegraph. This printing telegraph was an extremely ingenious one at the time. A modification of it was afterwards at work for some time over a few miles on the South Western Railway.

"In this patent also was included a mode of insulating wires by means of bitumen.

"A second patent was taken out by Mr Bain in 1843 [Patent 9,745].

"This patent contains improvements on the foregoing plans, besides several other new arrangements, and also a plan of lowering the plates of a battery by means of clock-work mechanism and an electro-magnet, so as to keep the power employed always of the same strength.

"The patent has also inventions with respect to electric clocks, and describes as well a mode of producing copies of type by means of electro-chemical decomposition.

"The telegraph known as Bain's I and V telegraph (so called from the particular figures which were employed in forming words and sentences) is fully described in the Specification.

"Mr Bain also, in the same Specification, describes his mode of burying in the earth a mass of copper at one terminal station, and a mass of zinc at the other, and joining, when desired, these metals by the line-wire. A current of electricity could of course flow through the wire, and this electricity was to produce the necessary signals.

"To those versed in the science of electricity, it will be evident that this arrangement was but the using of one large cell, in which the mass of copper and of zinc formed the plates, the earth the jar or cell, and the moisture in the earth the exciting liquid.

"The practical objections to this arrangement consist in the want of intensity in the electricity generated, and in the motion of a magnetic body being obtained only in one direction.

"A third patent was taken out by Mr Bain in 1845. This patent was sealed on the 25th September [Patent 10,835].

"The first part refers to suspending wires in a kind of fence railing, and also a peculiar mode of suspending wires on posts.

"Another part refers to the handle apparatus of a telegraph for transmitting currents of electricity. There is nothing new in the principle herein employed, but the mechanism differed from that in use at the time.

"There are also modes of sounding alarums, and also improvements on codes to be used with the I and V telegraph.

"Improvements are also set forth in step-by-step movement telegraphs, and in printing or dotting telegraphs. Several improvements in electric clocks are also described.

"A fourth patent was taken out by Mr Bain in 1846. This patent was sealed on the 12th of December [Patent 11,480]. The first part refers to the mode described of a one-wire chemically marking telegraph. A circular wheel, with moveable projecting pins, was employed. When the pins were pulled out as the wheel revolved, they came into contact with other spring pins, and thus caused currents of electricity to be transmitted from a battery, producing thereby corresponding chemical marks on chemically prepared paper at the distant station.

"Another plan consisted in cutting out slits of different lengths in a long strip of paper at the transmitting station, and allowing this perforated strip to pass uniformly over a metal cylinder with a pin or spring pressing on the top of the paper. Whenever, therefore, a hole in the paper passed under the pin, the pin came into metallic contact with the cylinder underneath, and allowed a current of electricity to pass through the line wire. All the holes in the paper, and their length, were therefore proportionably represented at the distant station by chemical marks of corresponding lengths on the prepared paper at that station. This form of telegraph is the quickest at present invented. It does not, however, seem suited to ordinary communications, but only to the transmission of very long documents on extraordinary occasions.

"If one person only is employed to punch holes in the paper, it is evident that, instead of making a hole in the paper, a current of electricity might as readily be sent, and a chemical mark made at the distant station, and thus the message might actually be sent in the same time as that required for cutting the paper. But this remark applies only to the case where there is but one attendant for a wire. If a number of men be employed at each station, then, by dividing the message into parts, and each man punching out his part, the whole paper can be perforated in less time than one man could send the message. On uniting this perforated paper, and applying it to a machine, and on turning the cylinder round, corresponding chemical marks may be made at a distant station with very great rapidity. The commercial question is therefore, where ordinary communications are alone required, one of large working expenses versus a rather larger outlay of capital in the first instance. The plan proposed, however, is most ingenious, and the instrument will form a good adjunct to the other instruments at very important stations.

"This same patent also includes a form of telegraph post. This is composed of four thin slabs of timber fastened together in the manner of a box, the interior being hollow. The author is not aware that this plan of post has ever been adopted.

"Owing to the fact that *no publication of the Specifications of these patents has yet been made,* the author is unable to give drawings of the same, or to refer more fully thereto. These telegraphs show very great ingenuity in their various parts, as also in the mechanical details employed."

Highton in his chronology misses out some of Bain's other patents, including those for the electric clock and its improvements, but makes the important point in culmination that Bain avoided publishing the details of many of his ideas until they were proven to work, which they often did not. The sheer volume of Bain's ideas at this time is remarkable, particularly as he chose to work entirely alone in developing them.

Bitter Revilings

Early in 1842 Bain had acquired a patron, John Finlaison, of Alghers House, Loughton, Essex, who had seen his clocks at the Polytechnic. Finlaison was a man of some wealth, eminent in the insurance industry, Actuary of the National Debt and Government Calculator. The association initially came about from their common origin in the north of Scotland. Finlaison was generous, providing Bain with funds, assistance in publicising his devices and allowing the grounds of his house in Essex to be used for experiments. Bain was also to meet Matilda Bowie, the widowed sister of Finlaison's wife, at Loughton and was to marry her in 1844, adopting also her six year old daughter.

Finlaison was sufficiently impressed with Bain's work to loan him £3,000 in 1846 to complete his principal telegraphic work, the circuit between Edinburgh and Glasgow. This was used to demonstrate both his I & V telegraph and the transmission of time using his electric clock. He also paid to have a large electric clock installed in the new Church of St John the Baptist, in Church Lane, Loughton in 1848. It proved unreliable and was replaced in 1850, by which time John Finlaison had moved to Lower Mead, Richmond-upon-Thames, Surrey and Bain was in America.

It was John Finlaison's substantial, even lavish pamphlet of 1843 giving a partial view of Bain's dispute with Charles Wheatstone over the electric clock that has affected all subsequent views of the inventor's grievances. Although Wheatstone chose to ignore "the bitter revilings" contained in the paper, others at the time were more forthcoming with their opinions. C V Walker, the electrician of the South Eastern Railway, wrote in 'The Electrical Magazine' of October 1843, "We are quite sure that the great want of courtesy displayed in every page of Mr Finlaison's work will induce many to close the volume without doing justice to the young man, in whose behalf it is penned. The author has been 'zealous overmuch;' in his ardour to maintain the rights of his fellow-townsman, he has outstripped his better self, and has so interwoven the plain statement of the case with sarcasm and 'railing accusation.'"

The relationship between Finlaison and Bain does not seem to have survived beyond 1850.

Biter Bit

Bain was to construct an experimental circuit alongside the London & South Western Railway in April 1844, in competition with Cooke & Wheatstone. This was the route of a planned telegraph for the Admiralty from London to the naval port of Portsmouth. Rather than his new, untried chemical telegraph he installed two mechanical printers on a trial line between Nine Elms and Wimbledon in London, a distance of nine miles.

This telegraph was, according to Alexander Bain, demonstrated "before the Lords of the Admiralty and several hundred visitors". This was his first great opportunity to enter the new market for electrical communication; the first long line of electric telegraph to be built in Britain. It would show to the government and, more importantly, to the railway companies which had access to all the cities and towns of Britain, that his apparatus had the potential to work effectively over long distance. Bain got it all wrong.

Bain's electric printing telegraph was a small but complex machine mounted on a tall table. The two instruments were precisely similar, connected by a single copper wire in a thin layer of asphalt. At Nine Elms, imbedded in the earth, and attached to the apparatus by a copper wire was a plate of *copper* one foot square; and, at Wimbledon, a plate of *zinc*, also one foot square, these, which with the action of the earth's moisture, formed a natural or *telluric* battery.

They were mechanical telegraphs, each containing *two* clockwork mechanisms, one to propel the message function, the other the printing function, worked by two large weights; "electricity being employed merely as the agent of setting the apparatus in motion and stopping it at the points required".

Communication was undertaken by freeing the hand on the dial and allowing it to rotate, simultaneously with a separate print-wheel, by the first clockwork, the speed and action controlled by centrifugal governors. When the hand reached the appropriate figure or number on the dial the operator pressed down on a tubular mercury-filled switch to complete the electric circuit and stop the rotation. The stopping and collapse of the centrifugal governor triggered the second clockwork, propelling the print mechanism, to press the still print wheel against a vertical cylinder carrying the paper, through a double ink ribbon. Once the mark was made the print mechanism rotated the cylinder one character and moved fractionally upwards on a spiral shaft.

The message was read at both instruments on the dial and was printed spirally around the rising cylinder. Twelve figures or numbers were used for signalling, not the roman alphabet. For special messages a slip of paper could be inserted between the pair of ink ribbons to make an additional, removable copy. A spiral metallic rod alarm or sounder was also included to warn of a message, "much the same as is used in clocks on the Continent..., producing a sound as distinct as a bell, but of a much more mellow and musical note."

"Such is its velocity, that when this telegraph shall be laid down the entire line, the time occupied in the transit of a message, from Nine Elms to Portsmouth, and receiving the answer in town, will not exceed two minutes and a quarter."

The extreme complexity of the clockwork-driven electric printing telegraph, the frailty of its line-side circuit and the unreliability of the *telluric* or earth battery, militated against its adoption. Cooke & Wheatstone won, and completed the very first long line of electric telegraph in Britain between London and Portsmouth on February 1, 1845 using their two-needle system.

Bought Out

The Bain chemical telegraph was purchased by the Electric Telegraph Company in Britain by an agreement dated June 8, 1846, and used between 1848 and 1862 on its longest and busiest circuits, and for the intense traffic between its West End office in the Strand and its Central Station at Founders' Court. He improved this apparatus during 1848 to create the *fast telegraph* - where the 'finger pedal' was replaced by a small manual hole-punch and strips of paper that were fed into a rotary transmitter. The Company also used his 'Bain code' in these circuits, and bought his clock patent, intending to manufacture them in Edinburgh for sale throughout Britain.

Latterly the crude small hole-punch worked by a rubber hammer was replaced by two machines. In the first, "two handles are fixed to levers with which circular punches are connected; the levers, by a ratchet and pawl, feed the tape from a reel through the instrument. The lever on the right actuates the feed motion without punching, so giving spaces between letters and words; the combinations of circular perforations give the code". A later punch, designed by Latimer Clark of the Electric Telegraph Company and made by Meinrad Theiler in 1855, had three levers: one for moving the tape, one for punching dots and one for punching dashes for the "European Alphabet".

Bain received 150 shares in the Electric Telegraph Company, taken as fully paid-up, with a nominal value of £3,750 on July 1, 1847. He had disposed of them all by December 1848.

Bain had previously licensed, for a handsome fee, the entire French rights for the chemical telegraph to William Boggett, a button manufacturer, of 50 St Martin's Lane, Charing Cross, an electrical dilettante who corresponded with Michael Faraday. It was tried over ever longer distances and at remarkable speeds but was not adopted in France.

Although it was extremely sensitive, requiring relatively little galvanic energy in its circuits, the chief disadvantage of the chemical telegraph was the need for the marking paper to be kept damp in use, which made it frail and malodorous. It was also vulnerable to disruption by 'atmospheric electricity'. When used in America Bain's chemical-paper rolls were replaced by more durable flat disks of treated paper on a metal plate, twenty-inches in diameter, rotated by a clockwork-driven roller, and the receiving wire caused to move spirally across the disk on a metal arm from a central spindle in the manner of a gramophone needle.

The Bain telegraph was used in the Electric's domestic circuits until replaced by the American telegraph in 1862 and later by Charles Wheatstone's *automatic telegraph*. Both of these substituted more stable electromagnetic 'writers' using ink on a plain-paper tape for chemical elements.

The Electric Telegraph Company paid Bain £7,500 for his initial clock and telegraph patents in Britain and allowed him £2,500 contingent on his services to the firm in 1846. He became a director of the Company for a short while. When he patented the fast telegraph in 1848 the Company purchased the rights for Britain for £13,250, half in cash, half in shares. Bain was also scrupulous in simultaneously patenting his clock and telegraphs throughout Europe and America.

The Electric Telegraph Company formed a separate Clock Department under Bain's management and initially displayed his electric clocks at their show- and news-rooms at 142 Strand, opposite their first chief office at 345 Strand. They retained Bain's clock manufactory at 11 Hanover Street, Edinburgh until 1848 when it was closed and the work contracted out to William Reid in London. In April 1847 the manufactory was developing an *electric chronometer*, to keep perfect time at sea, using salt water to produce a continuous source of galvanic energy.

The electric clocks were extremely expensive, selling for £16 16s for 'master' timepieces and £10 10s for each 'companion' dial. Running costs were high, too: 1d a week using a single small Smee zinc-silver cell, which lasted just fourteen days. Despite this several hundred were made between 1845 and 1848, and serially numbered; they were marked on the dial "*Electric Telegraph Compy. No. XXX. A. Bain Invenit.*"

During 1847 there was a major effort to publicise the electric clocks. In February, the parish church in Leeds in Yorkshire installed one in its tower, followed by another at Great Wenham in Suffolk in April. The latter had two dials each four feet in diameter and was still going well, according to the Ipswich newspapers, in the autumn. In August the Electric Telegraph Company installed one in the window of the offices of the 'Manchester Times' and was rewarded amply with column inches of publicity. The Exchange in Manchester also possessed an electric clock in 1847, which the other newspapers diligently covered in their columns. The Company promoted them as "the Electric Clock with Perpetual Motion", as it relied on a *telluric* or earth battery buried deep in the ground; adding "there is not a single spring in this clock".

The Electric company had severe financial problems in the late 1840s and was unable to proceed with the marketing of electric clocks. It is likely that Bain was disillusioned with this; but he had also failed to use his period with the Electric to build any peer relationships. The company's engineers, rather than Bain, had to adapt the fast telegraph into an effective device.

He proved resentful of the company's lack of resource in promoting the clocks and was to oppose their interests subsequently in public and in law.

Whatever his other business commitments were in that hectic period Bain found time to devise a "musical instrument". It was actually a musical box with a pneumatic source modulated by holes in a tape, obviously based on the tape transmitter of his chemical telegraph, which he patented on October 7, 1847.

Austria

The *Hofkammer* or Privy Council of the Imperial Royal Austrian government appointed a technical commission to examine electric telegraphy in 1845. It was led by *Hofrat* or Privy Councillor Andreas Baumgartner who had wide experience in business as a director of the state porcelain works, the factories of the tobacco monopoly, and of the *Kaiser Ferdinand Nordbahn,* Austria's first railway. One member of the commission visited France and another, Baumgartner, went to Britain to review telegraphic progress.

Baumgartner was to visit, among other sites of interest, the telegraph installed on the Edinburgh & Glasgow Railway, which worked Alexander Bain's novel I & V single-needle telegraph with a single overhead wire. After comparing his report on the I & V telegraph with other British, French and German systems the Austrian technical commission agreed to adopt Bain's principles for their national network.

Alexander Bain is uncharacteristically reticent in regard to Austrian adoption of the I & V telegraph in 1846. It appears that the commission bought the patent right for the instrument's principles and implemented its use and development without further consultation. There is no evidence that Bain visited Austria.

However subsequent history shows that the I & V telegraph had considerable utility and its extension was only brought up short by the need to standardise on a single system in the German-speaking world rather than by any technical deficiency.

A short experimental Bain line was laid by the rails of the *Nordbahn* on the section between Vienna and Floridsdorf in 1845 to demonstrate the new system. It was to be extended to the rest of its network in the following years, which connected Vienna with Brünn for Prague, and Oderberg for Silesia and Russia.

On January 16, 1847 a decree of the Privy Council created the *kaiser königlichen Staats-Telegraph* or Imperial Royal State Telegraph as a monopoly of the government. It adopted Bain's apparatus as the basis of its system.

Although based on Alexander Bain's principles, using his rotating double-horseshoe armature, the Austrian Technical Commission created a unique pattern of telegraph and adopted it as their own. Instead of vertical needles the Austrian telegraph 'Indicator' had a horizontal needle that also struck two bells of differing tones. The 'Communicator' was a pair of wooden finger pedals or keys, with brass counter-weights rather than springs to operate the current-reversing levers. It retained the Bain I & V code, with 16 alphabetic letters and 10 numeric letters, and could transmit 30 letters a minute, about the same as the German dial telegraphs, but much less than the 100 letters a minute by the recently introduced American telegraphs used between Hamburg and Cuxhaven. To compensate for this apparent slowness the simple Alphabetic Signals were supplemented by Code Signals using a phrase book.

The initial Austrian Bain instruments were made by Johann Michael Ekling in Vienna, and later by the *k.k. Telegraphenwerkstätte Wein*, the Imperial Royal Telegraph Workshops Vienna. Each apparatus comprised two communicators or receivers, one double key, one Steinheil galvanic alarm, one electro-magnet, one resistance, and one box with a worktop, holding a battery in the base. The whole set cost 97.20 florins, a little less than £10. They were worked with eight Smee silver-zinc cells on short lines, and up to 24 Smee cells on the longest lines, these also originating in Britain.

The line wire was of copper, one Viennese "line" (2.4 mm) in gauge, supported on wooden poles between 9 and 14 Viennese feet high, and 80 Viennese feet apart (1 Viennese foot = 31.61 cm), topped with small zinc-metal "roofs" to deflect rain. The pottery insulators were of a novel semi-circular pattern with a hole for the line wire, made by the *k.k. Porzellanfabrik* in Vienna, stapled to each side of the pole, much like W F Cooke's first ceramic insulator.

There were four Bain circuits built in Austria for the *k.k. Staatstelegraph*: the Northern line from Vienna to Prague, by way of Prerau and Olmütz, (164 km), and the alternate Vienna to Prague route via Lundenburg and Brünn (150 km); the Eastern line from Vienna to Pressburg (11 km); and the exceptionally long and difficult Southern line from Vienna to the port of Trieste on the Adriatic coast (954 km). A planned Western line running from Vienna to Linz and Salzburg in 1849 was not built as a Bain circuit.

By 1849 the *k.k. Staatstelegraph* worked 1,667 km of Bain line, with 23 stations employing 94 "manipulators" and 55 line-men.

Although the Austrian Bain system was abandoned by the *k.k. Staatstelegraph* with the adherence of Vienna to the German-Austrian Telegraph Union in 1850 which standardised on the American telegraph, the *Kaiser Fer-*

dinand Nordbahn retained it in service on its railway network to Silesia and Russia until 1886.

The writer thanks Prof Franz Pichler of the Johannes Kepler University, Linz, Austria, for introducing him to his works 'Elektrisches Schreiben in die Ferne', and 'Telegraphen-Apparate' on which this section is based.

Table 24

Bain I & V Alphabet
Austria 1846

A	= 12	1 = 11
C or Z	= 21	2 = 15
I or Y	= 16	3 = 51
O	= 61	4 = 55
U or W	= 25	5 = 12
B or P	= 22	6 = 21
V or X	= 26	7 = 16
D or T	= 52	8 = 61
F or V	= 56	9 = 25
G or K	= 65	0 = 52
H or CH	= 15	
L	= 62	
M	= 66	
N	= 11	
R	= 51	
S	= 55	

Formed from combinations of numbers 1 and 5 (I and V) on the receiver.
As used by the *k.k. Staatstelegraph*, taking into account letter usage in the German language

America

It was in May 1848 that Bain made his first "flying visit" to America, staying a few weeks to commence his claim for a United States patent. He returned to New York in late August 1848 by the Cunard steamer *Cambria* from Liverpool, intending to proceed immediately to Washington to complete the patent negotiations. His arrival was enthusiastically reported by the 'Scientific American' magazine, anticipating a competitor to the overweening Morse Syndicate.

A mammoth battle then commenced in the courts, where the Morse Syndicate used its financial influence to affect the law officers and the patent office in its favour. It took many years to secure Bain's patent right for the chemical telegraph.

Bain left England after commuting his payment from the Electric Telegraph Company, receiving instead the residual rights to the electric clock patent and the chemical telegraph rights for British North America. The Company also lent him £1,000 at 4% interest. On his arrival he licensed his American patent for the chemical telegraph to Henry Rogers & Company of Baltimore, Maryland, to be used in a 250 mile line between New York and Washington, by way of Philadelphia and Baltimore, challenging the Morse Syndicate over that route. Shortly after Bain entered into another licensing agreement with Henry O'Rielly, who had been previously a Morse licensee, who undertook to make 800 miles of telegraph line a year working his patents. Bain was to receive $30 per mile and 25% of the paid-up stock of these new main lines, and 10% of the stock for all branch circuits. O'Rielly constructed six Bain lines; 1] from Boston to New York; 2] from Buffalo to New York; 3] from Boston to Portland, Maine; 4] from Boston to Burlington in Vermont; 5] from Louisville, Kentucky, to New Orleans, Louisiana; and 6] minor lines in Massachusetts and Vermont.

Henry O'Rielly was to be driven into bankruptcy by the Morse Syndicate in 1851 and his interest in the Bain patents and his 2,000 miles of line in the United States passed to Marshall Lefferts. Not long after this, with Bain back in England, Lefferts came to an agreement with the Syndicate to merge their competing interests.

Bain initially took rooms at 128 Broadway, New York, the office of his lawyer W H Allen, where he displayed his electric clocks and the chemical telegraph. The version of the latter he presented in October 1848 was quite different from his British version: it had a rotary sender using punched paper tape attached to a box which held two metallic receiving drums covered with chemically sensitive paper propelled by clockwork. A fine metallic feeler rested on each drum to create the circuit, one of which recorded the sent message, the other received messages. The messages were "written" spirally around the drum as the sender was cranked by hand. It was demonstrated as sending 1,200 letters a minute.

This elaborate device was replaced in actual service by a simple on-off finger pedal or key for transmitting and a flat rotating circular plate with the electric feeler on a swivelling arm to "write" or receive the novel Bain Code of dots and dashes helically on a damp paper disk. The receiver was propelled by clockwork. The alarm used was electro-magnetic with a glass sounder.

By 1850 there were 2,012 miles of electric telegraph in the United States worked under Bain's patents.

During October 1848 'Scientific American' lauded Alexander Bain as "the first electrical engineer in the World". The reaction of S F B Morse to this accolade is not recorded.

Europe

In 1850 Bain had returned to Europe; on February 23 he was a witness for the defendant in London in a patent case prosecuted by his former employers and benefactors, the Electric Telegraph Company. His elaborate, hostile testimony lasted four hours and required the use of models and drawings.

During May 1850 Bain presented a new automatic telegraph to *la Société d'encouragement pour l'industrie nationale* in Paris, France. This comprised, as with his fast telegraph, a small punch making long and short holes in a long paper tape which was rolled on to a wooden cylinder. The second component was a sending apparatus that fed, by means of a hand crank, the punched paper between four metallic feelers and a metallic cylinder creating a circuit. The final part, a clockwork-driven receiver, had a rotating metallic disk covered with a circular sheet of chemically-damped paper. A screw carrying an electrical feeler spanned the radius of the disk, as the disk rotated, "turning with great quickness", so the screw moved the feeler which lay on the damp paper from its rim to its axis writing a spiral of long and short dashes. When the apparatus was tested by the assembled scientists it chemically printed 1,200 'letters' in forty-five seconds.

Subsequently this Bain automatic telegraph was given a more robust trial on the circuit between Paris and Lyons. The two wires of this line were joined at Lyons creating a 336 mile circuit back to Paris, to which were added wire coils to extend the length to 1,082 miles. A message of 282 words was then transmitted and received on the adjacent disk in fifty-two seconds.

Despite this success the French selected the American telegraph in place of their Breguet needle apparatus.

What was almost Bain's last telegraph patent in England was granted on May 29, 1852 for further "Improvements in Electric Telegraphs". In this the sender was the common on-off "finger pedal"; the receiver was a unique contrivance that used an endless narrow cloth band several feet in length with a loose hanging fringe, moved horizontally by clockwork. The current was used to deflect the fringe either side of a long plate that paralleled the endless band; by this means the clerk could read the message as it travelled along the plate from whether the fringe was in front or behind it.

Living Large

Alexander Bain, inventor, had a stand in the galleries of the Crystal Palace at the Great Exhibition of 1851. He exhibited according to the descriptions in the catalogue:

- Patent electric clocks, suitable for halls of mansions, offices, steeples, &c., kept in action by a small galvanic battery, or the electricity of the earth
- Time-ball, to be discharged by electricity sent by an ordinary regulator clock
- Pair of electro-chemical telegraphs, stated to be capable of transmitting and recording communications at the rate of 1,000 letters, or even 1,000 words, per minute
- Patent electro-chemical copying telegraph, said to be capable of copying any figure, such as profiles, autographs, stenography, &c.
- Patent electric telegraph for printing all the letters of the alphabet in the roman character

The Great Exhibition occupied much of Bain's time and energy during 1851, in preparation for the event and in attending the display stand between May 1 and October 15. The Crystal Palace in Hyde Park proved not to be the best venue to show his electric clocks, movement of insubstantial floor boards of the galleries caused their pendulums to quiver. The 'Morning Chronicle' reported that of the four he displayed on the first Wednesday, two had stopped by Saturday, and the other two "varied by some minutes" for this reason.

When Alexander Bain returned to London in 1850, he was, apparently, comfortably off, living with his wife, Matilda, in a large house in Hammersmith, a small, smart suburb of London, on the river Thames, with five servants and a teacher for their six children. One of his neighbours there was Charles Wheatstone. His chemical telegraph patent in America was validated, despite the attacks of the Morse Syndicate; over two thousand miles of circuits had been built using his rights. At this time Bain still possessed valid, and possibly valuable, patents in British North America, France, Belgium and Austria for the chemical telegraph; in England for a musical instrument and for the electric ship's log; and in France for the electric clock. Bain also claimed to possess 100 shares in the Mississippi & Illinois Telegraph Company, 1,354 shares in the People's Telegraph Line (Louisville to New Orleans), 100 shares in the Ohio, Indiana & Illinois Telegraph Company, 225 shares in the Vermont & Boston Telegraph Company and 71 shares in the New York State Telegraph Company; all of some value in America.

Previously, in 1848, the Electric Telegraph Company had returned his patent rights to the electric clock, all their stock and the implements for their manufacture. Bain had neglected his "first child" for the telegraph, now with the pressure of the Great Exhibition past he took up electric timekeeping once gain and, on April 30, 1852 he opened a fine shop, with showrooms and manufactory, at 43 Old Bond Street, Mayfair, London, large premises lately occupied by Henry and William Powell, coach-builders, four doors from Piccadilly, to retail his clocks. It was, interestingly, just a few minutes' walk from Wheatstone Brothers, musical instrument makers, at 20 Conduit Street, Mayfair.

However, all was not what it seemed. Henry Fletcher, a bookseller, had advertised in the London newspapers in October 1851 that he had money to invest in a new business. Bain borrowed £1,000 from Fletcher, his life savings, offering 5% interest and a salary of £250 a year to be his Manager. Andrew Bonar, an Edinburgh merchant of some means living in London, was also induced to advance Bain £1,770 at 5% and £300 a year "for his influence in favour of 'the clocks'" in 1852.

"Electric Clocks"

"Mr Bain, the patentee, showrooms, 43 Old Bond Street, are open to the public, an extensive assortment of these Clocks, at all prices from £5, may be seen in motion. They require neither winding nor attendance of any kind and keep very accurate time. By one pendulum, power is obtained to work several Clocks, thereby ensuring perfect uniformity of time throughout the largest house."

Advertisement, June 1852

A handsome illustrated pamphlet, 'A Short History of the Electric Clocks' was published by Chapman & Hall in concert with the new venture. The author was Alexander Bain, "the Patentee." Advertisements announcing the opening of the showroom were taken in the

London papers, 'The Times', the 'Daily News' and the 'Morning Chronicle'.

Utterly Reckless

On December 3, 1852 Alexander Bain, electric clock maker, was declared bankrupt, owing £12,422 to unsecured creditors with just £932 in assets.

When his accounts were examined, they ran only from January 1, 1852 until December 3, 1852, and eventually balanced it was revealed that in January 1852 Bain was already £4,393 in debt, and was relying entirely on credit for his existence. He claimed as assets the residual rights to his several patents in Europe, £16,300, and property in America, comprising clocks and telegraph models, half of the chemical patent right and stock in telegraph companies, £22,350. Even before he left for America in 1848 the money he received from the Electric Telegraph Company in 1846 for the British rights to the chemical telegraph, £10,000, had all gone – mainly to pay his legal and parliamentary costs in fighting the same company. The values put on the European rights and American assets were illusory. In the weeks previous Bain had despatched his solicitor to New York in an attempt to redeem his assets there; he came away with nothing. Marshall Lefferts had already sold his controlling interest in the rights to the Morse Syndicate rendering Bain's portion, claimed as half, worthless.

The trading accounts of the shop were disastrous. Cash sales in 1852 were £1,200, profit was £70. Bain's expenses included £599 for his house, £520 for law costs, £347 for staff wages, and £206 for interest on loans. The sums borrowed exceeded £4,200. Bain had been lavish with other people's money.

The few timepieces sold at the shop were marked on the silvered dial "*Alex^{r} Bain's Patent Electric Clock*".

In addition to these woes the very short-lived *Electric Time Company* intended to promote a Bill for an Act of Parliament to acquire the residue of Bain's clock patent and to manufacture his timepieces. The Bill authorised its provision of timepieces and its charging for supplying time by electricity, as well as powers to open up roads, streets and highways in England and Wales for its time circuits. The Bill was deposited on November 1, 1852, but then almost immediately abandoned. Apart from Bain it is not known who the promoters were. The Time company failed miserably, not making a single electric clock and leaving Bain with liabilities of £4,364.

The bankruptcy court pointedly observed that his borrowings of Fletcher, who was reduced to penury, and Bonar had funded a substantial lifestyle rather than improving the clock business. It also catalogued his previous, and equally unfortunate, financial backers, Barwise, Wright, Boggett and Finlaison.

He appeared before the court on December 16, 1852 and several times during the spring of 1853. There were three classes of bankruptcy certificate, the first was granted almost immediately if it came about through unavoidable losses or misfortunes; the third if there were wilful or criminal intent, and was a "stigma for life"; Bain fell into the second class, between the two, although described as "utterly reckless as to the consequences" of his borrowing in mitigation he had given up all he had, his shares and his patents, to his creditors, and there was no fraud or preference in his accounting. He was given a year in April 1853 to cooperate and settle with his deeply suspicious creditors with an allowance of £3 a week from the estate. Bain was finally discharged from bankruptcy on May 11, 1854. Two dividends were eventually paid, 8d in the pound on June 28, 1853, and 11/12d (0.91d) in the pound on December 6, 1859, 3¾ % in all.

His large family were compelled to move from the house by the river Thames at Hammersmith to Westbourne Park Road in slightly less congenial Paddington in 1853. Their story after 1856 is vague, however on August 14 of that year Matilda Bain died at the house of John Finlaison, her elderly brother-in-law and Bain's former patron, in Richmond, Surrey. What happened subsequently does not reflect well on Alexander Bain. It is not known who cared for their six children between 1856 and 1860, but when Bain left again for America the children, ranging in age between fifteen years and ten, were divided. At least one was lodged in the British Orphan Asylum in Clapham during 1861 and died in 1865. With the exception of one daughter, a teacher in India, the others vanish from history; none were part of Alexander Bain's later life.

America Again

In the years immediately after the dissolution of his family Bain made his home and worked in a great many places about London; Brompton in mid-1856, Fetter Lane, Holborn, in 1857 and Rahere Street, Goswell Road, Clerkenwell, from 1857 until 1860.

Ending up alone in the instrument-making district of Clerkenwell Bain tinkered with odd, non-telegraphic contrivances, including gas-meters and hydraulics, as well as pencil cases and his old sideline, ink-stands, which he, surprisingly, found the money, or finance, to patent. None of these patents saw out their full life of fourteen years, virtually all became void through the failure to pay the annual fees after a couple of years.

Tiring of this existence Bain then set off once again for America where his name still held celebrity, arriving in New York from Liverpool on September 27, 1860 on the Cunard liner *Persia*.

Whilst in New York Bain developed, among other things, a new compact, *galvanic dial telegraph* in 1863 that worked with a pierced rotating dial much like that on the later mechanical telephone. Samples were made and it would, almost certainly, have been successful in Britain where private wire telegraphy was becoming popular, but its technology was too sophisticated for America. Still inventive, he also patented an "earphone" to listen to acoustic telegraph messages in confidence, an improved telegraphic key, an alarm or call to be used with the telegraph sounder, and an extraordinarily elaborate machine for perforating message tapes. Most of these inventions were patented in concert with the New York lawyer W H Allen, the last of his many foolhardy patrons. After all these proved unworkable Bain eventually turned to plumbing for a living before deciding to return home.

Finis

Alexander Bain's career can be traced through his addresses in the Census. In 1841 he was lodging with William Williams, fishmonger, 35 Wigmore Street, London, no occupation given, but known to be working as an instrument-maker, or, as the patent documents would have it, "a mechanist". By 1851 he had married and his wife and six children were living in some style at Beevor (or Beaver) Lodge, Hammersmith. He styled himself, then abroad, as a 'gentleman'. In 1861 he was resident in New York. Then in 1871, age 60, Bain was once again a lodger, and a widower, at Connop's Coffee House, 294 Oxford Street, London, as a humble machinist, sharing his accommodation with a letter-carrier, a seaman, a tutor and a domestic servant.

Bain returned to Britain in 1866 and tried to market his automatic chemical telegraph of 1850 for high speed messaging in London once more, now adapted to have clockwork motion for both sending and receiving. Unsuccessful yet again, he withdrew to Scotland as a journeyman instrument-maker.

Alexander Bain died in 1877 whilst living in a "home for incurables", depending on a pension organised through the charity of former employees of the telegraph companies, having sadly lost all of the opportunities that his electric clock, his chemical telegraph and his I & V telegraph had offered.

It is ironic, given his fatal weakness, that the largest memorial to Alexander Bain is a drinking house in Wick, Caithness.

Alexander Bain's British Patents

This is a complete list of all of Bain's twenty-one patent titles:

1.] **Patent 8,783**, January 11, 1841 (with John Barwise), Application of moving power to clocks and timepieces

2.] **Patent 8,996**, June 6, 1841 (with Joseph Gauci), Inkstands and ink-holders

3.] **Patent 9,204**, April 21, 1842 (with Thomas Wright), Application of electricity to control railway engines, mark time, give signals and print intelligence at distant places

4] **Patent 9,745**, May 27, 1843, Production and regulation of electric currents, electric timepieces and electric printing and signal telegraphs

5.] **Patent 10,540**, December 31, 1844, Apparatus for ascertaining and regulating the progress and direction of ships, for ascertaining the temperature of holds and for taking soundings at sea

6.] **Patent 10,838**, September 25, 1845, Electric clocks and electric telegraphs

7.] **Patent 11,480**, December 12, 1846, Transmitting and receiving electric telegraphic communications, and apparatus connected therewith

8.] **Patent 11,584**, February 19, 1847, Timekeepers and clocks, and apparatus connected therewith

9.] **Patent 11,886**, October 10, 1847, Musical instruments and means of playing on musical instruments

10.] **Patent 14,146**, May 29, 1852, Electric telegraphs and electric clocks and timekeepers, apparatus connected therewith

11.] **Patent 2,709**, November 22, 1853, Cases for holding cards

12.] **Patent 2,806**, December 2, 1853, Apparatus for damping paper and other substances, in order to prepare the same for the reception of labels, stamps and other like articles coated with a gummy or adhesive matter

13.] **Patent 1,881**, August 20, 1855, Apparatus for distributing liquids

14.] **Patent 2,509**, November 7, 1855 (with William Lord), Pencil cases

15.] **Patent 89**, January 12, 1856, Construction of inkstands

16.**] Patent 1,747**, July 23, 1856 (with B J Heywood), Improved apparatus for supplying or drawing-off liquids, and for stopping the flow of liquids and "æriform" bodies

17.] **Patent 2,923**, November 21, 1857 (with Thomas Glover), Electric telegraphs

18.] **Patent 1,434**, June 14, 1859 (with Joseph Wansbrough), Effecting communications between parts of railway carriages

19.] **Patent 1,101**, May 2, 1860, Means of obtaining copies of letters and other writings or documents

20.] **Patent 1,718**, July 16, 1860, Means, apparatus or articles for holding and supplying ink,

21.] **Patent 1,933**, August 3, 1864, Improved apparatus for drawing off liquids

---

Alexander Bain's US Patents

This is believed to be a complete list:

1.] **Patent 5,967**, December 5, 1848, Improvement in copying surfaces by electricity (copying telegraph)

2.] **Patent 6,328**, April 17, 1849, Improvement in electric telegraph (chemical telegraph)

3.] **Patent 6,837**, October 30, 1849, (with Robert Smith), Improvement in electro-chemical telegraph

4.] **Patent 7,406**, May 28, 1850 (with G Westbrook and Henry Rogers), Improvement in electro-chemical telegraph (disk receiver)

5.] **Patent 32,854**, July 23, 1861, Improvement in telegraphs (electro-acoustic telegraph or earpiece)

6.] **Patent 37,997**, March 24, 1863 (with W H Allen), Improvement in electric telegraphs (galvanic dial telegraph)

7.] **Patent 38,530**, May 13, 1863 (with W H Allen), Improvement in keys for electric telegraphs (silent key)

8.] **Patent 38,929**, May 12, 1863 (with W H Allen), Improved call for telegraphs (alarm)

9.] **Patent 43,618**, July 19, 1864 (with W H Allen), Improvement in machines for punching paper for telegraphic purposes

10.] **Patent 45,012** (with W H Allen), November 15, 1864, Improvement in faucets (a tap)

11.] **Patent 45,013**, November 15, 1864 (with W H Allen), Improvement in apparatus for drawing liquids (a flexible tube)

6.] **NON-COMPETITORS**

To complete the picture of the telegraph industry in the mid-nineteenth century it is necessary to hark back to some predecessors.

Pre-History

Before the electric telegraph there had existed several forms of optical signalling, using flags, shutters and semaphores, for messaging over great distances. In these, stations were established on hill-tops in sight of one another along the route or "circuit".

In Britain the first such was the Admiralty's *Shutter Telegraph* created in 1795 in reaction to the Bonapartiste threat to England. It worked Lord John Murray's apparatus with six rotating shutters to indicate a complex message code. There were three lines constructed, the first was from the Admiralty in London east to the dockyard at Sheerness and to Deal, overlooking the Channel to France, opened in January 1796. The second was a very long line south from London to the naval station at Portsmouth, on the Channel coast, and west to Plymouth facing the Atlantic Ocean, opened in May 1806. The third was worked to Yarmouth on the east coast and commenced work in June 1808. All three were abandoned in 1814 once the Bonapartiste regime in France had been expelled.

The Admiralty almost immediately regretted the loss of the telegraph and in 1815 obtained permission of Parliament to build a new *Semaphore Telegraph* system; securing peacetime powers to acquire property and prevent obstruction of the signals. It adopted the semaphore apparatus of Hume Popham which had two rotating arms, rather than swinging shutters, for an experimental telegraph from London to Chatham dockyard, this was worked from 1816 until 1822. Its semaphores were then transferred to a new line from London to Portsmouth, which operated from 1824 until December 1847 when it was superseded by the electric telegraph. An extension to distant Plymouth was started but never finished in 1827.

It, in its developed state, used a system based on a vertical mast set above station-houses on high ground within sight of each other over its course; requiring constant, eye-straining vigilance by the signallers in the daylight hours. The most important semaphore telegraph, that between the Admiralty in London and Portsmouth, ran over 72 miles and cost latterly between £3,000 and £3,500 a year to work. In addition to this substantial sum it was, allegedly, only fully operational for one-fifth of the year; being interrupted regularly by fog, by rain and even by gloomy weather. The Admiralty semaphore was abandoned at the end of 1847.

Watson's Marine Telegraphs

Independent of these obsolete government semaphore lines there were several other similar commercial *marine telegraphs* still functioning early in this period.

The *Liverpool & Holyhead Marine Telegraph* was the first commercial semaphore created in Britain. Its Act of Parliament of 1825 allowed the Liverpool Dock Trustees to "establish a speedy Mode of Communication to the Ship-owners and Merchants at Liverpool of the arrival of Ships and vessels off the Port of Liverpool or the Coast of Wales, by building, erecting and maintaining Signal Houses, Telegraphs or such other Modes of Communication as to them shall seem expedient, between Liverpool and Hoylake, or between Liverpool and the Isle of Anglesea (sic)." The line was constructed to the design of Barnard Lindsay Watson, a lieutenant in the West Oxford Militia, often erroneously (or mischievously) referred to as a lieutenant of the Navy, who was appointed the "Superintendent of the Telegraph" with a salary of £250 a year.

The initial apparatus combined a six-armed semaphore mast to communicate between the eleven stations surmounted by a flag staff for speaking with passing ships. Additionally, each station was outfitted with two telescopes, a telegraph vocabulary or code book, a ship list and a message log. Some also possessed barometers and wind vanes to observe weather conditions. Each station was worked by a single Telegraph Keeper, paid £50 per year in the late 1830s.

The line opened throughout on November 5, 1827, having cost £2,281 12s 3d to build. Messages allegedly took just five minutes to pass from Holyhead to Liverpool.

Watson proposed extending the semaphore telegraph from Liverpool to Manchester in May 1835, and from Liverpool to London, along the line of a newly planned railway, in October 1837.

The nature and amount of work accomplished by the Liverpool to Holyhead semaphore telegraph is summarised in Watson's report to the Dock Trustees dated December 12, 1836: "In the year 1828 there were about 847 vessels reported by name inward and outward bound; in 1831 there were 1,712; in the present year, up to 30th Nov., [1836] there were upwards of 2,440, besides several hundred without numbers, upwards of 500 reports respecting pilot-boats, about 200 communications respecting wrecks, accidents and casualties, and the state of the wind and weather reported upwards of 700 different times."

In addition to his semaphore telegraphic duties Watson was, between 1827 and 1842, making and selling large numbers of sets of his proprietary signal flags for ships to communicate to shore and with each other at sea, and publishing and selling his *Code of Signals for Shipping*. He was also, unbeknown to the Dock Trustees, receiving and collating intelligence for the chambers of commerce, for the exchange and for shipping insurance companies in Liverpool. On May 9, 1839 Watson was replaced as superintendant of the Holyhead line due to his "outside interest" of flag-making, just as he was installing a new two-tower, four-arm semaphore to replace his old telegraph that had been virtually destroyed in the "Great Gale" of January 1839. The Holyhead semaphore telegraph in that new form continued in use until 1861.

"Lieutenant" Watson was not deterred. The Hull Chamber of Commerce had commissioned him to survey and erect a semaphore telegraph in March 1839, which opened in September 1839, from their port across the Humber river to Grimsby and to Spurn Head to report shipping arrivals from northern Europe using the two-tower, four-arm semaphore and from these stations to speak with vessels using his flags. By mid-1841 it was part of Watson's *General Telegraph Association*, when that failed it became independent as the *General East Coast Telegraph* and finally as the *Hull & East Coast Marine Telegraph Association* until 1857 when the electric telegraph took over its duties.

Always looking for ways to promote sales of his flags to ship-owners Watson had created the *General Telegraph Association* at 282 Regent Street in the West End of London during August 1840 to work coastal signal stations about the country in receiving messages from passing merchant ships for forwarding by post to the port cities. By July 23, 1841, when the Association had moved to premises at 83 Cornhill in the City of London, he had eleven such stations working, including those on his Hull line: in England they were at Flamborough Head, Hull, Yarmouth, Orfordness, North Foreland for London, the Downs in the Channel, St Catharine's Point and The Needles for Southampton; in Scotland, Skirsa Head for Wick, and Peterhead; and in Ireland, Kinsale. Five more, at Dartmouth, and Durdham Downs for Bristol, Scrabster for Thurso, Tuskar Rock and Cape Clear were building. The Association's stations used Watson's flags on masts to speak with ships. It also worked the telegraph cutter *Osprey* off the Isle of Wight to collect messages from passing vessels in the Channel, which was transferred to Cape Clear in Ireland during January 1842 where Watson had a coastal signal station.

The largest enterprise promoted by *General Telegraph Association* was a long semaphore line to connect London with the coastal signal station at North Foreland and eastwards to the South Foreland at Kingsdown by Deal on the Kent coast, the so-called "Downs". It had twelve stations to the Downs with a "branch-line" to the North Foreland and was successful in reporting the arrivals of ships and requests for tugs between 1841 and 1843. The Association also received reports from all of the remote coastal signal stations. "Watson's Telegraph" was to contribute to the regular Ship News column in 'The Times' newspaper from August 31, 1841, and provided other news to the City coffee houses and exchanges from its Kentish and its other coast stations.

As with Hull and Spurn Head and London and the Downs, the stations at St Catharine's Point and The Needles on the Isle of Wight were connected by a semaphore line with the port of Southampton, the Association's third "line".

Initially there was an annual subscription of 10s 0d for each ship to access the coastal signal stations, as well as the cost of Watson's thirteen signal flags. It had risen to 20s per annum per vessel by 1841, and permitted communication with all stations using Watson's flags, including those between Liverpool and Holyhead.

The ships' flags cost £8 8s for the "complete set" of thirteen that enabled the sending of messages; for a basic set of three for sending just the ship's number in the register the price was £2 5s. The code book to work the flags cost 12s 6d. Watson claimed that he had sold 800 flag sets before 1827 and 1,700 up to 1833, after the Liverpool line opened.

The Admiralty required that its sea-going ships carried Watson's code book, as did the East India Company. The Company of Trinity House had its lighthouses and lightships in communication by flag with Watson's coastal signal stations.

On August 1, 1842, in attempt to recover his personal investment in the South Foreland semaphore, Watson re-launched the General Telegraph Association as a joint-stock concern, with a nominal capital of £20,000 in 2,000 shares of £10 each, £2 10s to be paid on allotment of shares. Watson had overreached himself financially.

In August 1843 the London signal tower at Southwark which had cost £900 to erect and was uninsured, burned down, ending the Association's corporate existence. The "dense smoke" of the metropolis disrupting its messages had hindered its business and made replacing the tower uneconomic.

Watson's Hull concern eventually assumed control of several of his other coastal stations that talked with passing shipping as well as the Hull to Spurn Head semaphore line, and in 1848 was working his flags at Flamborough Head, Spurn Head, Great Yarmouth, Aldborough and North Foreland, still adding ships to his register and selling Watson's flags and flag code. The Hull association also then had a network of twenty-two agents, extending from Arbroath in Scotland, down the East Coast of England and along the Channel as far as Weymouth. By then Watson himself had long left the semaphore and flag business.

All of the later commercial optical telegraph companies used the two-tower, four-arm semaphore system of Barnard Watson, with moving arms atop tall masts on a sequence of hill-top stations, to give advance warning to docks and wharfs of approaching shipping, with an accompanying mast or staff on the coast to speak with ships using Watson's flags. Messages had to be received and re-signalled by each station in the line in daylight hours, but even so – if the weather was clement – they worked regularly.

The marine telegraphs were private investments of the port chambers of commerce and dock companies; the semaphore service was used free-of-charge by shipowners. But there was an annual subscription for each ship for the right to use Watson's proprietary signal flags; over 1,300 vessels carried them. Marine telegraphs did not offer public access or messaging unconnected with shipping.

Even before the failure of the London Association, Barnard Lindsay Watson was declared bankrupt on November 16, 1842 as a "manufacturer of flags". He had debts of £5,182 and assets of £756, the difference he put down to losses in building the new semaphores. He became a hotel-keeper, a manager of pleasure gardens and later managed the refreshment rooms at the Crystal Palace in Sydenham. He died in February 1865, as "a retired lieutenant in the Oxford Militia".

At the maturity of the telegraph companies, during the early 1860s, there had been a technical consolidation into three wholly-independent, incompatible national operating 'systems', Cooke & Wheatstone's single-needle with the Electric Telegraph Company, Bright's bell with the British & Irish Magnetic Telegraph Company and Hughes' printer with the United Kingdom Electric Telegraph Company. But there had been others.

The Voltaic Telegraph Company

Had Edward Davy's marital affairs been more ordered the history of the telegraph would have been radically different.

Edward Davy proposed the first company of proprietors for the working of an electric telegraph. On September 8, 1838 he launched the prospectus of the *Voltaic Telegraph Company*, of 5 Exeter Hall, Strand, London, with a joint-stock capital of £500,000 in 10,000 shares each of £50, requiring a deposit of £5. This was, on the surface, a substantial concern. The Marquis of Douro (son of the Duke of Wellington), and Lord Sandon agreed to be Trustees, in whose names all property would be held. A Board of Directors was assembled: Sir Francis Knowles FRS, John Wright, James Emerson Tennent MP, William Bagge MP and a Mr Harrison. Knowles was a director of the St Marylebone Bank, Wright was proprietor of Wright & Co., bankers to the catholic hierarchy, and Harrison was chairman of the London & Southampton Railway. Charles Fox, an associate of Robert Stephenson on the London & Birmingham Railway, was appointed Engineer, and Edward Davy was to be Superintendent of Machinery. McDougall & Co., Parliament Street, Westminster, one of the few firms of lawyers familiar with joint-stock companies, was to handle legal matters. The price of Davy's new telegraph patent was to be £10,000 and "one or two thousand shares".

The draft prospectus was circulated to railway companies throughout England, seeking wayleaves or rights of way as well as capital during 1838. Mr Brunel, *junior*, and the directors of the Great Western Railway called on Davy to view his telegraph. Other companies contacted during 1838 included, in order of approach, the London & Birmingham, London & Southampton, Birmingham & Gloucester, Midland Counties, Bristol & Exeter, Grand Junction, Birmingham & Derby, and London & Brighton.

All of this advanced corporate activity was undertaken in the year that W F Cooke and Charles Wheatstone obtained their first patent. It took them, or rather W F Cooke, another *ten years* of negotiations and heartache before they got to the same state.

Davy was a man of quite incredible genius. By education and training he was a surgeon and apothecary, born in 1806 at Ottery St Mary, Devonshire, and dying in 1883 in Australia. He established a successful business in 1830 as *Davy & Company*, operative chemists, 390 Strand, London, manufacturing and supplying instruments and devising chemical products, such as a cement to repair fine china.

In May 1837 Davy described in detail his first plan for a *message telegraph*. This was a twelve-needle apparatus, including letter and colour (or "shift") functions, and alarms, worked by twelve keys and two current reversers, with "electrical renewers", transmitting fifty letters of the alphabet in two-and-a-half minutes. This was wholly original in introducing both current reversal, rather than "on-off" switches, and the relay to electric telegraphy! He published estimates for six-wire circuits connecting London with Dover, Brighton, Bristol, Portsmouth, Birmingham, Liverpool, York, Newcastle, Edinburgh, Glasgow and Exeter, as well as Liverpool to Manchester, totalling £144,000. He proposed up and down circuits, as in the working of the railways, anticipating traffic would be too great for one line. Davy even calculated individual station expenses in staff and materials. Earlier in that year he had obtained permission of HM Commissioners of Woods & Forests to lay a one mile long circuit of copper wire around the Inner Circle of the Regent's Park in Marylebone, London. Unsurprisingly, given his enthusiasm and enterprise, Davy opposed the grant of Cooke & Wheatstone's telegraph patent of May 1837.

During November and December 1837 the initial Davy apparatus, made in his own workshops, was demonstrated to the public at the Belgrave Institution, 30 Sloane Street, London. Then from December 29, 1837 until November 10, 1838 Edward Davy took a showroom and office at No 5 Exeter Hall, Strand, in London from which to promote and display his telegraphs. The exhibition, "lighted by an enormous galvanic battery", was open from 11 o'clock to 5 o'clock each day, entry was one shilling.

Early in 1838 Edward Davy launched his *chemical recording telegraph* in direct competition with Cooke & Wheatstone's patented needle instrument. The new telegraph utilised three wires with individual circuits that combined to work by means of six keys both a two-needle telegraph with a third needle as a "shift" function, *and* a printer that recorded a six-element cipher on a continuous roll of chemically-treated calico cloth by means of six clockwork-driven metallic cylinders.

The recording telegraph was reviewed by the famous physicist Michael Faraday and a favourable report given by him to the Commissioners of Patents. This enabled Davy to obtain a patent in spite of Cooke & Wheatstone's opposition, including his "electrical renewer" or relay. It was completed on January 4, 1839. Davy, anticipating that the railway companies would beat a path to his door to pay for rights, began to organise the Voltaic Telegraph Company.

But by the summer of 1839 Edward Davy had abandoned all his plans and sold his operative chemist business at 390 Strand to Dr William George Welch and had sailed to a new life in Australia.

The Davy family, though not understanding the opportunities they offered, attempted to promote the message and recording telegraphs in new rooms at the Exeter Hall through 1839 and 1840. They had not Edward Davy's talent or determination; late in 1840 his telegraphs were taken off to his home town of Ottery St Mary in Devon where they survived until 1878 before being broken up.

Charles Wheatstone thought sufficient of the competitive telegraphs to propose to W F Cooke on July 18, 1839 that they buy Edward Davy's patent. However Davy eventually acknowledged that the partners' apparatus was of more utility than his own complex devices. It was not until May 12, 1847 that the Electric Telegraph Company acquired the patent so as to utilise the "electrical renewer" – the very first electrical relay. The company bought it for £600.

J J Fahie, from whose work this long extract is drawn, wrote in 1884 "it is certain that… (Davy) had a clearer grasp of the requirements and capabilities of an electric telegraph than … Cooke and Wheatstone." Even if he had persevered Davy's Voltaic Telegraph Company may not have prospered, the banks of his directors, Knowles and Wright, both failed catastrophically in the next couple of years.

Edward Davy left London in 1839, his family records show, not for any nefarious or coercive reason, but to escape from Mrs Davy… It is therefore pleasing to record that Davy had a full and successful career (and private life) in Melbourne, Victoria.

Alexander's Telegraph

Another curious might-have-been is in an advertisement in 'The Times' of July 8, 1837. William Alexander of 19 Windsor Street, Edinburgh, Scotland, proposed to connect his home city with London, a distance of 450 miles, through his own system of galvanic telegraphy. This involved having one copper wire for each letter of the alphabet and for punctuation and one common return circuit, i.e. thirty-one wires in all, laid three feet beneath the public highways, each wire insulated with lacquer or "resin" within two boards of baked wood for further protection. The "telegraph" itself was a three-foot square horizontal screen with thirty one-inch square apertures each with a lifting shutter worked by a four-inch electro-magnet connected with a distant set of thirty keys. He estimated that such a circuit would cost £26,000, and, anticipating sending a minimum of sixty-five words in five minutes at 5s 0d a message, an annual revenue over 300 twelve hour working days of £10,800. Experiments at the University of Edinburgh over several hundred yards, Alexander felt, had proven the technical aspects of his ideas; he expected the Post Office to take an interest in continuing his plan. Although reviewed by the learned and mechanical societies it was otherwise ignored. Like Banquo's ghost Alexander's telegraph reappeared at the Great Exhibition of 1851 to haunt the telegraph companies!

Whishaw's Hydraulic Telegraph

The advent of Cooke & Wheatstone's patent of 1838 caused an eruption of competitive inventions, one of which was described in detail in Mechanics' Magazine of March that year, Whishaw's *Hydraulic Telegraph*:

"We have long ago heard it suggested... that a column of water could be conveniently employed to transmit information. Mr Francis Whishaw has conveyed a column of water through sixty yards of pipe in the most convoluted form, and the two ends of the column being on a level, motion is no sooner given to one end than it is communicated through the whole sixty yards to the other end of the column. No perceptible interval elapses between the time of impressing motion on one end of the column and of communicating it to the other. To each end of a column he attaches a float board with an index, and the depression of any given number of figures on one index, will be immediately followed by a corresponding rise of the float board and index at the other end. It is supposed that this simple longitudinal motion can be made to convey all kinds of information. It appears to us that the amount of information which can be conveyed by the motion in one direction only, of the water, or backward and forwards, must be limited. To make the mere motion backwards and forwards of a float board, indicated on a graduated index, convey a great number of words or letters, is the difficulty to be overcome. Mr. Whishaw has exerted his ingenuity in this way, with a promise of success, and by-and-bye, the hydraulic telegraph may supersede the semaphore and the galvanic telegraph."

The hydraulic or water telegraph, in one form or another, dates back to antiquity. It was to be reinvented or improved several times in the nineteenth century. Indeed Francis Whishaw, although to become an advocate and engineer of the electric telegraph, was led to improve his apparatus as late as 1848: in this he substituted vertical copper wires attached to floats instead of columns of water; introduced three-way cocks instead of two separate cocks for the elevation and depression of the water at the different stations; and adopted engraved index slides, "whereby an infinity of codes could be used."

Crosley's Telegraph

Samuel Crosley, a gas engineer of considerable repute, who had previously devised what was then the commonest gas-meter, introduced the *pneumatic telegraph* in

March 1839. It had two versions, one using a series of ten weights in a tube or piston to send ten digital signals by pressure of air to a 'pressure register' that recorded them on a moving strip of paper. The register was similar to that used to constantly record gas pressure in suppliers' mains. Another pattern used a simple, large diameter air pump barrel with an index or indicator connected by a one inch diameter gas pipe to a small air reservoir part filled with coloured water linked to a small diameter glass tube. Pressure on the pump caused the air in the reservoir to push the water up the index glass to indicate massages.

It was tried successfully in a tube "very nearly two miles" in length, and was a consistent exhibit at the Polytechnic Institution, Regent Street, London, for many years from the autumn of 1839.

General Oceanic Telegraph

According to Board of Trade returns the Railway Mania year of 1845 saw the registration under the new Joint Stock Companies Act of the *General Oceanic Telegraph Company*, the *General Commercial Telegraph Company* and the *British Commercial Electro-Telegraph Company.*

General Oceanic was registered by Jacob Brett on June 16, 1845 with the formidable objective "to form a connecting mode of communication by telegraphic means from the British Islands and across the Atlantic Ocean to Nova Scotia and the Canadas, the Colonies and Continental Kingdoms." It was also known later as the "General Oceanic & Subterranean Electric Printing Telegraph Company"; the Brett family, promoters of the first successful submarine telegraph, had a weakness for compendious company titles.

General Commercial Telegraph

The *General Commercial Telegraph Company*, a mysterious, anonymous promotion, of 1 Bond Court, Walbrook, City, sought a capital £600,000 in twenty-four thousand shares, on September 15, 1845 – the same day as the Electric Telegraph Company was launched in the press. It was through this concern that S F B Morse, having a competitive apparatus to sell, attempted to challenge both Cooke & Wheatstone and Edward Davy in the British market.

Morse had arrived in Liverpool from New York on August 25, 1845, and took lodgings in London at the end of the month. During the first week in September he approached the General Commercial Telegraph Company touting his apparatus and was invited to meet members of its board on September 11, 1845. He launched into an elaborate pitch:

"In prefacing my proposition to you, I would beg leave to ask, if Mr Wheatstone or Davy in their systems can give a certain amount of intelligence with two wires in one minute, is not a system which gives double the amount with one wire in the same time worth four times as much?"

"I will guarantee that my apparatus shall accomplish what I promise it shall do, and ocular demonstration shall be given."

"I have with me the apparatus complete for establishing my system of Electro-Magnetic Telegraphs, now in such successful operation in the United States. I have a part of the apparatus never revealed to the public, and which is essential to the efficacy of my plan. I can put it in operation (if arrangements are concluded with a company) in a few days. If we can agree on terms, I will delay my visit to Russia; put in order the apparatus; fully explain it to those authorized by you to take out the patent for you, and leave my whole apparatus with you. I will also instruct two persons whom you may designate in the use of it."

"On the delivery of the apparatus into your possession, you shall pay me one thousand pounds sterling, and further guarantee to pay me one-fourth part of the savings derived from the use of my system. That is to say, ascertain the utmost amount of intelligence under the most favorable circumstances that Messrs Wheatstone & Cooke, or Mr Davy, can give in a minute, and the number of wires necessary to produce their result. If I cannot give more under the same circumstances in the same time, I will ask no more than the one thousand pounds to be paid down on delivery to you of the apparatus, although the advantage alone of recording in so simple and easy a manner is very greatly in favor of mine. If I can give more, then I must be paid, in addition, a certain proportion of the savings by my system. For example, say that Messrs W & C or Mr D, by giving the signals complete for twenty-five letters of the alphabet in one minute, enable you to realize fifteen per cent, on your capital; if I can by my system give you fifty letters per minute, I enable you to realize a much larger per cent., and I will then ask one-fourth part of your savings derived from the use of my system. To illustrate my proposition, say that the expense of one wire from London to Birmingham will cost £500. Four will cost £2,000. Suppose that I can communicate with two wires as much information as W or D can give with four. Here would be a saving of £1,000 to you. Of this I propose you should pay me £250. Say that W & C or D's apparatus at each station cost £80, and mine but £40, here would be a saving of 40. I propose you should pay, on account of this saving, £10."

"Say that two attendants are necessary at each station with W & C's or D's apparatus with salary of £100 per annum each, and mine should require but one, here would be a saving of £100 per annum at each station. Of this sum I propose you should pay me £25 per annum, and so for the saving in any other item of expense."

The proposition had two major flaws; first Morse had no patent rights in England whereas his native competitors did and could prevent the introduction of his apparatus, effectively he had nothing to sell. Second, the General Commercial Telegraph Company was a piece of City speculation with no money behind it. It was quite literally a fourteen-day wonder, registered as a joint-stock company on September 3, consulting Morse on September 11, and being launched on September 15. The only person known connected with it is William

Eyre, a solicitor, from whose offices it was promoted. Nothing more was heard of the venture. Morse left for the Continent a week later to pursue other sales opportunities, all proving to be equally unsatisfactory.

British Commercial Electro-Telegraph

Even more transient was the *British Commercial Electro-Telegraph Company* which was provisionally registered on August 2, 1845. It made a single fleeting appearance in the daily newspapers on September 1st, giving its address as a law office and immediately vanished. Its advertisement calling for £500,000 in 40,000 shares and offering an eye-catching 16% dividend, quoted Cooke & Wheatstone's own prospectus, but failed to name its promoters.

The General Oceanic, the General Commercial and British Commercial firms did not progress beyond discussion in the press. But the Brett family did as they promised over the subsequent ten years, forming electrical connections "from the British Islands and across the Atlantic Ocean to Nova Scotia and the Canadas, the Colonies and Continental Kingdoms"...

Jowett's Hydraulic Telegraph

On February 19, 1848 Frederick William Jowett and Henry Alfred Jowett of Burton-upon-Trent, Staffordshire, provisionally registered the *Hydraulic Telegraph Company,* located at 17 Wellington Street, Strand, London. It was intended to work F W Jowett's patent of January 23, 1847 for 'Improvements in Telegraph Communications'. Unlike Francis Whishaw's apparatus also based on the hydraulic principle, Jowett's was a dial telegraph, which he claimed would be cheaper to make and work than the electric competition. He constructed a successful "water circuit" of two miles length at Derby, messages being transmitted "in a minute or so"; estimating that such a speed could be maintained for "two hundred or two thousand" miles. As it was marketed based on its economy there was a version with a simple rising index as well as dials.

Although organising a joint-stock company, and having it widely reviewed in the technical press, Jowett's water telegraph was not a commercial success. However, it encouraged Francis Whishaw to revive and improve his similar machine, dating from March 1838.

Scottish Electric Telegraph

The *Scottish Electric Telegraph Company* was the first promotion of the serial capitalist Thomas Allan in Edinburgh. It was advertised on December 8, 1848, to acquire and work the improved needle and dial telegraphs patented by Prof George Henry Bachhoffner, the founder and principal lecturer at the Royal Polytechnic Institution in London. It was only able to promote itself as the master patent of Cooke & Wheatstone did not apply in Scotland; however the Scots proved quite happy to have the Electric Telegraph Company of England provide its circuits in their country and the Scottish company had the briefest of lives. Allan was to go on to project telegraph companies for another twenty years, all of which were unsuccessful.

Highton

Henry Highton, a cleric from Rugby, took out a patent in February 1846 for his 'gold-leaf' telegraph. The indicator was a gold-leaf filament in an air-filled glass tube moved left and right by an electro-magnet, using a single wire. Although it was a frail contrivance it was adopted on the Baden Railway in South Germany in October 1847, and was bought by the Electric Telegraph Company. The Highton family were to found the first competitor to the Company in 1850.

Due to its sensitivity Highton's 'gold-leaf' telegraph was resurrected briefly in February 1874 by the *Light Cable Telegraph Company* for use on their speculative circuit, the so-called "Atlantic Line", between England, the Azores and Halifax, Nova Scotia. The use of twenty-eight year old technology did not recommend it to investors.

Little

George Little, an American living in London in 1847, obtained a patent for a remarkably simple two-needle telegraph along with a host of other electrical devices, relays, lightning conductors, clocks, batteries and insulators. Only the insulators survived into posterity. From the patent drawings the device was obviously manufactured (they were illustrations not schematics). A substantial pamphlet was produced to promote the patent apparatus. Initially Little was in partnership with Alfred Brett, not, apparently, one of the famous Brett family who organised the cross-Channel cable, but a brandy merchant. After successfully challenging Little's patent in the Courts during 1851 the Electric Telegraph Company suppressed its use. At this time George Little went on devise an ingenious miniature telegraph receiver using magnetised moving filaments in oil-filled glass tubes instead of needle galvanometers, which he attempted to market in Britain, Europe and America during the 1850s. In July 1852 Little returned to New York and, in the later 1860s, patented his version of an *automatic telegraph,* which T A Edison in America subsequently perfected – the great man's first electrical success.

Pitt Gamble

One of the side-bars to the early telegraph chronology in Britain is that created by *Douglas Pitt Gamble*. He was born in 1819 as one of the family that successfully introduced preserved provisions in tin-plated canisters. By 1844 he was in partnership with John Richard Gamble, trading as provision merchants of 78 Cornhill, London. By his own account he first took an interest in the dial telegraph devised by John Nott late in 1845.

John Nott of the city of Cork in Ireland obtained a patent for a dial telegraph on January 20, 1846. This apparatus used two keys to work an electrically-controlled ratchet that propelled a pointer around a large dial to indicate letters and numbers. By the end of the year Nott had taken into partnership D P Gamble and J R Gamble, with offices at 2 Royal Exchange Buildings, in the financial district of London.

Pitt Gamble had considerable influence in the City and in government through his firm's provision contracts with the shipping companies and with the Admiralty. The latter was, of all state bodies, the most interested in the electric telegraph – even as early as 1844 connecting its staff in London with its stations and yards on the coasts by that medium. Gamble was a pragmatist and quickly realised the future of the telegraph lay in cooperating with the trunk lines of railway extending out from London.

His first activity on behalf of Nott's telegraph was in approaching the chairman of the newly-formed London & North-Western Railway, George Carr Glyn, the banker, and meeting with its Secretary, Richard Creed on January 28, 1846. Creed commissioned a series of tenders from Pitt Gamble, ranging from constructing telegraph lines at a rate per twenty-five miles, up to 500 miles, to purchasing a license for the Nott patent and erecting the line themselves. Creed and Pitt Gamble continued negotiations over the next two months, at which time a committee of the Board of Directors was set up to examine the telegraph issue.

Cooke & Wheatstone had already contracted with the Grand Junction Railway, one of the components of the London & North-Western Railway, whose Secretary was the formidable Captain Mark Huish, to lay its telegraph alongside of its rails between Birmingham and Newton Junction for Liverpool and Manchester. This was to prove a considerable lobbying base in the Amalgamated Board.

At Pitt Gamble's own expense an experimental Nott line with overhead wires on poles was made on the railway's branch between Northampton and Blisworth (part of the Northampton & Peterborough railway, which seems to have been used by the North-Western company for several electrical experiments). He also organised an 'impartial' report on Nott's apparatus from Professor William Thomas Brande of the Royal Institution, an academic associate of Michael Faraday. The railway company appointed Edward Highton, who had his own patented instruments to promote, to be its Telegraph Engineer and to advise its Telegraph Committee on the best technical arrangements. He was tasked with comparing the competitive systems of Cooke & Wheatstone and Nott on the two test circuits. Highton and the Telegraph Committee reported in favour of the Electric Telegraph Company, owners of Cooke & Wheatstone's patents.

Pitt Gamble was to claim that "the Chairman, many of the Directors and the Engineer of the London & North-Western Railway Company, were *deeply interested* in the [Electric] Telegraph Company with Mr Ricardo" in 1846. Whilst the engineer, Robert Stephenson, and his business partner George Parker Bidder, were indeed advocates of the Electric company, this was scarcely a secret, neither was the fact that Glyn & Co. were the Electric's bankers.

However none of this stopped Pitt Gamble from using his insider contacts to obtain reports made for the Admiralty by Michael Faraday and Major Brandreth on his telegraph and having them sent to the railway's board to further his cause.

The Electric Telegraph Company pursued Nott and Gamble ruthlessly through the Court claiming patent infringement. The first suit was heard on November 13, 1846 when they sought an injunction against the use of Nott's apparatus. It was refused. Between February 10 and 19, 1847 a much more substantial case was presented against Nott and Gamble. In this the affidavits, from Prof George Henry Bachhoffner, Prof William Thomas Brande, John Raymond Brittan, clockmaker, Isambard Kingdom Brunel, civil engineer, William Carpmael, engineer, Prof John Thomas Cooper, John Farey, engineer, James Sealy Fourdrinier, engineer, Charles Frodsham, chronometer-maker, Prof William Allen Miller, William Newton, engineer, Peter Mark Roget of the Royal Society, George Stephenson, civil engineer, Robert Stephenson, civil engineer and Prof Charles Wheatstone, totalled 133 pages. Once again the Court of Chancery refused an injunction without legal proof of patent piracy by Nott and Gamble.

The telegraph company almost immediately commenced three more actions against Nott and Gamble. These lasted from March 30, 1847 until 1848, when they were abandoned.

On December 14, 1846 Pitt Gamble was bluntly informed that the London & North-Western Railway and the Electric Telegraph Company were in negotiation and that other parties were no longer involved in the telegraph issue. Richard Creed advised Pitt Gamble to amalgamate his telegraph interests with the Electric company, and that the railway's chairman, Glyn, would recommend such a course to the telegraph company's chairman, Lewis Ricardo, as he was "a personal friend". Pitt Gamble was made bankrupt on his own petition on December 7, 1847 as an "electric telegraph manufacturer and contractor". His property was sold at auction on December 23, 1847.

Douglas Pitt Gamble became private secretary to Lewis Ricardo, chairman of the Electric Telegraph Company, in 1848. Once in that role he successfully had James Sealy Fourdrinier, one of the witnesses for Nott's telegraph, installed as Secretary and Manager of the Electric and his ally William Wylde, to the Board. Pitt Gamble became Secretary and Manager of the International Telegraph Company, and of the Channel Islands Telegraph Company, both of which were subsidiaries of the Electric. He was dismissed from these roles for gross insubordination in 1859 and, age 40, after a short period of exile as "travelling superintendent" with Glass, Elliot & Company, on their Malta & Alexandria cable in 1861, had no further employment. He applied in 1874 for a pension from the Post Office Telegraphs; the request was rejected.

Whilst Pitt Gamble had sorted out his own future in 1848, according to one source "poor Nott, the inventor, was left to starve". In truth, John Nott was born in 1805, the son of Francis Nott, a cabinet-maker of Duncan Street, Cork. He was much interested in scientific matters, demonstrating a *camera lucida* as well as his electromagnetic telegraph to the members of the Royal Cork Institution in the 1840s. Whether or not disappointed over his treatment by Pitt Gamble, Nott emigrated to Australia in 1854, living there until his death in 1890.

Nott's apparatus was subsequently re-installed by the Electric company on the Great Western Railway on December 1, 1847 to control trains through the long tunnel at Box on its London to Bristol line.

Whishaw and the General Telegraph Company
The General Telegraph Company, a simple partnership not a joint-stock concern, was promoted in October 1848 by Francis Whishaw, the civil engineer who had written so much about Cooke & Wheatstone's apparatus, "to execute, by contract or otherwise, the most approved electric, hydraulic, pneumatic or mechanical telegraphs". He had publicised a hydraulic telegraph in 1838 but abandoned that and had been employed by Royal Society of Arts & Sciences before joining the Electric Telegraph Company between 1845 and 1848 to manage the correspondence or message department. Whishaw devised the translation system used in abbreviating the Company's messages. He also introduced the sending of a time signal from London to the provincial offices once each day so that telegraph clocks might be set.

At the Royal Society Whishaw was introduced to the new insulating resin, gutta-percha. He became a strong advocate for its use in telegraphy. In 1844 he presented the case for its use at a lecture attended by William Siemens, then working in Birmingham in England.

On leaving the Electric, Whishaw opened showrooms in the name of the General Telegraph Company at 9 John Street, Adelphi, opposite his former employers at the Royal Society of Arts, off the Strand in London, during November 1848. Here he displayed and demonstrated several instruments, including the clock telegraph that worked either electrically or mechanically, the hydraulic telegraph, an electric burglar alarm, gutta-percha insulation for electric wires, the chain-pipe for protecting submarine circuits, and the 'telekouphonon' (or *speaking telegraph*).

It is worth demonstrating Francis Whishaw's ambitions by quoting in full one of his first advertisements, appearing in 'The Times' newspaper of May 22, 1849.

"General Telegraph Office, 9, John Street, Adelphi, London; established for the purpose of supplying the public with Hydraulic, Electric, Pneumatic, and Mechanical Telegraphs of the simplest construction, and on the most moderate terms - Whishaw's Hydraulic Telegraph, from 2s 6d a yard upwards. Whishaw's Telekouphonon, or Speaking Telegraph, complete from 6d a foot upwards, according to length. Sent to any part of the kingdom. Whishaw's Uniformity of Time Regulator and Telegraph. This simple and beautiful invention combines a clock and a telegraph in one, and may be introduced wherever the electric telegraph wires are already established. Whishaw's Multi-tubular Pipes for enclosing the wires of electric telegraphs according to the underground arrangement. £44 a mile for three wires. Whishaw's Insulated and Protected Telegraph Conductor for sub-aqueous and subterraneous purposes, varying in price according to the number of wires. Sent to any part of the kingdom on due notice being given to the Secretary. Whishaw's Domestic Telegraph. Whishaw's Electro-Mechanical Telegraph, the use of which may be learned in five minutes. From £30 a mile, according to circumstances. Whishaw's Battery Insulator. Many other inventions connected with the subject of telegraphy may be seen at the General Telegraph offices."

Of the eight devices listed only one, the 'telekouphonon', had any form of legal protection. The master patent of Cooke & Wheatstone effectively prevented the introduction of competitive electric telegraphs before it expired 1851.

Whishaw's widely-publicized 'telekouphonon' was simply a long, flexible gutta-percha tube with a rigid mouth-piece and removable whistle at either end through which people spoke with others up to three-quarters of a mile away: in detail it was described in 1851 as "consisting of gutta-percha, glass, metal, or other tubing, with mouth-pieces of ivory, hardwood or metal; furnished with whistles, organ-pipes, and other means of calling attention. The index mouth-piece attached to one end of the tube has an indicator to show from which room the call as been made."

In Spring 1849 Whishaw and the General Telegraph Company, along with the Gutta Percha Company, of Wharf Road, City Road, London, and Horne, Thornthwaite & Wood, instrument makers, of Newgate Street, City, were offering the 'telekouphonon' at 8d a foot, for installation in "private and public buildings, mines, stations, trains, docks, ships, steamboats, lighthouses, hospitals, clubs, taverns and asylums."

Whishaw continued to improve the 'telekouphonon': by 1854, "A compound terminal arrangement has also been introduced, having a mouthpiece and also an acoustic duct [ear piece] connected therewith, so that a conversation may be carried on without moving the mouth until the communication is completed. If the message has to be transferred to a third party, an additional pipe is attached to the mouthpiece, and the sound being shut off from the receiving-pipe, is transmitted through the sending-pipe to the third party as above." To sound the whistle on very long tubes a simple, small brass air pump was attached near the mouthpiece. A version of the mouth-piece with a hinged, spring-loaded cover was also made so that the whistle could not be lost.

Whishaw made the first tube for his 'telekouphonon' by hand when Secretary of the Society of Arts. By 1854 he had "put up hundreds of feet in very many establishments, and in two buildings in London upwards of a quarter of a mile each... The Oriental Bank, Walbrook, was then furnished throughout with this valuable appliance, so as to give, as it were, a sort of ubiquity to the principal officers. The Bank of England has also adopted it upon a small scale, as well as the Society of

Arts, and many others." His former employers, the Electric Telegraph Company, installed the 'telekouphonon' for internal communication at their large Central Station in Founders' Court, Lothbury, London.

It was also recommended as a *Railway Train Communicator*, to be used "for communicating between guard and driver, or passengers and driver, a 'telekouphonon', in different lengths, with screw joints to suit the lengths of carriages and the spaces between them."

The 'telekouphonon' proved very successful in the later 1850s domestically, in hotels, in clubs and in business houses, where batteries of such speaking telegraphs were employed to connect distant departments. Although Whishaw obtained a "poor man's patent", a Registered Design, for it on May 22, 1849 it was imitated by many others.

The earliest gutta-percha tubes for the 'telekouphonon' of 1848 were manufactured by the Gutta Percha Company of Wharf Road, City Road, London, who also made insulation in the same material for underground and submarine electric telegraph cables. By 1852 the tubes were being made for Francis Whishaw by the West Ham Gutta Percha Company and the mouthpieces and other fitments by Richard & Edward Kepp, copper and platina smiths, of 40, 41 & 42 Chandos Street, Charing Cross, London.

In the 1860s, after Whishaw's death, the 'telekouphonon' was expensive: when made by Benham & Froud, who took over Kepps' business in Chandos Street, Charing Cross, it cost 1s 5d a foot for its ¾ inch diameter gutta-percha tube covered in coloured worsted fabric; ivory mouthpieces were 6s 0d, or in wood and brass 3s 0d, each; and brass connecting screws 1s 0d each.

Whishaw's other widely publicised "invention" was a form of telegraph that went under a variety of titles, for reasons of brevity and accuracy it is here referred to as the *clock telegraph*. He also called it at different times, the "telekoiograph", the isochronic telegraph, the uniformity-of-time clock and telegraph and, more prosaically, the index telegraph; all worked on the same basic, very basic, principle.

The clock telegraph was remarkably simple: two finely-made clock movements ran synchronously in separate locations, an index hand turned continuously past numbers or symbols on the dial plate. The signalling mechanism was simply a bell by each clock, which could be worked mechanically by wires or cords and pulleys, or by an electro-magnet, a single wire circuit and a galvanic current. Once the index was in motion messages were sent by sounding the bell as it passed the appropriate number or symbol on the synchronised clock dials. Even with a slow-moving index hand, the receiving operator had to be quick-witted to register the correct coincidence of it and the dial symbol before it moved on, the clocks and bells being independent.

To avoid infringing Cooke & Wheatstone's electric telegraph patents, a mechanical bell was offered as well as an electro-galvanic one. Over time Whishaw elaborated the clock telegraph, adding inner and outer rings to the clock dial, additional hands to the index and left and right tones to the bell in attempts to accelerate its message speed. By 1848 it was already obsolete.

Eventually Whishaw had the major clockmaker, John Smith & Sons, of 2 & 18 St John's Square, Clerkenwell, manufacture the immensely complex "Uniformity-of-time clock and telegraph" in 1848 in competition with Cooke & Wheatstone. This was demonstrated as a mechanical telegraph with several functions, including time and cipher transmission; in essence it was an elaborate clock telegraph.

Smith described Whishaw's telegraph in 1851: "one of the uses of it being to regulate time between distant places to the hundredth part of a minute, by means of sounds transmitted by electrical agency. It also formed a telegraph, as there were four distinct alphabets and numerous signs and signals distinctly marked in red and black on the annular movable plate which surrounded the dial. There were four hands, which rotated together; one of these was distinguished from the others by being of a light colour, and was called the index hand, as by it the class of signals to be used was indicated. The other hands were used for pointing to the signals, which were thus more quickly given than if only one hand had been used. By two electrical bells, of dissimilar sound, the particular quarter of the dial on which the signals were to be read off was readily understood. Besides the telegraph dial and regulator, there was a second face with the ordinary hands, so that one side might be in the telegraph room of the railway station, while the other faced the booking office."

The 'Artizan' magazine, reporting the meeting of the British Association for the Advancement of Science held at Swansea on August 9 and 10, 1848, was to describe, rather sceptically, the mode of working the device as a Telegraph:

"Mr F Whishaw exhibited and explained his Uniformity of Time telegraph. In this telegraph two chronometers are employed, which must be regulated so as to keep time *exactly* together, one at each station. The second hand is prolonged, and as it moves round, it points at each second to some sentence printed radially on a dial, through the centre of which the second hand appears. In transmitting a message to a distance, it is requisite there should be a communication by an insulated wire, for the purpose of transmitting instantaneous signals by electricity. Thus, when the hand of the chronometer points to a question required to be answered, the operator instantly completes the electric circuit, and by that means strikes a bell at the distant station. The operator at the distance, being on the alert to watch, observes the question to which the hand points, since both hands as they move round are *supposed* to be pointing to exactly the same sentences. He then answers the question, if it be contained on the dial, by a similar process, and in two minutes' time a question and answer might thus be transmitted. As various codes are printed on moveable dials, containing a vast variety of subjects, it is *supposed* that by this means the purposes of telegraphic communication might be easily effected. The difficulties to be encountered would be the exact regulation of the chronometers, which might be done by electric signals, and the quickness of observation and action required in the operators."

Two were made, one kept by the Smiths, the other by Whishaw. Its appearance can only be imagined...

John Smith & Sons survive today as Smiths Industries, manufacturers of instruments for the aerospace industry.

From his experience with the Electric Telegraph Company Whishaw developed the *Two-Letter Code* System which he offered for sale to businesses to reduce the cost of messaging: "The letters of the alphabet are placed on two sides of a square - the left hand column and the top line - and lines are drawn through the spaces intersecting each other, and forming 676 compartments, in each of which is written a word, sentence, sum of money, or weight, or any other signal which might be agreed on. By employing the letters, roman and italics, capitals and small letters, and printed in black, green, blue, &c., an innumerable quantity of these codes, of 676 signs in each can be produced."

Latterly Whishaw acted as agent or licensee for Richard Wrighton's electric train signal; for Nathaniel Holmes' electric whistle; for J O N Rutter's fire and burglar alarm; as well as, and more importantly, for Siemens original galvanic index telegraph.

The Siemens *zeigertelegraph* was patented in England in 1850, three years after its brevet in Berlin. It was very widely used in Prussia, Russia and the German States. Using galvanic batteries, it consisted of a twelve-inch diameter dial with thirty ivory keys about its circumference and a needle or index at its centre. Once the machine was put in circuit the needle was kept constantly rotating by the electric current, pressing one of the keys stopped the needle at the same point on both the sending and receiving instruments. The large brass case of the dial also possessed a bell alarm in its mechanism. It was contained in a substantial horizontal mahogany box, twenty-four inches by sixteen inches by nine inches, along with its own galvanometer and all the commutators necessary to manage its circuits. Once in circuit the index rotated at thirty times a minute, to achieve this twenty-five pairs of Daniell cells were required at both the transmitting and receiving instruments to work over a distance of 250 miles. It was said to be the perfect galvanic dial telegraph in its ease of operation and integrity. This, the first Siemens instrument, was relatively complex and expensive in original cost and in working. It was to be replaced in manufacture by Siemens magneto-electric dial in 1859.

It was anticipated in the late 1840s that there would be a market for index or dial telegraphs in those locations where the employment of a dedicated, specially-trained operator would not be economical. On European railways station-masters, porters and other staff worked these instruments which did not require knowledge of codes or cipher. As it turned out in Britain the reverse situation transpired; telegraph companies' clerks assisted with railway duties.

Whishaw, along with C W Siemens, presented the Siemens index telegraph to the Society of Arts on May 30, 1849. The instruments were then put on show at the offices of the General Telegraph Company, opposite the Society's rooms in the Adelphi. Whishaw also arranged several other exhibitions of the apparatus in London.

Apart from promotional demonstrations there is no evidence that the very effective Siemens *zeigertelegraph* was used in Britain. Its complexity, price and running costs militated against its adoption for public service in Britain; no attempt was made to promote the Siemens index device for private wire service, for which it was particularly suitable.

In Prussia it was in competition for railway messaging with August Kramer's *zeigertelegraph*. This was of similar operation, with a constantly rotating index or pointer, but in this device driven by clockwork, the electric power being used only to control the escapement and not propel the index, as in Wheatstone's original. The Kramer index telegraph of 1848 originally had a similar large case to the Siemens 1847 device, with switches and instruments built-in, but it was soon reduced to its essentials within a small square box containing the inner index dial and a ring of thirty small ivory button keys around the circumference. The first weight-driven clockwork was then replaced by a steel spring. Several hundred Kramer telegraphs were used on railways in Germany.

In 1859 Siemens replaced their galvanic *zeigertelegraph* with a new battery-free *magnetzeiger*, worked by a rotary magneto device. This was to be adopted widely in London for use on private wires.

Whishaw also promoted Siemens chain-pipe, lengths of articulated cast-iron tube, 3 feet long and 1 to 2½ inches in diameter connected by ball-and-socket joints. This was used to protect submarine gutta-percha insulated wires in Prussia from 1849 before armouring of cables with iron wire was perfected. The longest span of chain-pipe was 1,200 feet, crossing the Rhine river from the town of Cologne to Deutz.

When Siemens opened their own office in London during 1850 Whishaw began exhibiting and marketing the electro-magnetic printing telegraph of 1848 devised by P A J Dujardin of Lille, France. This used a rotating magneto to generate a series of dots that were printed in ink in a spiral on a paper-covered drum.

Although Francis Whishaw's name was publicly attached to several of these devices; he widely advertised and organised public expositions of "Whishaw's Telegraphic System" during 1849 and 1850 with an index apparatus and a peculiar gutta-percha insulated subterranean cable; his only patent protection was for multi-tubular stone-ware pipes to protect resin-covered wires and an electro-magnetic lock. The East India Company, which governed most of the sub-continent, invited him to submit proposals for a telegraph system for India and for undertaking its construction, in September 1849. It was received by their Board but not taken-up.

The General Telegraph concern survived at least until 1851: its real contribution to telegraphy was in the employment of Nathaniel J Holmes as manager in 1849, after W H Hatcher, Whishaw and he were let go by the Electric company in March 1848. An associate of Wheatstone, Holmes became one of the principal electrical engineers in domestic and submarine telegraphy.

Whishaw died in 1856 after a long illness.

Later Speculations

The *Dublin & Holyhead Submarine Telegraph Company* was projected by Charles John Blunt, a civil engineer previously employed by John Watkin Brett, the cable pioneer. Blunt, a man of dubious probity, fell out with Brett and launched this concern on February 24, 1849. He looked for a capital of £40,000 in eight thousand shares. It got nowhere.

George Edward Dering patented a single-needle telegraph in December 1850. In this the needle was suspended like a pendulum from the top rather than rotating on an axis to prevent unnecessary oscillation, with the advantage of reducing the power of the batteries needed. There was also a novel secrecy accessory, in this a separate dial rotated to obscure the needle at selected stations, as well as a *paratonnerre* or lightning protector, and an insulator. The single pendulum needle telegraph was licensed to the Bank of England, who created an internal network in its vast premises on Threadneedle Street, London, and it was used experimentally on the London to Dover circuit of the European Telegraph Company and on the Great Northern Railway. The ill-fated Electric Telegraph Company of Ireland selected Dering's apparatus for its circuits in 1852, and elected him a director.

The Universal Electric Telegraph Company was formed in 1853 with a capital of £300,000 to work the patent of J Walker-Wilkins. The novelty of this apparatus lay in using a roll of carbon-paper interleaved with plain paper on which an electro-magnetically-worked blunt needle or stylus moved left and right to indicate signals. The Company advertised Charles Wheatstone as its "Scientific Referee". It did not raise any capital. Walker-Wilkins had previously worked for the partnership of Cooke & Wheatstone on their first long line to Southampton and for the Electric Telegraph Company. He had also, previously to this promotion, worked in America for the "People's Line", a telegraph from Kentucky to Louisiana, where he had developed a new electrical relay that challenged the Morse Syndicate's monopoly.

The *European & American Submarine Telegraph Company* was created in 1856 by John Watkins Brett and the directors of the Submarine Telegraph Company for a cable between Ireland and America. With a capital of £750,000 in £5 shares it claimed to be the successor to Brett's General Ocean company of 1845, combining the oceanic interests of the Submarine and original Magnetic companies in England just before the creation of the British & Irish Magnetic Company in 1857. This evolved quickly into the Atlantic Telegraph Company, described later in this work.

There was a rush of promotions for underwater cable lines after the first Atlantic cable failed in 1857, none of which were built, or even raised any significant capital:

On July 10, 1858 the *European & American Submarine Telegraph Company* reappeared seeking an enlarged capital of £1,000,000. It proposed an elaborate system of cables: from Plymouth to Cape Finisterre, Spain, with a feeder cable from Bordeaux, France, to Cape Rocco, Lisbon, St Michael's Island in the Azores, to Flores in the Azores, hence direct to Boston, Massachusetts, or by way of Bermuda to Cape Hatteras, North Carolina. It claimed concessions of the governments of France, Spain and Portugal, negotiations with the United States were "pending". Its advertising in the 'Morning Chronicle' gave no directors or engineers, merely a temporary office and a Secretary "pro. tem."

The new European & American Submarine company had some weight behind it. In March, 1857, the Portuguese Government granted a concession to William Wylde and J Lewis Ricardo, directors of the Electric Telegraph Company, to land cables on the Azores for a period of 20 years. They were joined in May 1857 by J A M Pinniger, the lawyer employed by John Watkins Brett, and by William Tupper, a director of the Atlantic Telegraph Company. The concessionaires then sold their rights to the eminent and wealthy lawyer, William Glover, Serjeant-at-law, for £10,000 and £5,000 in shares in the European & American Submarine company then in the hands of the learned Serjeant. Five French politicians a Spanish and an American banker were recruited to the direction. The deal was subject to ratification by the Portuguese Cortes, which due to political turbulence in Lisbon was never granted. Serjeant Glover also owned the 'Morning Chronicle' in which the new cable company was promoted.

The *South Atlantic Telegraph Company* was registered in London during 1858. It proposed a very ambitious programme of cable laying: connecting Falmouth in the west of England with Cape Finisterre, Lisbon in Portugal, Cape St Vincent, the Canary Islands, St Paul Island, Fernando Noronha Island and Pernambuco in Brazil. Branches were to be built from St Vincent to Cadiz and Gibraltar; from the Canaries to Madeira. A land line was to be constructed from Pernambuco north to Para, with a submarine line hence to Demerara in British Guiana, then along the West Indian islands to New Orleans in the United States.

In the following year, 1859, Taliaferro Preston Shaffner, an American telegraph engineer, registered the *British Transatlantic Telegraph Company* in London to make a chain of cables from Scotland to the Faroes, Iceland, Greenland and Labrador in Canada. This route was first planned by the *Ocean Telegraph Company* of 1852, and was later taken up by the *North American Telegraph Company* and the *British & Canadian Telegraph Company* in the 1860s. Shaffner in America and the geographer

James Wyld in Britain competed for the concessions related to these ultimately unsuccessful lines. Shaffner was determined enough to survey the icy route himself in a chartered schooner. But there is more of the cable business elsewhere in this piece…

On May 21, 1860 Captain William Rowett, a Cornish-born former sea-captain, then a rope-maker and patentee of hemp-covered submarine telegraph cables obtained a concession of the Imperial government in Paris for a cable from France to the United States.

The 1860s, particularly after the passing of a new liberal Limited Liability Act in 1855 and the Companies Act in 1862, saw the promotion of several speculative concerns. Thomas Allan, the telegraph engineer and serial promoter, launched the *Ocean Telegraph Company* (the second of that name, also called the *Great Ocean Telegraph Company)* and the *Great Indian Submarine Telegraph Company* in 1858, *Allan's Telegraph & Factory Company* in 1861, the *Railway Electric Engineering & Telegraph Works Company* in 1865, then, after being dismissed by the United Kingdom company, the *National Telegraph Company* in 1865, from his home in the Adelphi; none of these proceeded beyond publicity.

'The Engineer' magazine gave a candid summary of Thomas Allan's international ambitions and failures in its edition of October 5, 1866:

"Some years ago projects to lay a number of lines in connection with the United Kingdom Telegraph Company were set on foot, the whole to be constructed on Allan's systems. So vast were those projects, five in all, that they would have covered the whole civilised and uncivilised world with wires, and the schemes might well have been amalgamated as 'The Great Global Telegraph Company (Limited).' The first of these projects was the United Kingdom Electric Telegraph Company, and, and the original prospectus now before us shows the enormous profits which would accrue on completion of the undertaking; we will not reproduce the figures in that prospectus, lest they should prove too aggravation to the present shareholders. The second of Mr Allan's projects was 'The Great Ocean Telegraph Company,' to lay a cable direct from Falmouth to Halifax, and a branch by Bermuda to Jamaica, thence by connecting lines to the West Indies and the Central States of America. The third was 'The Great Indian Submarine Telegraph Company,' to establish direct communication between London and Bombay by a chain of submarine lines from Falmouth to Gibraltar, Malta and Alexandria, thence, via the Red Sea, to India. The fourth was 'The Great Indian Submarine Extension Telegraph Company,' to connect Bombay with China and Australia, via Galle, Penang, Singapore, Hong Kong, and Shanghai, also via Singapore, Cape York, Moreton Bay, to the land lines in Australia. The fifth, 'The South Atlantic Telegraph Company,' to run lines from Gibraltar to Madeira, Cape de Verde, Sierra Leone, Ascension, St Helena, Saldanha Bay, to the Cape of Good Hope; and from Ascension to Pernambuco, Bahia, Rio de Janeiro, Monte Video, to Buenos Ayres; also a branch between Gibraltar and Lisbon. All these schemes fell through, except the United Kingdom Telegraph Company, which, however, has done good service in reducing the price of telegrams between places in this country to more reasonable rates."

What is truly remarkable is that within a decade almost all this entire ambitious cable network was made and the circuits successfully worked, under the guidance of one man, John Pender. His overall holding company was called, curiously enough, 'The Globe Telegraph & Trust Company.'

Other "independent" stock promotions included the *Indian & Australian Telegraph Company* of 1858, the *General Electric Telegraph Company* of 1861 and the *Private Telegraph Company* of 1862, which, apart from lodging draft Bills with Parliament, have left no trace of their promoters or ambitions.

In May 1864 William Rowett, obtained a renewal of his 1860 concession of the French government for a circuit running from Brest to St Pierre et Miquelon off Newfoundland, by way of Cape Finisterre, and the Azores. The cable was to be 2,000 miles overall, but the longest single length was 800 miles from the Azores to Canada. It was to be made just one-inch in diameter, with a copper core imbedded in "virgin" india-rubber, rather than contaminated "manufactured" rubber, covered in hemp rope and a new protective compound, weighing only three hundredweight per mile. Rowett formed the *International Ocean Telegraphic Company* in London during 1864, seeking £500,000 in 25,000 shares of £20, to complete the project but got nowhere. He was sued by Serjeant Glover who claimed the landing rights on the Azores as his own, purchased in 1857 on behalf of the European & American Submarine Telegraph Company.

Rowett eventually promoted the *Scilly Islands Telegraph Company* in 1869 and laid a thirty-one mile circuit between the islands and his home county of Cornwall. The hemp-covered cable, to an identical specification to that proposed for his Atlantic circuit, quickly failed.

In September 1865 Thomas Allan promoted the *Transatlantic Telegraph Company* with a capital of £1,500,000 to lay a 'non-extending cable' from England to Oporto in Portugal (600 miles), from Oporto to Flores in the Azores (900 miles) and from Flores to Halifax in Nova Scotia, Canada (1,400 miles).

"The cable consists of a solid copper wire, weighing 250 lb per nautical mile, surrounded with twenty best steel wires of No 9 gauge. The dielectric [insulator] in Alan's cable is... [composed of] four coats of gutta-percha alternated with four thin layers of compound. The proposed external coating is of hemp..., intended merely to protect the cable from the handling operations... The weight of the cable is 8 ½ cwt per nautical mile."

This was called "Allan's Light Cable", patented in 1853, and was intended for use in all of his underwater projects. It is remarkably similar to modern cable design, with the core and steel wire forming the interior, whilst the insulating resin, now synthetic plastic, forms the thick external covering.

Allan managed his final, futile effort at company promotion on February 11, 1867. Despite being personally bankrupt he found sufficient support to launch the *British & American Telegraph Company*, yet another incarnation the cable route from England, actually Falmouth, Devon, to Halifax, Nova Scotia, by way of the Azores. It had a capital of £600,000, and was to use Allan's light cable, "one quarter of the weight of the Atlantic cable, and one third of the cost". The Company was incorporated in Nova Scotia and New Brunswick as well as in Britain. It proposed a tariff of £4 for twenty words. Allan was to have 5% of the capital as royalty for his rights, and a share of all annual profits above 10%. The petition for its winding-up was presented on October 15, 1867.

The Globe Telegraph Company was formed in 1863 with a capital of £100,000 to construct and maintain telegraphs, to acquire and work letters-patent relating to electro-magnetic telegraphs and apparatus, and for other purposes. It was intended to work the instrument of Henry Wilde of Manchester, which he patented on February 25, 1863, having been working on it since 1860 after Charles Wheatstone sent him samples of his Universal telegraph. This was an electro-magnetic dial telegraph with separate communicator and indicator, which he called the "Globe telegraph" and was obviously derived from Wheatstone's Universal telegraph. The indicator was spherical, containing both a dial and an alarm, hence "globe". The main difference between the two instruments was the use of a foot treadle to work the magneto rather than a handle. Wilde was sued, unsuccessfully, for patent infringement by the Universal Private Telegraph Company, owners of Wheatstone's patent. His Company was substantial enough to acquire a Special Act of Parliament in 1864 "to connect dwelling houses, manufactories, warehouses, collieries, gas and water works, barracks, police stations, &c.", but it was unable to raise more than a derisory £1,500 in capital. The Globe attempted to provide private circuits in its home city of Manchester and in the towns of Huddersfield, Middlesbrough, Oldham and Sheffield, claiming to have sold forty or so pairs of instruments to factory owners, but it did not survive long. Wilde tried to get the Post Office to purchase the jetsam of the Globe company in 1869 but a Parliamentary Committee threw the claim out.

The Globe Telegraph Company was not connected with Septimus Beardmore's so-called "globe telegraph" of 1859; nor was it related to the hugely successful *Globe Telegraph & Trust Company* created by John Pender, coincidentally also of Manchester, in 1873 to invest in and manage intercontinental cables.

Among the "amusing nondescripts" that the Limited Liability Act encouraged was the *Floating Telegraph Station & Lightship Company*, launched in May 1864, appealing for a capital of £250,000, one-third to be paid-up. This anticipated placing stationary vessels off the Scilly Isles, where the English and Irish Channels met, in the West of England, and off Cape Race, Newfoundland, each connected to land by a short underwater telegraph cable to send and receive messages from passing steamers and sailing packets. The vessels were to be outfitted with brilliant lanterns, day and night signals, steam whistles and lifeboats, and carry stores, provisions and water for sale and for ships in distress. The floating stations would also have a steam tender or tug alongside. In addition to telegrams, at £1 a message, income was to come from salvage, sale of stores, towage, and the transfer of mail, parcels and passengers. Surprisingly this project was revived in 1869 and a floating telegraph station, lately HMS *Brisk*, was actually set afloat in the English Channel on April 14, 1870 for a short period by another company.

7.] HOW THE COMPANIES WORKED

The telegraph companies in their public presence were retail concerns. Originally they operated through their own telegraph offices at railway stations, then eventually during the 1850s, and more often, in the high streets of Britain's cities and towns; effectively these were all 'shops'.

The transaction followed a common course in all of the companies. A message, written on a form and signed by the sender, was handed in to a telegraph office. After being pre-paid for in cash, or latterly in telegraph stamps, the text was transmitted electrically to the nearest station to the address in the message, where it was written down in long-hand on another form by a clerk as received and immediately despatched to the recipient by a foot messenger.

The Electric Telegraph Company sent *Telegraphic Despatches*, the early British and English & Irish companies did not give their messages a special title, and the later British & Irish, London District and United Kingdom companies were to use the neologism *Telegram* in their businesses. The word 'telegram', originating in April 1852 in America, began to enter the popular English vocabulary from around 1853 or 1854.

The public entered the office and handed over a *message forwarding form* at a shop counter; behind the counter were shelves with the telegraphic instruments and the batteries of electric cells. The clerks received the messages and worked the telegraphic instruments.

In all except the largest City offices the instruments were visible to the public. The needle instruments were large; contained in handsome pieces of glass-fronted cabinet-work, the bodies mainly in mahogany or oak, or occasionally veneered soft-wood. They were often ornamented with fine-carved scroll-work and columns. The common double-needle apparatus was around twenty-four inches tall by fifteen inches wide, with a six inch square box for the alarm on top. The earliest single-needle instruments of Highton were similarly substantially housed, in pointed-arched cabinet-quality cases about twenty-four inches tall and nine inches broad. Dial faces were often silvered and lacquered, later coloured enamels were used to contrast with the blued metal needles. The needles were later enamelled in white. Within the instrument the workings occupied a small space unrelated to the cabinet size, especially after the alarms were removed in the 1850s. The outward size and material quality was intended to represent the importance and value of their function.

The degree of public service was variable; for instance, even in quite small towns the company's telegraph offices were open twelve hours a day, from 8am to 8pm, six-days-a-week, but the offices at rural railway stations, not all of which on the line had telegraphs, were open, along with the ticketing offices, only at the times when trains were due. The bulk of public telegraphic traffic, estimated in 1867 as between three-quarters and four-fifths of all business, was communicated between the hours of 10am and 4pm between twenty offices in the largest cities.

The following forty-nine cities and towns in Great Britain had a *twenty-four-hour-a-day* telegraph service in 1860, by either the Electric or Magnetic companies' circuits: Beattock, Belfast, Bilton Junction, Birmingham, Bristol, Broxbourne, Cambridge, Carstairs, Chester, Coatbridge, Coventry, Crewe, Cromer, Darlington, Derby, Doncaster, Dover, Dublin, Ely, Glasgow, Greenhill, Kingston (Surrey), Lancaster, Liverpool, London, Manchester, Milford Junction, Motherwell, Newcastle-upon-Tyne, Normanton, Northallerton, Norwich, Peterborough, Preston, Rugby, Selby, Southampton, Stafford, Stirling, Stratford (Essex), Thirsk, Tweedmouth, Warrington, Watford, Wolverhampton, Wolverton, Worcester and York.

By the late 1860s there were around 220 minor railway stations where the telegraph company did not maintain a separate office but the "station master might send and receive messages to oblige residents". There were in addition 350 other "auxiliary stations" where railway staff could accept messages for forwarding for an additional fee, which they kept as a gratuity.

In many towns, where the telegraph was distant, hotels and other public establishments served as "Official Agents" of the telegraph company, to transact its business. These would forward by messenger any message received to the nearest office, usually at a railway station, at extra cost.

During the mid-1850s the many railway news-stands and bookstalls of W H Smith & Sons accepted the message forms of the Electric Telegraph Company, passing them on to the instruments at the railway stations that they served. W H Smith was a director of the Company.

It was not until the 1860s that the majority of telegraph offices were open on Sundays, and then only for limited hours in the morning and late afternoon. Where the service was available there was a 1s 0d additional charge for Sunday messages.

The general public only gradually frequented the telegraph; in Liverpool in early 1854 of 4,993 messages examined, rather impertinently, by the Magnetic company only 201 or 4% were personal or domestic in nature, the balance were all sent on business, although 233 did relate to betting, which might or might not be personal. When the exercise was repeated by the Magnetic thirteen years later in February 1867, with an analysis of 1,000 messages through Liverpool, 124 or 12½% were defined as personal, and just one involved betting – indicating at least a moral improvement? Again the balance was related to commerce.

Another survey, of a thousand messages, by the Magnetic in 1853 showed that the speed of a message from the sending counter in its stations to the receiving counter averaged from 4½ to 5 minutes.

On January 1, 1858, 'The Telegraph Guide', intending to be a monthly publication, was announced, being a complete guide to every telegraph station in the United Kingdom, with hours of attendance and charges from London, Liverpool, Manchester, Dublin, Glasgow and Hull to every other telegraph station in the country. With a price of 1d, a circulation of 10,000 a month was promised by its publishers Lee and Nightingale in Liverpool. Surprisingly, given the complexity of the national network in that year, it was not a success.

The Electric company noted in 1867 that "the class who use the electric telegraph most freely are stockbrokers, mining agents, shipbrokers, colonial brokers, racing and betting-men, fruit merchants and others engaged in business of a speculative character, or who deal in articles of a perishable nature."

The dependence on the commercial and professional classes for revenue is best demonstrated by the proximities of the telegraph offices in London. As well as their Stock Exchange and Royal Exchange branches, the several companies' closely-adjacent stations in Lothbury, Threadneedle Street, Old Broad Street and Cornhill were next to the banking, financial, mercantile and shipping firms in the City. Those in Mincing Lane and Mark Lane in the east of the City were for the produce and commodity markets. The legal profession, and latterly the press, were served by the telegraphs in Holborn, Chancery Lane, Strand and Fleet Street. Only the common offices in Charing Cross and Cockspur Street could be said to serve a purely 'public' market.

The telegraph office front counters were all partitioned off into spaces "from two feet to two feet three inches in width" where there were pre-printed *message-forms* on which the sender had to write their communication, along with the customary institutional ink-wells, pens-on-chains and pencils. The counter clerk wrote-in the charges to pay and a unique message number. On the reverse the form listed the contractual obligations of the Company; the form had to be signed by the sender in agreeing to these.

The larger offices "had counters at a height suitable for writing, when standing, and sub-divided into spaces, with fluted glass screens between each, to prevent any person seeing another's message".

In return for the message forwarding form the clerk provided a numbered receipt to the sender detailing the recipient, the destination station and the charges paid or payable on delivery. Pre-payment was generally insisted upon for all public messages, but regular customers were permitted a daily account which had to be settled in cash each evening.

For people who could not write the clerk would fill-in the message form and read it back to the sender, ensuring after that they made their "mark" of recognition.

All of the telegraph companies in Britain accepted messages in foreign languages, but at the sender's risk.

The message number was entered on to a list and the form passed to the instrument. Once the message had been sent the form was returned to the counter clerk who crossed it off the list and set it aside for filing. If, by reference to the list, the message had not been sent and returned within fifteen minutes it was chased-up.

Originally no one was allowed free messages; the directors and shareholders of the telegraph companies paid the same message rate as the public.

There were two other printed forms used by the office clerks: the *message delivery form*, used for received messages, and the *message transmission form*, used within the larger offices for transcribing or copying messages from one circuit to another. Each sort of form was printed on different coloured paper.

Where porterage or delivery to a distant address was estimated and paid in advance any 'overplus' was repaid with a *money order* drawn up by the secretary, cashable at any of the Company's offices. These orders proved a fruitful source of petty theft by the less responsible among the "boy" clerks.

Odd stationery included *Advice Notes* left at addresses by messengers to show a message had to be collected; an *Indemnification Note* to be signed by the sender if a message might render the Company liable to action; a *Number Sheet* that the instrument clerk had to fill-in each day logging his work; and a *Transmission Note* where a message had to be transcribed to another company's circuits. There was also a pre-printed *Funds & Share List* that just had to have the numbers added next to the appropriate stock title.

The companies distributed a *Card of Rates* from most large towns as part of their publicity.

In the 1850s the Magnetic company's message and delivery forms, with all the rules and regulations on the reverse, cost 5s 3d per 1,000 to print; the printing and making envelopes for delivery cost 5s 0d for 1,000.

The telegraph companies were periodically criticised in the press for errors and delays in transmission of messages. However in the mid 1850s only one in 2,400 messages on the Magnetic company's circuits was found to contain error, and two-thirds of these were due to the "indistinct writing" of the sender. Even the oft-vilified London District Telegraph Company insisted that only one in 2,000 of its messages was subject to complaint. The number of messages "lost" in transmission was, over the companies' lifetime, in single figures. Delays of over one hour in sending on national circuits were reported by messenger to the sender with the options of cancellation and a refund or sending when possible.

During 1864, after being criticised in the London news press, the United Kingdom company revealed that it received on average one complaint for every 1,729 messages sent using its American telegraphs.

However in 1853 a telegraph clerk in London incontinently added an extra zero to a merchant's order for £8,000 sent from Manchester. Fortunately it was questioned by the merchant's agent at the Founders' Court station and the error immediately discovered without reference to his distant principal as it had been recorded on the tape of a Bain printer.

On October 7, 1846 one of the grimmer aspects of electric communication was brought home on the circuits of the South Eastern Railway. A man named Hutching, who had poisoned his wife, was to be hanged at Maidstone gaol at 12 o'clock on that day. The Home Secretary on receiving a representative of the condemned telegraphed Maidstone with a stay of execution of two hours whilst his officials investigated the appeal. The new evidence proved inadequate and the Home Secretary sent another message by telegraph instructing that the execution should proceed immediately. The clerk at London Bridge station refused to send the message for the execution without additional authority; his refusal was endorsed by the railway company's chairman, James McGregor. A messenger had to be sent to the Home Office in McGregor's name to obtain the personal written instruction of the Home Secretary. It was received and Hutching was hanged that afternoon.

Table 25

Electric Telegraph Company
Station Staffing 1860
Male – Female - Messengers

	M	F	MS
Liverpool	21	25	23
Manchester	28	21	19
Glasgow	15	-	8
Edinburgh	12	-	8
Birmingham	16	-	8
Hull	9	-	4
Leeds	8	-	6
Aberdeen	4	-	2
Bristol	16	-	6
Nottingham	3	-	2
Stock Exchange	6	-	2
Southampton	9	-	11
Central Station	6	107	93

The Correspondence Department, the largest in the Company, managing the message traffic, consisted of District Superintendents, Cashiers, Chief Clerks, Counter Clerks, Instrument Clerks and Messengers. In minor stations the role of chief clerk, cashier and counter clerk might be combined.

The Counter Clerk, probably the most important individual in the Company's structure, received messages, computed charges, received payments, enclosed messages in envelopes and despatched them by messenger. Except in the largest offices where there were Instrument Clerks dedicated to working apparatus, the Counter Clerk also sent the messages.

The Cashier was employed in large stations or in District offices to record income and disbursements.

The Chief Clerk, called by the Electric Telegraph Company, the Clerk-in-Charge, kept the diary, the complaints-, the mail- and the general order books. As the station manager he was also responsible for the Messages Forwarded Book, the Messages Received Book, the Porterage Book, the Postage Book, the Gratuities Book, the Petty Cash Book, and the Pay Bill. Each month there was a Balance Sheet to compile and summaries of the office books, as well as a Weekly Instrument Report and a Weekly Signal Report on the state of the circuits, and Monthly Returns comparing the last three months and the year-on-year figures for head office. For offices at railway stations there were also Railway Message and Railway Signal Books to maintain. Messages there were carefully divided into Commercial and Railway.

One of the more arcane functions within the telegraph office was that known as *translating*. This involved the rewriting of the sender's message into an abbreviated telegraphic script before being passed to the instrument; and the reverse function at the receiving end. The companies in Britain reduced each of its station addresses to two-letter codes; in addition letters, syllables and portions of words were excised, with conventionalised instrument signs introduced for full-points, paragraphs and underlining to shorten the message.

Common words such as 'the', 'from', 'and', 'to', 'you', 'yes' and so forth, and terminations such as '-tion', '-ing', and '-ment', were reduced to signs.

As a cautionary note, the word "translating" was used in telegraphy at the time to represent several other functions including forms of electrical relay.

Early Codes

Francis Whishaw, who managed the message department from 1845 to 1848, devised a translating system for business traffic sent by the Company similar in principle to short-hand. Codes were prepared for shipping, horse racing, share lists, corn-market prices, and so on. The sending clerk signalled the code being used and the common phrases and words for that special traffic were substituted by *arbitraries*, as in short-hand. This translating system reduced message length on a ratio of five to three, five hours work might be done in three.

Frederick Ebenezer Baines, a former telegraph clerk, gave a description in 1895 of the earliest codes used by the Electric Telegraph Company:

"The 'codes' were not those used by the public for the sake of shrouding the meaning or lowering the cost of telegrams, but Whishaw's Codes of 1846, which substituted a brace of letters for names of men or places or a group of words."

"They were ingenious devices, but of little practical utility. Out of these, however, came IK, the code equivalent of the name of the chief station (Lothbury)."

"The double-needle apparatus of Cooke and Wheatstone was in use. The needles at first were long and heavy. They waved to and fro across the face of the dial with exasperating slowness. About six or eight words a minute was a fair working speed, so the saving or abbreviating of words was of real importance. In later years, with shorter and lighter needles, as many as 40 words a minute could be read with ease, then codes were of still less value."

"Mr Whishaw's codes, however, furnished a good deal of information by the use of four letters - two for principles and two for details. Thus, ZD or ZL meant a number of some sort; AM a particular number - one for instance. ZY meant a telegram of some sort, CW a private one. So in this rather cumbrous way the first paid private telegram of the day was signalled: ZD, AM; ZY, CW. [i.e. Number One; Message or Telegram, Private] A telegram in the earliest days of all was delivered to a merchant in Sheffield with these cabalistic signs upon it, much to his bewilderment."

"CW existed until recently [1895]; amongst the old stagers it is still understood, but M has freely taken its place. 'What caused the delay?' would ask an official querist. 'A very long CW to Birmingham,' might be the answer forty years ago; or as now, 'Derby had a good many M's on hand.' "

"ZM referred to wind and weather. 'ZM fine,' is still a frequent entry in the office diaries, London fogs notwithstanding. DO for shipping news, and CS for Parliamentary intelligence, survived until the transfer of the telegraphs to the Post Office. Then the work of editing news was handed over to the news agencies, and many of the old codes fell into disuse. CQ, meaning all stations, still holds its own."

"PQ was one of the last to go, as it was, in the order of signals, the last for use in a message. It was an innocent code enough, meaning only 'end of message.' But under certain circumstances it could goad the distant operator to fury; because, abruptly given, it might have the significance of 'Shut up!' 'You're a muff!' and other interjections more vigorous than polite. Now, for the clerk, say at York, to be PQ'd by IK [Lothbury] in the middle of some courteous explanation of the causes of slow reading 200 miles away, was more than the best-balanced mind and strongest apparatus could stand; and it was a common occurrence for the stout brass handles of the double-needle telegraph to be broken off by the aggrieved clerk in the white heat of his passionate telegraphic remonstrance."

"Beside IK for London, Whishaw's Codes provided IH for Liverpool, AP for Manchester, GX for Hull, KM for Newcastle; EL for Edinburgh, FO for Glasgow, and so on. The initials did not necessarily bear any relation to the names of the places, and ultimately the codes were rearranged in order to produce some sort of connection between the two. The LY stood for Lothbury, instead of

IK; and MR for Manchester, BM for Birmingham, GW for Glasgow, etc., replaced the arbitrary codes formerly used."

Baines imagined an early conversation using the Whishaw Code:

'Are you through to KU [Normanton]?' might have inquired the genial manager, Mr W H Hatcher, circa 1850, of Mr [John J] Jackson, the superintendent [at Lothbury].

'Not yet, sir; there's a want of continuity on the stop E, and full earth on the HN' (i.e., the left-hand wire to Normanton is broken, and the right-hand wire touches the earth).

'What are you doing with the CW's?'

'Sending them to MI [Rugby] to go on by train.'

'What is wrong? How is the ZM [weather]?'

'High wind and heavy rain in Derbyshire. I think the linemen are shifting a pole.'

Diarial entry: '11.30, line right. KU reading well.'

Then an unofficial conversation by telegraph between Normanton [KU] and Lothbury in London [IK] -

'How many CW's at IK?' asks KU, about 180 miles away.

'Twenty-three,' replies IK.

'All right; will clear you out.'

Joy overspreads at IK the face of J M, aged fifteen. He signals 'ZL' (all being messages for stations beyond Normanton, otherwise he would have sent ZD), and away fly the CW's, the double-needle rattling like the stones of Cheapside under the wheels of Mrs Gilpin's chaise*. All twenty-three messages are taken without a single 'Not Understand.'

'Good! good! good! [GD, GD, GD]' signals IK, in a paroxysm of praise.

(* from 'The Entertaining and Facetious History of John Gilpin' by William Cowper, 1783)

Other arbitrary early call signs used by the Electric Telegraph Company for busy offices included KX for the Stock Exchange, KR for Cardiff, RW for Derby, KT for Stockport and VT for Coventry.

Eventually, as Baines noted, by the 1860s, the major cities and offices adopted, officially or otherwise, more obvious calls: Liverpool LV, Newcastle-upon-Tyne NC, Edinburgh EH, Dublin DB, Belfast BT, for example. The other telegraph companies had different call signs for their offices, the Magnetic used LN for Threadneedle Street, the United Kingdom company GH for Gresham House, and the District CO for Cannon Street, all in London. The Magnetic's calls were commonly distinguished by being three letters long.

As well as being used in transmission the calls were incorporated into the india-rubber obliterating stamps used on accepted message forms and frank stamps at the offices.

Special signs were also used unofficially between the clerk-operators by 1848 to represent emotions such as laughing and astonishment. The adaptability of human nature to this the most revolutionary of technology was remarked on at the time.

The Electric's C F Varley noted in 1859 that "telegraph working generally causes great nervous irritation, and the clerks are very prone to quarrel". He cited delays caused by impatience with repeated errors by distant colleagues leading to electrical arguments, and to clerks refusing to work with those on some lines.

The Small Print

The Message Form in 1855

The Electric Telegraph Company, Central Station, Founders' Court, Lothbury, Bank of England

Prefix ...	Code time...	No of words...
Date...	Received... (*time*)	Finished... (*time*)
Sent to... Station		By me... (*clerk*)
Message	£ s d	
Repeating	£ s d	
Porterage	£ s d	
To be paid out	£ s d	
Total	£ s d	

All numbers must be written at length in words.

Please send the following message according to the conditions indorsed hereon,

From... To...
(*Text of Message*)
Signature... Address...

Before signing, please see that the amount to be charged for the message is correctly entered above, and on the receipt; and read the indorsed conditions.

The company will not be answerable for errors caused by indistinct writing.

(*Reverse*) *The Electric Telegraph Company*
Conditions as to uninsured messages

The public are informed, that, in order to provide against mistakes in the transmission of messages by the electric telegraph, every message of consequence ought to be repeated by being sent back from the station at which it is to be received, to the station from which it is originally sent. Half the usual price for transmission will be charged for repeating the message. The company will not be responsible for mistakes in the transmission of unrepeated messages, from whatever cause they may arise: nor will the company be responsible for mistakes in the transmission of a repeated message, nor for delay in transmission or delivery, nor for non-transmission or non-delivery of any message, whether repeated or unrepeated, to any extent above £5, unless it be insured.

Correctness in the transmission of messages can be insured at the following rates in addition to the usual charge for repetition:-

For any sum up to £100 £1 0s 0d

Above £100 to £200	£2 0s 0d
£200 to £300	£3 0s 0d
£300 to £400	£4 0s 0d
£400 to £500	£5 0s 0d
£500 to £600	£6 0s 0d
£600 to £700	£7 0s 0d
£700 to £800	£8 0s 0d
£800 to £900	£9 0s 0d
£900 to £1,000	£10 0s 0d

and 20s for every £100 or fraction of £100 above that sum: and the company will not be responsible for any amount beyond the sum for which the message was insured and the rate paid. The company will not be responsible in any case for delays arising from interruptions in the working of the telegraphs.

Notice Messages to be sent to any places beyond the extent of the company's lines or stations will be delivered by the company's officers at their terminal mentioned in the subjoined request, to such parties as may have charge of the further means of conveyance; but it is expressly provided that the company are in no case to be held responsible for the transmission or delivery of the message beyond the terminal that is in such request mentioned.

Request I request that this message be forwarded from the company's office at ... (being the nearest station of the company) by... (*means of forwarding*) to the address mentioned therein, subject to the above conditions, and have deposited 5s to be applied to that purpose.

(Signed)

Every message had a *Prefix* consisting of two or three letter codes. The first was the *Message Type*: free, special express, government, chairman's, duplicate, ordinary, danger, transmit on, engineer's, urgent, insured, repeated, train report, company and private. This was followed by two letter *Station Codes*, the "calls", LY for Lothbury, EN for Euston Square, WV for Wolverton, RY for Rugby, YK for York, for example, to identify the originating office and the destination, and a two or three letter *Time Code*.

After the message was an *Affix*, also in the form of short letter codes usually dealing with delivery: acknowledgement paid for, answer not paid for, forward by boat, forward by cab, forward by best means, forward by omnibus, forward by train or another telegraph, to be called for, completion of address, forward by first train, forward by cab or messenger up to three miles, instructions to follow, porterage not paid for, forward by most rapid conveyance without regard to cost, forward by special express, forward by post, reply paid.

There were arbitrary responses signalling Engaged, Engaged to all business and Now Un-engaged; for Repeat all, Repeat from, Repeat word after, Repeat word before, Repeat words from/to, Word Number incorrect, Wait, which indicated an error in transmission, and All Right, when the error was corrected. There was a "collate" signal inserted into messages that indicated the next word was to be repeated back to ensure accuracy. There was also the End signal at the termination of the message, and the all-purpose Good signal (GD) which was the British equivalent of OK.

Interruption of messages was forbidden; the reason for the signalling of the Wait code from the receiving station had to be documented.

In the early days of the Magnetic company each word had to be confirmed as it was received by the instrument clerk to ensure accuracy.

Table 26

Telegraphic Apparatus

The instruments and apparatus used in telegraph offices were limited in number. The assembly included:

- *Telegraph* – the sending and receiving instrument, commonly a single-needle instrument in circuit with the line and the battery
- *Galvanometer* – a small desk-top instrument for measuring the current in the line circuit; a portable galvanometer used to test battery and external circuits was called a *Detector*
- *Bell* or *Alarm* – in the line circuit to call the attention of the clerk to activity on a message circuit
- *Relay* – used in the message circuit to automatically forward messages and to maintain any loss of current by using its own battery
- *Turnplates* – small rotating switches used to direct circuits between instruments and between batteries and apparatus, also termed *Commutators*
- *Switchboard* – used in large offices to manage message or battery circuits instead of turnplates
- *Battery* – a set of chemical cells that produced the current, usually in a secure place as they contained volatile chemicals, the battery circuit ran to the telegraph instrument and to the relay
- *Lightning Protector* or *Paratonnerre* – a device in all offices inserted in message circuits between the line and the instruments
- *Screw Connectors* – small brass devices used to join circuit wires together

---

Business customers were allowed use of commercial *Telegraphic Vocabularies* that substituted words and numbers for most common phrases. These were published with the object of shortening messages for economic reasons rather than to conceal the content. The Magnetic company estimated that one message out of four was encoded in 1853.

However, stockbrokers, produce-brokers, merchants, banks and betting-men used codes and ciphers, commonly called a *Private Key*, for their confidential messages from the earliest days. The words in their Private Key, or code book, could not exceed two syllables to prevent abuse of the tariff and confusion in sending. Banks also used an authorising code phrase that preceded the text of their business messages. The phrase changed each day. Such messages related to delicate subjects such as the returning of bills-of-exchange and the stopping of local bank notes. Remittances between banks of £20,000 and £30,000 were regularly authorised this way by telegraph in the 1850s. The banks also "enquired as to the respectability of parties" by wire in that period, keeping the "party" waiting in the bank parlour until the reply was received.

Receiving bulk traffic, news messages, for example, required two clerks; one to read the instrument, the other to write down the script in a manifold book of alternate flimsy sheets and carbon-paper. The original was delivered to the recipient, the facsimile kept for the record. The sending of such messages required considerable concentration, flicking attention from script to instrument, sending letter-by-letter without translation. It was this traffic that, in the earliest days, the Bain and American writers were intended to mechanise and render more accurate especially on long and busy circuits.

News messages having special importance or priority were sent *Express* or in industry vernacular as *Expresses*. Apart from government traffic, which the companies were obliged in law to give preference, 'Expresses' of news were then the only priority paid messages.

Whether sending or receiving, the unique number and the hour and minute of commencement and completion of each message were recorded, and signed-off by the clerk. All of this detail and the message content was entered into the books of the Company, along with the charges paid, for accounting purposes and in case of any dispute with the sender or recipient.

As well as news all other messages were written out by the receiving clerk on a manifold writer (i.e. copying by carbon paper) and a duplicate copy of every message sent by telegraph was forwarded by rail to the Central Station at Lothbury to be compared with a copy of the original; through this process it was said that the clerks had to be particularly accurate, and the public efficiently protected from error. The copies were parcelled-up, placed in hampers and kept under lock-and-key for two years before being pulped.

At the Central Station where the business was intense there was a division of the clerical work into three areas which would otherwise have been done by one or two individuals: 1] two clerks to each instrument, one to read or send the signal, one to write down the received messages; 2] registering, numbering and making an abstract of each message; and 3] pricing, folding, sealing and addressing the message.

From the earliest systematic use of telegraphy in Britain the clerk-operators could recognise the telegraphic *hand* of their regular sending colleagues hundreds of miles distant, and engaged with them in private, unofficial electrical banter, to management's disapproval.

The other principal category of employee in the office was the uniformed *messenger*, a young boy, who carried the received message forms to addresses within one mile of their office in, as the Company stated reassuringly, *carefully-sealed* envelopes. For messages received on the type-printing telegraphs of House and Hughes the printed tape was cut into short lengths and glued to the ordinary received message form, for the convenience of business people who filed them as letters, before being folded-up and inserted into the envelope; only the outer address was hand-written. In the United States the printed tape was simply put in the envelope.

In Britain and the United States messages were always sent out in envelopes. In most other countries the message sheet was folded several times, the address written on the outside of the message form and one edge sealed with a small adhesive *telegraph label*.

The small white envelopes of the Electric Telegraph Company carried their crest and the exciting (or terrifying) injunction "Immediate" printed in red on their face. Those of the Magnetic company were overprinted blue with its crest. The District company had demur plain brown envelopes simply marked "Telegram".

Each messenger carried a book of numbered receipts that recorded the message's number, sending and delivery times and any charges to pay on delivery. The messenger had to obtain the recipient's signature on the receipt. No tips were permitted.

Where no messengers were employed, in the smallest offices, the message was passed to a self-employed porter or a railway porter at the sender's risk, or put into the Post Office mails for delivery.

Table 27

Electric Telegraph Company
District Staff 1860
Inspectors – Mechanics – Linemen – Labourers

	I	M	LI	LA
North	7	1	20	60
South West	2	1	10	10
London	4	4	6	-
Midland	3	1	7	50
Western	7	1	29	140
Scottish	5	1	16	?
Great Eastern	4	-	11	40
North Western	10	3	30	58
Irish	3	1	16	7

In addition there were 18 crew members on the cable ship *Monarch* and 108 workers in the Company's stores

From a confidential report from Mark Huish to Robert Grimston, chairman of the Electric Telegraph Company, October 1860

The Electric Telegraph Company issued a number of manuals for the guidance of its staff: the principal of these were the *General Regulations.* Originally in 1850 these were in two parts, for clerks in stations and for inspectors and linemen. But these were eventually combined into a single seventy-two page volume. There were also *Tariff Books*, especially for continental traffic, which ran from thirty-seven pages in 1859 to eighty-nine in 1866 as foreign connections developed. Instrument galleries used the twelve-page *General Code Book* listing the two-letter arbitrary substitutes for words and syllables. The Company printed one-sheet Double-Needle and Single-Needle *Alphabets* for training.

At its busy Founders' Court and Charing Cross offices in London the Electric Telegraph Company, as a charitable gesture, allowed red-coated boys from the Saffron Hill Ragged School's "Shoeblack Brigade" to earn an income carrying messages and packages for patrons.

The common telegraph office in a medium-sized provincial town employed only two or three people, the clerks mainly young men, usually called 'boys' or young women, always termed 'ladies', and the messengers, working long 'shop' hours, six-days-a-week, in small, often shared premises.

Clerks and messengers worked either nine hour days or eight hours during the evenings and nights. Only older, male clerks were permitted to work at night.

Circuits

In the simplest terms the original electrical circuits for telegraph comprised a main and return; these were both wires until the earth return was introduced. Other than for two-needle instruments each circuit was then essentially a single wire.

The several telegraph stations were all, at first, connected to the same circuit. Each sending and receiving instrument had an alarm attached so that once current was applied the bell rang on all those in circuit to attract the clerks. The alarm was originally continuous and then just a series of single beats. The sending clerk would signal a short two-letter "call" message with the intended station's identification code; the clerk at the appropriate station would then acknowledge the call and take the incoming message whilst the others ignored it. The sending clerk had to repeat the call announcement until it was acknowledged.

All of the stations in the circuit could read the through traffic to other destinations.

With the coming of more intense traffic the ringing of *all* the bells on the circuit was an unnecessary nuisance as the ticking of the needle became sufficient and the alarm became an accessory only in branch stations. With traffic over great distances or to branch lines where there was no continuous circuit the 'call' signal would be received at a large office, acknowledged, and diverted through to another line using either simple switches or a switchboard to create a circuit. Once this was connected the 'call' signal would need to be repeated again until it was acknowledged. The message could then, after a delay, be sent.

Where no switching for a through circuit was possible the message was transcribed, re-written, at the intermediate station and re-sent at a later time (if pressure of work was the cause) or taken to another instrument on the correct circuit, if no direct connection existed. The traffic between the busiest stations soon required separate or dedicated circuits, either a direct, point-to-point, line, or one with only a limited number of intermediate stations in parallel with the existing ones. The planning and constructing of these separate circuits was a critical issue in the telegraphic business.

The telegraph instrument was set to work on *one line* in the station or gallery; it was permanently attached to the circuit. The clerk would be tasked to work, for example, the Birmingham instrument in London, responsible for sending and receiving all messages on that wire, and all stations attached to it. Intermediate stations had to wait for traffic to clear, observing the traffic on their dial, knowing that the total of a group of messages was always announced in advance. Switching, usually though an additional relay or repeater, to make a connection to a distant destination, other than in city galleries to their local stations, took place only at what were termed "transmission stations."

Table 28

Employment in the Telegraph Industry 1861

Analysis of the Census by Leone Levi 1865

Men	Age 10 – 15	493
	Age 15 – 20	862
	Age 20+	1,044
Male Total		*2,399*
Women	Age -15	2
	Age 15 – 20	61
	Age 20 – 25	100
	Age 25 – 30	33
	Age 30+	17
Female Total		*213*
Census Total 1861		2,612
Census Total 1851		261

As this data is drawn from census forms filled-in by door-to-door enumerators in 1861 the statistics are shown for the purpose of showing *approximate* divisions of sex and age. In fact the Electric and the Magnetic companies alone employed 2,638 people in 1859, without counting those working the railway telegraphs.

By 1852 the ordinary lines were divided into Divisions of between four to six stations, between two larger offices, between London and Birmingham for example. These could then only have direct internal access. The messages in or out of the Division had to be switched or transcribed at the larger offices.

One of the duties peculiar to British telegraphy was that related to the need to regularly re-magnetise the receiving needles of the instrument, which gradually lost power over time. Instrument clerks each possessed a permanent magnet for this purpose.

An Evening with the Telegraph

This long descriptive piece was published in 'Chambers' Edinburgh Journal', on January 4, 1851:

"The spider's touch, how exquisitely fine,
Feels at each thread, and lives along the line."

On arriving at the ------------ station, I found that my luggage, which was to have been sent on from town, had not arrived. There was no time to be lost, and on applying to the superintendent of the station, an order was given to make inquiries at London by means of the telegraph. Impatient to get some information about the missing baggage, I strolled to the electric telegraph office, to hear what was the answer received. But no satisfactory information had as yet been obtained; on the contrary, nothing at all was known about the matter. I wanted another message sent up to town, but on working the needles, it was found that the telegraph was engaged in corresponding with some intermediate or branch station.

The clerk, with whom I continued chatting through the little opening where all communications are given and received, was very young; but there was something in his manner that prepossessed you favourably, and, moreover, there was a total absence of that abruptness of speech and quickness of manner that seem to have become a second nature with our railway officials. At last he invited me to enter his office - the very thing I had been manoeuvring for and longing to do - for as I squeezed my head through the small opening, and looked into the snug room, warmly carpeted, and, although it was the beginning of August, with a fire burning in the grate, I could just catch a glimpse of the small mahogany stand and dial of the telegraph, with which he had been talking to the people in London about my trunks, and was very desirous of seeing a little more. Books were lying about the table, which seemed to indicate a taste not only for literature, but for its more imaginative productions; and so, then, as we sat over the cheerful fire, our conversation taking its tone from the volume into which I had dipped, we chatted about authors, style, and such matters.

"You would hardly believe," he said, "how such an employment as mine teaches one curtness: how one gets into the habit of saying what one has to say in as few words as possible, and yet with perfect clearness. I write occasionally little articles, and I find that in them I unconsciously avoid all redundancy of words, just as when transmitting a message. You have no idea what a lengthy affair the messages are which we have given us to transmit, with so many useless expressions that make the inquiry, or whatever it may be, nearly twice as long as necessary. In delivering it, we cut it down about one-half, and yet our version tells all that is to be said quite as intelligibly as the original."

"The cause, no doubt, is, that those who want to give some information about a missing thing are anxious to describe it with all exactness, in order to make as sure as possible of its being recognised."

"But the details on such occasions," he answered, "are really without end. Now we, for our parts, seize on the salient features: we give the necessary marks or tokens, and these only. For nothing is the telegraph so often put in requisition as to inquire about ladies' dogs that are missing. Hardly a day passes without such inquiries. And such descriptions! A perfect history of the animals' habits and virtues: it seems they never can say enough. I have often thought how they would be shocked did they but see how all the long history of their favourites is condensed into a couple of lines. And yet it answers the purpose as well."

He here turned round to the dial-plate of the telegraph, and after a moment's watching, looked again into the volume, the leaves of which he was turning over.

"Was any one speaking to you ?" I asked.

"Not to me; they are talking with the ------------ station."

"But how did you know it ? - what made you look up?" I asked.

"Because I heard the wires."

"That's very strange," I observed: "my hearing is unusually fine, yet I heard nothing."

"'It is habit; besides, perhaps, you heard the vibration too without knowing what it was. My ears are alive to the sound, that, as I sit here reading, the instant the hands of the dial move, I hear them. That low click-click attracts my attention as surely as the bell."

"There is an alarum, is there not, which sounds when the clerk's attention is required?"

"Yes," he said; "this is it." And so saying, he touched a wire, and instantly a hammer struck upon a bell, making a slow, penetrating, long-continued noise. "But I generally stop the communication with it, for it is so loud, that it is extremely disagreeable to be disturbed by the ringing of that thing at one's shoulder. Besides, I hear the other just as well, let me be never so immersed in what I am about."

I now heard such a snap as takes place when, on putting your knuckles to an electric machine, the spark is produced. It was repeated, and on looking up, I saw the needles reeling to and fro. The clerk observed them for a moment, and then rising, went to the machine. Backwards and forwards they went, to the right and to the left, then with a jerk half-way back again - left, right, left - left, left - jerk, jerk - right, left, jerk, and so on; while the clerk, who held two handles hanging from the instrument in his hands, every now and then would also give a good rattle with them, and pull them right and left, and give an answering jerk. All the time, of course, he was looking fixedly at the dial-plate, as he would have done into the countenance of a person who was speaking to him, and whose character he fain would learn from his looks. Jerk, jerk, jerk - rattle, rattle, rattle - all was done; and writing down the message on a slate beside him, he copied it afterwards on a paper to give to one of the porters. It was about some boxes sent on to ------------ by the last train.

"I know what clerk sent down that message," he said. "It was ------------ ."

"But how do you know which clerk it was ?"

"By the manner of his handling the needles, and their corresponding movements. I am as sure who is working them as if I saw the person with my eyes. You of course would not detect any difference in the vibrations, yet there *is* a very great difference. There may be timidity, indecision, flurry, or firmness, in their movements. You see quite clearly if the person speaking to you is master of what he is about; if he does it with ease and decision, or if he is spelling his way, and anxious about getting through the matter well. And it is not only the quickness of the delivery that shows whether the person is skilful or not, but his very character communicates itself to the wires, and shows itself in the movements of the needles."

"How strange! - and it is really possible?"

"That in a man's movements much of his character is shown, you will allow. Well, as he takes hold of the handles to work the telegraph, he does it in a way corresponding with his own particular individuality. That is communicated to the wires, and here on the dial-plate I see the inner man before me. The person I just mentioned is a very good fellow, but cautious, undecided - never sure whether what he does will be quite right or not. He is always hesitating; as soon as his hand touches the instrument, I know it is he instantly. There go the needles slowly from one side to the other, as if not quite certain about going across or not; they never go back suddenly, but always take their time, and move right or left hesitatingly, and with no decided swing. It is as like the man who is moving them as it is possible to be. It is quite a reflex of his mind: there is the impress of him exactly as he is. And it is very natural it should be so. The least hesitation or doubt communicates itself involuntarily to the hands as you hold the handles working the telegraph; and so fine and sympathetic is the conducting power - so sensitive are the wires- that every passing shade of feeling is felt by them. On the dial-plate it is all betrayed. Just as the mind of him at the other end of the wire is wavering, exactly so the needles are wavering too. Now he feels more sure; and yet that very same instant the change that has gone on within him is marked there also: the needles swing directly with sudden decision."

"This is really very interesting," I said; "and it is besides, to me at least, a new wonder connected with electric communication. That one should be able to talk with a person a hundred miles off, as if they were both face to face, is certainly extraordinary; but that the affections of the mind and their sudden varyings should be instantaneously transmitted such a distance - perhaps even before the individual himself was aware of them - this is assuredly very much more wonderful!"

"'It is not," he continued, "in the manner of delivering a communication only that you discover the sort of person with whom you have to do. The way in which he receives yours is also very indicative. One, slow of thought, will let you give the whole word; while another, of quick comprehension, and of a bolder nature, will give the sign, 'I understand,- at the first letters. The very jerk too, which signifies that you know what is meant, is given by one with a decided, sure, firm knock; while with another, of a hesitating character, the needles seem to be hesitating too!'

"Just now," said I, "while you were receiving a message, I observed that every now and then you gave an unusually strong jerk - much stronger than the others. What did that mean?"

"Oh," said he, laughing, "that was an indignant 'Understand!' The other was stopping to see if I knew well what he had said, and I showed, by my manner of saying yes, that I was out of patience with his distrust. Such an 'Understand,' given in that brusque manner, is not exactly very civil: but I really can't help it - one gets at last out of patience with such dawdling."

"And will the other, think you, understand that his questions and slowness put you out of patience?"

"No doubt of that. I knew he understood the way I answered him, and was sulky about it, for his manner changed directly. In the way I said 'I understand,' was expressed besides, 'Of course I understand! Do get on, can't you, and don't stop to ask such foolish questions!' That is what we call an indignant "understand!"'

All this interested me much; and we talked on, now about a favourite author lying on the table, now of this thing, now of that, only interrupted occasionally by the click-click of the mahogany case, that, like a something endued with life, was calling its attendant to come to it, and take heed. But while there, as one in presence of some demoniac thing, the telegraph exercised a sort of spell over me; and I always recurred to it, much as our conversation on other matters would have pleased me at any other time.

"You must not leave the telegraph for a moment?" I observed. "There must be always someone here to watch it, and be in readiness?"

"'Yes; I or my brother remain here always. We take it by turns. Night and day he or I am here. He is gone to-day some miles off; so I have taken his watch for him. I was on duty before; to-night, therefore, will be the third night I have been up!"

"It must be very fatiguing for you; besides, you cannot venture to doze a little, lest something should happen."

"'Though I were to do so, if the wires began to move, I should awake directly. I cannot tell you how or why it is, but if there is the slightest tremor, I am sensible of it at once. Whether I hear it or feel it, I do not exactly know; but I am sensible that they are moving !"

"By intense watchfulness, by constant companionship with that animate yet lifeless thing, a sort of sympathy, or magnetic influence - call it what you will - may exist between you and it," I observed.

"It may be so," he replied; "but really I cannot say. The strain of attention that all occupation with the telegraph produces is very great. While reading off the communications just given, your mind is on the stretch. The intentness of observation with which you must follow the needles in their movements is very fatiguing. There is nothing hardly that demands suck minute attention; for a slight mistake, and you lose the thread of the meaning, and this directly causes delay. Besides which, you get confused."

"This constant state of excitement must, I should think, at last make itself felt. It would be highly interesting to observe the influence it would exercise. Now, in yourself, have you," I asked, "remarked that any change has taken place since you have been occupied with the telegraph - that you are more irritable and excitable than before - or that the constant tension in which the faculties are kept has at all affected you ?"

"I think it has made me more excitable than I was before. It certainly has an effect upon the nerves. Tho vibration of the needles, for example, I should hear much farther off than you would - so far, indeed, that you would think it scarcely credible."

"Besides the constant attention and the night-watching, I have no doubt that the incessant, quick, uncertain motion of the needles backwards and forwards, and from side to side - that constant tremulousness which you are obliged to observe and to follow so closely - must tend to irritate."

"Yes," he replied, "I daresay it is so. At night, however, one is seldom interrupted. Towards morning the foreign mails arrive, and then the despatches for the newspapers have to be transmitted. This takes about a couple of hours or more close, uninterrupted work. When a correspondence continues thus long without a break, it is very tiring for the mind. As soon as it is over, all has to be written down in a book: this is the most uninteresting part of our occupation. Every message, important or not, is entered in a journal, and then, from time to time (every month, I believe.), the accounts and money received are sent in, and the journals at the different offices compared, to see that all is right. All this is tiresome enough, but it must be done."

"In this way you hear all the foreign news before anyone else. When the first morning edition appears, to you it is already stale. I wonder, though, that persons who have anything secret and important to transmit, should like to trust their secret to two individuals wholly unknown to them."

"Oh, there is no fear of our divulging anything," he replied. "Get something out of an electric-telegraph clerk if you can! Besides, we are forced to the strictest secrecy; bound, too, in a good round sum of money, which we must deposit as security (If I remember rightly, £500). There is nothing to be got out of us, I can assure you. It would never do if it were otherwise; for often matters of very great importance are forwarded in this way, and the confidence placed in us must be entire, and our secrecy above even suspicion."

He afterwards showed me his dwelling. Close to the office was a sitting-room, and opposite this the kitchen, &c. Above stairs were the bedrooms; and though all was on a small scale, the arrangements were as comfortable as one could wish. I observed this to my new acquaintance, and that all was neat and well planned.

"Yes," he answered, "it is so. The company have not been sparing in making us comfortable. All is as nice as we could desire it to be. It is really very necessary, however, that it should be so; for, being obliged to be always here ready and on the watch, one could hardly do without these little comforts. My brother and I are happy enough together."

"I should think," I observed, 'the employment must have much in it that is pleasant - a charm peculiar to itself?"

"You are right," he said; "at first it possessed an indescribable charm. There was something mysterious about it; and it was with a strange feeling, unlike anything I had ever known, that I used to find myself holding converse with others far off, and watching, as it were, their countenances in the dial-plate. But the novelty over, all this died away; and though I still like the employment, it is no longer invested with its original charm."

"Were you long in learning to work?" I inquired.

"Not very long - it is not so difficult; but it takes a long time before you are able to read the communications sent to you - that is to say, quickly and easily. The speed with which a message is conveyed depends much on the person receiving it; for if he is quick and clever, he will understand what the words are before they are spelled to the end; and so, meeting the other, as it were, half-way, the communication is carried on with great rapidity."

Here the hammer of the alarum, which, before we went into the other room, had been set, began making a tremendous noise.

"Ha!" said I, "someone is about to speak with you."

We went to the door of the little parlour, and looked into the office at the needles. They were moving backwards and forwards with their usual click-click.

"Is it for you ?" I asked.

"Yes," he replied; "so many times to the right, and so many times to the left, that signifies ------------ station."

"What is it about?" I inquired, as I watched the two needles, which, by their different movements over the small segment of a circle, expressed everything.

"It's about the down-train to-morrow. We are to send up some carriages."

"And where is it from ?"

"From the chief station in town."

The needles soon moved again.

"Is it still the people in London who are speaking ?"

"'No: now it is the ------------ station"

I now had an opportunity of seeing how quickly my companion read the movements of the needles. Incessantly came the jerk, meaning "I understand;" again and again at quickly-repeated intervals. Once there was an unusual movement, and I afterwards inquired what it meant.

"It meant," he replied, "'Say that once more.' I could not make out what was said; and, just as I imagined, the other clerks had made a mistake."

Now came the answer; and it was astonishing how quickly it was delivered. As one's words pour out of the mouth in speaking, so here they were poured forth by hands-full. How the needles rushed backwards and forwards, then halted! now came a quick shake, and then off they dashed to the side with a bold decided swing! There was no hesitation here. Rattle, rattle, rattle; right, left, right: on it went without a pause; and soon the people at ------------ had got their answer from the snug little parlour at the ------------ station.

The evening had closed in, and there I still sat over the fire. A fire - a coal-fire in an English grate has a wonderful attraction for an Englishman who has been a long time from his old home. This was the case with myself; and therefore it was, I suppose, that I hung about the hearth as one does about a spot that is fraught with pleasant recollections. It was quiet, and cheerful, and cozy. Presently the clicking noise was heard again.

"Ah, ah! it is from the ------------ station," said my companion, rising. "It is a friend of mine who is speaking," he continued. "He wants to know if I shall come up next Sunday or not. 'I—don't—think—I shall,'" he said, repeating the words he was expressing by the wires. "He asks me if 'I am alone.' No—a—friend —is—here—with—me."

"'I am glad you have somebody with you, and are not alone, for it is most confoundedly dull," came back in reply.

"Almost every evening," said my companion, "we have a little chat before night comes on. He does not like being alone, so he talks with me"

"Who have you got with you?" asked the friend so lonesome at the ------------- station.

"No—one—you—know" was the answer.

"I tell you what," I said, laughing, "I'll give him a riddle. Ask him, from me, 'When did Adam first use a walking-stick ?'"

"When Eve presented him with a little Cain (cane)," came back as reply almost directly.

"Confound the fellow !" I exclaimed; "I am sure he knew it before;" and we both laughed heartily.

"'Confound—the—fellow—I'm—sure—he—knew it—before" - repeated my companion by means of the wires.

"Look at the needles," I said; "how they are moving!"

"'Yes, he is laughing," he replied; "that means laughing! He is laughing heartily!"

Shake! shake! shake! shake! We laughed too in return by telegraph, just as we were then doing in reality. Another hearty laugh came back, with a "Good-night!" We wished "Good-night" in return, and our bit of chat was over.

And soon after, bidding my friend a good-night too, I left him to pass the long hours till morning in companionship with that wonderful thing, which, though lifeless, was so sensitive, and though inanimate, could yet make itself heard by him who was appointed its watcher; its low yet audible vibrations being as the pulsations of a heart that at intervals, by its faint beating, gives sign of vitality.

Normanton

Frederick Ebenezer Baines graphically described the workings of one of the most vital but isolated telegraph stations in the Electric Telegraph Company's system in the early 1850s:

"There were two spots within the telegraphic area which were not the most ardently desired of telegraphists - Normanton in Yorkshire, and Carstairs on the Caledonian line in Scotland. The former included a railway-station and hotel; the latter, in early years at all events, little more than a signal-box."

"All the clerks were extremely young and very frugally paid. Their ages ranged from sixteen to eighteen; they had a guinea [21 shillings] a week apiece. A few graybeards who had attained a score of years had perhaps some shillings more, while a Methuselah of five-and-twenty, who was the clerk-in-charge, might even enjoy a weekly stipend of a couple of guineas. The latter post and pay were, however, the prizes of the profession, and not to be reached at a single bound."

"The work was wonderfully well done considering. These youngsters, especially at Normanton, had nothing else to think of. The office at that station was a grimy room on a bridge built over the yard. Normanton owed its importance to the junction of four trunk lines of three great railway companies. Some of its public glory may have departed since the days when passengers habitually broke their journey there and slept at the station hotel. But in another way Normanton is a vaster place than ever, with a traffic which no figures can measure. Yet the social gaiety of this railway stronghold is even now not very far from what it was in the remote days of KU."

"Here we [re-]transmitted for the North, for YO, KM, EL, and FO, i.e., for York, Newcastle, Edinburgh and Glasgow, the last being the *Ultima Thule*. Sometimes in fine, dry weather IK could work to KM; and a dim recollection is preserved of seeing, on one hot August Saturday afternoon, on the dial-plate at Lothbury faint defections from FO."

"But Normanton was our frontier point. Beyond we might penetrate by chance. It did not, however, pay to work slowly, with weakened signals, into a dim and misty distance, and to stations only known to us by tradition."

"So Normanton 'took' for Hull and Leeds; for York, Newcastle, Edinburgh and Glasgow, and for the town and county of Berwick-upon-Tweed. In those days, as no other towns of importance were known to telegraph clerks, could it be that they did not exist? Where were Greenock, Inverness and Aberdeen, Dundee and the towns in Fife? Where were the Hartlepools, Darlington and Middlesbrough? Bristol we had heard of, because every Saturday at noon a stock-broking message was sent around by Birmingham to go by train from Gloucester to the great town in the West. But Cardiff and South Wales - we knew them not!"

"At Normanton, amongst a galaxy of fine double-needle readers, shone a bright and particular star, F C. He was dark, young, small and slender; self-contained, gentle in his ways, and a most consummate reader. He could read off the double-needle, it was thought, with his eyes shut - even perhaps during a needful nap! Fifty words a minute, as fast as the fastest sender could work, he, with good signals, was supposed to be able to read with ease. But his glory was to read when signals were bad."

"Imagine two clock faces, each with a single hand, standing side by side, the needle when at rest pointing to 12 o'clock. When in action, the needles shall singly, or both together, beat against ivory pins sent a little way to the right and left respectively - say at 2 minutes past 12 to the right-hand, and 2 minutes to 12 on the left. That was the normal state of things; and them distracting wobbles, numbering at top speed 400 to 500 a minute, i.e., at an average of five letters a word, and two deflections to a letter, sometimes of both needles in parallel deflections, sometimes of one needle reversing between its pins, had to be instantaneously deciphered."

"To read the vibrations of one needle, even when the deflections were well defined, seems at first sight sufficiently difficult; but how it was that the signs of two needles moving together, or rapidly changing from one to the other, did not bewilder the reading clerk in a mystery. It is still possible for me [in 1893] to read at the rate of twenty words - that is 200 deflections - a minute."

"When the signals were bad, distractions arose in three ways: 1) one needle would deflect strongly, the other scarcely at all; 2) one or both needles would be in contact; i.e., the messages of other wires would to some extent leak into our wires and impart irrational pulsations, which had nothing to do with, and only confused, the work in hand; and 3) nine-tenths of the current from London would run down the wet posts into the earth, or dissipate into the moist air of the Midland counties, and only a fraction would find its way to Yorkshire and feebly actuate the needles there."

"Then was F C seen at his best. As photography discovers stars which no telescope can reveal to the human retina, so F C could read where no signal could be seen by ordinary telegraphists. Those are the days of the far away past. The double-needle has long since gone to the tomb of the Capulets, although contacts and full earth, the aurora borealis and earth-currents, still play their merry pranks in the regions of telegraphy."

Women

As was often mentioned at the time, the telegraph companies were substantial employers of women. From its commencement the Electric company employed women as clerk-operators; competition for these positions was often embarrassingly high. Although paid less than male clerks their working conditions were far more attractive than factory, domestic or other common female employment. The Electric had separate female management, welfare, social and "toilette" facilities for the hundred women that worked in their own instrument galleries at Founders' Court and Telegraph Street, and all contact by male employees was forbidden on penalty of his immediate dismissal. Initially, and for many years - until the 1860s, women were only taken on in London, Liverpool and Manchester; none were employed in its branch stations.

In the Electric's gallery, when not actively employed at the instruments the ladies were allowed to engage in knitting, needlework and books. It was noted that they were primarily the daughters of tradesmen, with some from the families of government clerks and clergymen. There were strict age limits on their employment; they were only taken on between 16 to 23 years. It was assumed that women clerks would "retire" from their position upon marriage.

The Electric company provided their female, but not their male, clerks with tea, coffee, bread and butter, every morning and evening. It also allowed them fuel, light, attendance, culinary utensils, linen and crockery for their kitchen and dining room at Telegraph Street. "They themselves provided their dinner".

The employment of women as clerks by the Electric company was publicly advocated by its original director and largest shareholder, G P Bidder, initially as a cost-saving measure. The success of this innovation in both cost-saving and in public goodwill was reflected in the general employment of women, or rather 'ladies', as clerks both at their counters and in their back-office galleries by all subsequent domestic telegraph companies. The London District company, in particular, depended entirely on a female work force.

Before G P Bidder advocated the employment of women clerks J L Ricardo, the chairman, had introduced use of young boys from the Orphan Asylum as clerks; he noted that they could manipulate the two-needle instruments well after just one weeks' practice.

In December, 1858, a great political meeting was held one evening in Manchester. 'The Times' paper, in giving a report of that meeting afterwards, said: "It is only an act of justice to the Electric & International Telegraph Company, to mention the celerity and accuracy with which our report of the proceedings at Manchester on Friday night was transmitted to 'The Times' office. The first portion of the report was received at the telegraph office at Manchester at 10.55 on Friday night, and the last at 1.25 on Saturday morning. It may be added that the whole report, occupying nearly six columns, was in type at a quarter to three o'clock on Saturday morning, every word having been transmitted through the wire a distance of nearly 200 miles. Some of our readers may be surprised to hear that this report was transmitted entirely by young girls. An average speed of twenty-nine words per minute was obtained, principally on the printing instruments. The highest speed on the needles was thirty-nine words per minute. Four printing instruments and one needle were engaged, with one receiving clerk each, and two writers taking alternate sheets. Although young girls in general do not understand much of politics, there was hardly an error in the whole report."

In 1854 the Electric company had employed Mrs Maria Craig as "Matron" in charge of the lady clerks at Founders' Court. Mrs Craig made herself available every Saturday between 2pm and 4pm at the Central Station to interview the very many young ladies seeking employment. When taken on they were trained in the basics of telegraphy in classes of six on a pair of needle instruments by her in her room.

In that year, 1859, in London there were ninety women employed at the Electric's station at Founders' Court, eight at Charing Cross in the West End, two at Fleet Street and two at Knightsbridge.

Demand for the work was such that, in 1860, Maria Rye established the *Telegraph School for Women* at 6 Great Coram Street, London; one of several organisations she established to further female employment. Rye had previously published 'The Rise and Progress of the Telegraphs' in 1859. The secretary of the Telegraph School was Isa Craig, the Scottish poetess. Rye in her writing thanked the Electric Telegraph Company for "the liberal manner and practical form in which they have viewed the important question of female labour".

Women clerks were repeatedly recorded as being much preferred by the public in comparison to the "insolent boys" that had been previously employed behind the counters. So much so that during the 1860s the companies' *belle télégraphistes* even had a popular music-hall song written about their magnetic charms.

The Telegraph Song

George 'Champagne Charlie' Leybourne

'With a tap, tap, tap and a click, click, click'
'All day they sing and laugh'
'With a click, click, click and a tap, tap, tap'
'As they work at the telegraph'

The Submarine company, which handled continental traffic, did not employ women; similarly the Electric's Foreign Gallery was worked entirely by male clerks.

Many telegraph offices in Britain continued to be located in regional stock and produce exchanges in the larger cities, as the bulk of 'public' messages were actually related to business and news; others were often, but more accessible to the real public, within city hotels. In London the District company's stations were simply rented counter space in all manner of shops, where the sole telegraphic employee was almost always a woman working long hours.

A glimpse of the internal working of messages and the employment of women comes from a brief civil court case before the Oxford Assizes. A farmer dealing in strawberries at Covent Garden market on the early morning of July 17, 1861 found the weather poor and no one buying, he wished to inform his wife in Bath not to send more boxes of fruit by the railway to London as they would not sell. He called at the Electric Telegraph Company's office at Charing Cross at about 8 o'clock and was advised that a message to Bath would be received in about fifteen minutes. The farmer wrote out and sent his message. Unfortunately it took an hour and by then his wife had already sent more boxes of strawberries to London. He claimed breach of contract and £3 compensation for unsold spoilt fruit.

The Company took this suit seriously as it challenged their long-established indemnity against omissions and errors. In its evidence it demonstrated the progress of the message through its system: it was sent from the Strand to Founders' Court at 8.25 and received at 8.31. There the problems started. The message was only sent from Lothbury at 9.15 that is after a forty-five minute delay, and received in Bath at 9.18. It was delivered by messenger over a quarter of a mile at 9.25. The Company explained the delay as follows; at Founder's Court at 8.30 there were three other private messages queued in front of the strawberry one, these took ten minutes in transmission, there were also a series of mysterious service messages on the circuit to Bath. Then at 9 o'clock the day shift took over from the night shift; all of the men working at night had to leave the Telegraph Gallery before the women, who only worked during the day, could enter the room and go to their instruments – this exchange took about four minutes.

The Company won. The Court found it had no contract for service with the sender and had done all it sensibly could to progress the message. One of the influences seems to have been the introduction of several of the Company's "young lady" clerks from London as witnesses; something the rustic bench of judges in Oxford were unused to. They were singled out for congratulations on the "great distinctness and propriety" of their evidence. The presiding judge observed that he did not know whether the "young ladies" were good clerks or not but they certainly made the best witnesses.

On May 28, 1866 Herbert Harlee Playford, ship and insurance broker, ice merchant and firewood importer, of 73 Great Tower Street, London, owner of a cargo of 100 tons of ice on the schooner *Victor* just docked at Grimsby telegraphed Rice & Hellyer, ice merchants of Hull, that they could make an offer for the chilly freight. Rice & Hellyer immediately telegraphed back that they would take it at £23 a ton. On this Playford directed the *Victor* to sail to Hull to unload. Unfortunately Edith Smeaton, the clerk in the United Kingdom Electric Telegraph Company's head office in Gresham House, London, had miss-read the tape of the American telegraph, mistaking the £23 for £27 – the price Playford had actually accepted. Rice & Hellyer refused to accept the ice at that price and Playford sued the telegraph company for the difference, and the 1s 6d cost of the telegram. The court rejected the claim as the telegraph company had no interest in the contract for ice, and had made their agreement for service clear on their message form. Had he asked for the message to be repeated he could have claimed £5 maximum compensation. Neither had he insured the message, which with the United Kingdom company would cost £1 per cent of the risk. Miss Smeaton had two years of service with the Company and had a record of errors far less than the majority of their clerks. (The Court was informed that the figure 3 was ...--, and the figure 7 was --...)

In 1868 the telegraph companies collectively employed 479 women. In London there were 362 - 192 at the Electric company's General Office in Telegraph Street, 45 at the District's office in Cannon Street, 30 at the United Kingdom company's office at Gresham House, and 95 in the other stations about the metropolis. In Liverpool there were 29 women clerks, 14 in the rest of England, 59 in Ireland and 14 in Scotland. In comparison there were 1,471 boy messengers employed throughout the entire system.

Telegram or Telegraph?

"I hope you will join the crusade against the use of the new word 'telegram'. It comes to us from the Foreign Office, I believe. Certainly, no Englishman at all aware of the mode in which English words are derived from the Greek language could have invented such a word. If it should be adopted, half our language will have to be changed."

"We shall have to say paragram instead of paragraph, hologram instead of holograph, photogram instead of photograph, autogram instead of autograph, geogrammy instead of geography, lexicogrammy instead of lexicography, astrogrammy instead of astrography, lexicogrammer instead of lexicographer, polygrammy instead of polygraphy, stenogrammy instead of stenography, stereogrammy instead of stereography, horogrammy instead of horography, ichthyogrammy instead of ichthyography, micogrammy instead of micography, metallogrammy instead of metallography, &c. In short, we shall have to retrace our steps, and entirely alter our manner of forming English words from the Greek. Have all our lexicographers been wrong? And is the author of 'telegram' the only person who is right?"

'The Sun', London, October 12, 1857

News-rooms

In its formative years the Electric company opened news-rooms in the major towns it served. These were comfortable private saloons furnished with sofas and easy-chairs open to individual subscribers where local newspapers might be read, cigars smoked and coffee taken. During the day news messages, commodity and share prices were received by telegraph, announced by a clerk and circulated confidentially within the room, usually from a wall-mounted board.

These rooms raised the public profile of telegraphy by demonstrating the immediacy of its news delivery; and absorbed much of the early spare capacity in the Company's circuits. As public use of the telegraph grew others, especially hotel-owners and commercial exchanges, opened both public and private news-rooms for their customers and the Company gradually closed its own subscription rooms at Founders' Court, Edinburgh, Glasgow, Hull, Leeds, Liverpool, Manchester, Newcastle and Stockport during the 1850s.

News-rooms received the same service as the provincial press so were regarded as competitive by journalists; their subscribers reading the telegraph news-slips well before they could be published.

Pre-Paid Message Forms

From the earliest days of telegraphy books of blank message forms with the contract terms printed on their reverse side were made available free-of-charge for business users, and for the general message-sending public in news-rooms and hotels. For the Great Exhibition of 1851 the Electric company introduced *pre-paid* message forms in three denominations based on distance; under 50 miles, under 100 miles and over 100 miles. They were bound in perforated books and made available for sale at stationers, booksellers, hotels and other outlets in London. These forms might be retailed individually for private use to hand over at the telegraph office after inscribing one's twenty-word message or re-sold in their bound-books at a discount to businesses with a large telegraphic correspondence.

From December 14, 1852 these *Stamped Message Papers* were made available at 2s 6d and 5s 0d each, franking messages at all of the Company's stations in England, Scotland and Wales. A discount of 5 per cent was allowed on purchases amounting to £10.

Telegraph Stamps

The Electric Telegraph Company introduced large adhesive labels, called *Franked Message* stamps, to replace the pre-paid forms on June 1, 1854 at the suggestion of its engineer, Latimer Clark, for use nationally. They were large enough to have a summary of the Company's rules on their face and had to be signed by the sender, but could be stuck onto plain paper as well as pre-paying the official forms for a message of twenty words. The Franked Message stamps were sold in £10 blocks with a 20% discount given in stamps, so that the purchaser received either 250 1s 0d covers for distances under 50 miles, 100 2s 6d covers for distances over 50 miles or 50 5s 0d covers for distances above 100 miles.

The Message Papers and Franked Message Stamps enabled many businesses to become Agents for the Electric Telegraph Company, extending public knowledge and acceptance of the new medium. Stationers, booksellers and newsvendors in towns such as Birmingham, Carlisle, Exeter, Huddersfield, Plymouth, Preston, Rotherham, Salisbury, Stamford, Wells, Winchester and Worcester advertised themselves as telegraphic agents between April 1854 and April 1856.

Small *Frank Stamps* similar in size and appearance to postage stamps were reportedly introduced by the English & Irish Magnetic Telegraph Company sometime late in 1853; this may have been later as they were not mentioned in management reports published during 1854. Similar sized *Telegraph Stamps* were adopted by the Electric Telegraph Company in 1861. Most other inland companies were to issue several values of telegraph stamps to pre-pay their ordinary public message forms to cover virtually any message length and distance; these could not be used on plain paper as all messages had to have the company's conditions signed-off by the sender indemnifying it from errors.

The value of telegraph stamps was so high that they all had individual control numbers printed on their face as with bank-notes. These numbers were entered into the books of the issuing telegraph station to monitor their use, as was then customary with bank-notes. The impecunious United Kingdom company also paid bond interest with its message stamps. As examples, the:

- Electric Telegraph Company had *Telegraph Stamps* denominated at 3d, 6d, 1s 0d, 1s 6d, 2s 0d, 2s 6d, 3s 0d, 4s 0d, 5s 0d and 10s 0d.
- British Telegraph Company had *Frank Stamps*, with 1s 6d, 2s 0d and 4s 0d values
- English & Irish Magnetic Telegraph Company had *Frank Stamps*, of 1s 0d, 1s 6d, 2s 6d and 4s 0d.
- British & Irish Magnetic Telegraph Company, also had *Frank Stamps*, valued at 3d, 6d, 1s 6d, 2s 0d, 2s 6d, 3s 0d, and 5s 0d.
- London District Telegraph Company had *Message Stamps*, valued at 3d, 4d and 6d.
- Submarine Telegraph Company sold *Uninsured Message* stamps at 4½d, 3s 9d, 4s 0d, 7s 6d and 8s 0d.
- United Kingdom Telegraph Company, had its *Uninsured Message* stamps, valued at 3d, 6d, 1s 0d, 1s 6d and 2s 0d.

Stamps were issued by Bonelli's, the British & Irish Magnetic, the British, the Electric, the English & Irish Magnetic, the London, Chatham & Dover Railway, the London District, the South Eastern Railway, the Submarine, the West Highland and the United Kingdom lines. Railway-worked telegraphs did not, with two exceptions, adopt the convenience of stamps.

The message stamps of the Electric Telegraph Company always bore its original title, without the awkward "& International" addition.

Uniquely, from c 1860 the Electric's directors were provided with *Director's Message* stamps that could frank telegraph messages of any length without pre-payment; unsurprisingly several thousand of such were issued to and used by its board members.

Telegraph stamps were more popular with the general public and more flexible than the Electric's pre-paid forms in that both distance and message length could be allowed for by combining denominations.

It should be emphasised that only a small percentage of telegraph messages were pre-payed by frank stamps; the majority were paid for in cash at the counter.

The earliest forms and the adhesive stamps of all companies were "signed" or initialled in lithography by the company secretary. In the case of the Electric Telegraph Company this was J S Fourdrinier or Henry Weaver, and, for that company, also by the chairman, J L Ricardo or R Grimston.

Promotional Messaging

The London District Telegraph Company sold its 6d message stamps bound into small books with ten pages of six stamps in 1861. This was the first use of booklets for retailing any form of stamp, telegraph or postal. The District was to introduce many other promotional ideas into its business; it offered the public one hundred 6d stamps for one pound (240d) for a long period from 1862 until 1866, a rate of just 2½ d for fifteen words.

The Company introduced *Contract Messages* for tradesmen by which anyone purchasing one pounds worth of free message stamps could commence an open account for future messages without pre-payment. It had previously offered tradesmen a similar deal in which customers could place orders by telegraph free-of-charge, the tradesman paying in advance for one hundred messages for £1. A bonus of 500 free printed leaflets with details of the tradesman's business was also included in the offer. For example, in 1862 the Imperial Wine Company of Oxford Street, among many other similar concerns, advertised that orders for its fine wines and spirits could be given free at any office of the District company.

On January 2, 1862 the District company offered, for the first time "Trade Circulars by Telegraph" at its trade rate of 100 messages for 20s. This discount encouraged Maurice and Arnold Gabriel, trading as "Gabriel, the Old Established Dentists", to send out advertising telegrams from their practice, which had been founded in 1815 at 27 Harley Street, London, to a mass of people including government ministers on May 29, 1864. The simple message read: "Messrs Gabriel, dentists, Harley-street, Cavendish-square. Until October Messrs Gabriel's professional attendance at 27, Harley-Street, will be 10 till 5". It led to public uproar at what was seen as a vulgar misuse of the new medium.

The District was the only company that permitted messages, other than those for the press, to be sent on account, which is without pre-payment.

The General Private Telegraph Company in Manchester imitated the District company in May 1864. It, too, offered tradesmen "franked or free message forms" for use on its single circuit at the suburban railway stations between Manchester and Altrincham so that their customers might place orders. The facility was used by Richardson, Roebuck & Company, "Grocers & Purveyors to the Queen" in Manchester.

Free Passes

Sometime in the 1860s the Electric Telegraph Company introduced *Annual Free Passes* on ivory plaques that allowed individuals to send messages on their private business without pre-payment. These supplemented its Director's Message frank stamps, and were provided to senior managers and strategic individuals.

There were also similar *Railway Free Passes* that were provided by the Company to railway company directors and managers, whose use was limited to messages sent along the lines of wire at the side of their rails.

Electric Banking
The Electric company introduced money remittances by telegraph in January 1854, in return for a small per cent of the amount. This speedily transferred sums between its largest offices, where it maintained a substantial cash-float - from London to Liverpool, Manchester and Newcastle-upon-Tyne; and from Birmingham, Bristol, Dublin, Edinburgh, Exeter, Glasgow, Hull, Leeds, Liverpool, Manchester, Newcastle-upon-Tyne, Plymouth, Portsmouth, Sunderland and York to London. In many countries the telegraphic money order is the last relic of telegraph business.

By the 1860s the Electric Telegraph Company was offering more sophisticated services to the mercantile community. A trader could retire bills-of-exchange due in London telegraphically by paying-in the sum due along with a small commission; for example, paying off a £50 bill at Manchester on an account in London cost 4s 0d as well as 1s 0d for the message. The Company employed the new joint-stock Imperial Bank, created in May 1862, at 6 Lothbury, a few yards away from Founders' Court, rather than its corporate bank, Glyn & Co., to complete these transactions. A number of the Company's managers, engineers and clerks were shareholders in the Imperial Bank.

Wayleaves
Railway companies exchanged the right of the telegraph company to carry their public wires alongside their lines for private wires for their own use in signalling and internal message traffic. This was particularly so with the Electric company who by this means avoided wayleave (rental) payment for these rights. In Ireland the Magnetic company was similarly dominant over the railways, but, except in the North country where it was founded, it had to use road-side underground wires and poles on most of the English mainland. Whilst the companies acquired Parliamentary approval to lay wires alongside public roads, the municipal and turnpike authorities were still able to bargain for wayleaves. In England the new United Kingdom company was initially compelled to use canal-side overhead wires for the backbone of its system, in 1861, which the original Electric Telegraph Company had to do in Ireland a few years later.

Due to the manner in which rights-of-way were acquired by the several companies around one-half of telegraph offices were located at the local railway station. This was not necessarily the most convenient place for the public as the newly-constructed railways were made on the outskirts of many towns rather than through their expensive built-up areas; and, as has been mentioned; railway stations at the time were often closed between train arrivals. The telegraph company, in major cities, would frequently open a town office with a road-side overhead or underground branch wire from the railway station.

In London, by 1855, the Electric possessed nineteen telegraph offices – ten at railway stations, five in the residential West End and four in the business centre in the City. There were also other offices open 'part-time' at periodic cattle markets and in the Houses of Parliament for when the two houses were sitting. In the following year it had opened twenty-four telegraph offices in London. As noted, to gather messages in bulk the Company introduced small-bore pneumatic tubes from busy branch locations to its central office in 1853.

The other large cities in Britain, Birmingham, Liverpool, Manchester, Newcastle, Glasgow and Edinburgh, and Dublin, had just two or three offices; these were in either in the business districts or at the railway stations.

Along several railways the telegraph company and the railway company shared use of the wires rather than having separate circuits. This, it was claimed, could delay the transmission of public messages in favour of those for the railway.

In 1868 the principal "shared lines" were noted as London to Tunbridge, Tunbridge to Ashford, London to Tonbridge Wells and Hastings, (all on the independent circuits of the South Eastern Railway), Brighton to Portsmouth (London, Brighton & South Coast Railway), London to Bristol (except for Bath, Chippenham, Swindon and Reading, where other circuits connected) (Great Western Railway), Exeter to Bideford and Barnstaple, (London & South-Western Railway), Norwich to Ipswich and East Anglia and North Norfolk generally (Great Eastern, lately Eastern Counties, Railway), Birmingham to Leeds (except for Burton on Trent, Derby and Chesterfield, again where other circuits connected) (Midland Railway), Carlisle to Glasgow (Caledonian Railway), in Ireland, Dublin to Galway (Midland Great Western Railway), Dublin to Wicklow and Enniscorthy (Dublin, Wicklow & Wexford Railway), Waterford to Limerick (Waterford & Limerick Railway) and Dublin to Enniskillen (Dublin & Drogheda Railway).

Several substantial railway companies, the South Eastern, the London, Brighton & South Coast, the London, Chatham & Dover, the Lancashire & Yorkshire, the North British and the Caledonian being the principals, chose to work their own *public* telegraphs in circuit with one or other of the telegraph companies, using that company's electrical system but with their own clerks and offices, so keeping the local revenues. Some were to take this option on renewing their previous contractual relationship with the telegraph company. Where this was the case the extension of wire beyond the railway's property into town centres was neglected and led to considerable public annoyance. In a few instances the public were served by neither railway nor telegraph, or, more often, the railway station was at some inconvenient distance from the town centre.

By 1868 railway companies directly managed 22% of the public telegraph lines but only carried 6% of the traffic. This inefficiency was a factor that led to the call for state intervention.

Foreign Parts, before the Cable

From the earliest days when the first electric wires connected the mercantile cities with Britain's ports, well before underwater cables were laid, telegraph messages could be despatched for forwarding by overseas post to all parts of the world. The telegraph office in the port would simply add the necessary frank stamps to the message envelope and put it in the foreign mail, saving twenty four hours or more in time.

This was a service intended almost entirely for the commercial and mercantile community, where message cost was balanced against potential risk. It was advertised only in the commercial press of the time.

The simple forwarding procedure developed considerably during the 1850s, with the telegraph companies co-operating with steamship lines to offer an accelerated message service to the most distant parts, exclusive of the Post Office. The Magnetic company, for example, accepted messages for America at its Liverpool office as early as 1852, using an independent forwarding agent. In addition the messages could now be sent on from the receiving port overseas by the local telegraph provider to any inland destination, all at a set tariff.

As the European telegraph network extended by the mid-1850s telegraph messages were being sent to distant ports such as Marseilles and Trieste to be put aboard the scheduled mail steamers for Egypt on the route to India, China and Australasia, saving many days over the ordinary post.

The American route was similarly shortened by having telegraph messages put aboard and collected from the Atlantic liners at the Irish out-ports of Galway, Queenstown and Londonderry. This developed to such an extent in the early 1860s that dedicated wires were laid to these remote coastal stations and message transfers made to the liners using waterproof containers and nets as they steamed past, without stopping. The principal traffic was news or of a commercial nature, related to the American war.

The international forwarding or transfer tariff was based on the usual twenty-word message length and on standardised zones or groups of destinations. For America messages could be sent from London an hour before the mail steamer was due to sail, or an hour-and-a-half from the provinces.

Most of these transfer systems were abandoned with the completion in the late 1860s of land lines and cables connecting Britain with the Levant, America and the Far East.

Management

It wasn't until the 1860s that a specific class of management appeared independent of other business disciplines: Sir James Carmichael and John Pender of the Magnetic, Robert Grimston of the Electric, and Richard Glass of Glass, Elliot, were among the very few who came to prominence as strategic directors rather than technicians.

This group of strong personalities eventually was to dominate the world-wide cable network created between 1865 and 1900. None were to be associated with the Post Office telegraph monopoly.

Others left the stage early; William Ponsonby, Lord de Mauley, chairman of the Submarine Telegraph Company, and a considerable force in its ultimate success died in 1855, aged 68. John Watkins Brett, the pioneer of world-wide submarine telegraphy, was sadly to die in 1863, aged just 59.

Labour

Experienced male clerk-operators in the three principal telegraph companies earned between 14s and 25s a week in 1860. This was well-above the average wage of the period. Women clerks, 19% of the total in 1868, were paid between 10s and 14s per week for essentially the same work.

For example, a nineteen-year-old male "learner" with the Electric company in 1852 was taken on unpaid probation. After a month, once he reached a proficiency of sending twenty words and receiving fifteen words a minute, he was appointed junior telegraph clerk at 14s 0d per week and received his *Book of Instruction*, giving all of the Company's rules and regulations. This pay continued for two years, with an additional 3s 0d a week when posted away from home and with 4d an hour paid for work overtime. At age twenty-two years he was appointed telegraph clerk and was paid 20s 0d a week, this increased later to 22s 0d, his overtime rate increased correspondingly. At twenty-four he began working on the foreign circuits in London at 26s 0d a week, increasing to 30s 0d. At age twenty-five in 1858 he was appointed chief telegraph clerk at a provincial station at 40s 0d a week.

Male clerks could be taken on at fourteen years of age, so were quite literally 'boys'. Women were employed from age sixteen years.

There were deductions from salary for negligence; one-eighth of a day's pay for illegible or careless writing; for playing, absence without leave, errors in figures and dates, and disorderly conduct; and for insubordination. For miss-spelling and special errors, one-quarter of a day's pay; for gross message errors and loss of message a whole day's pay. They were liable to be transferred between offices at the will of the Directors, but the Company paid the expenses incurred.

One of the more exciting or flagrant misuses of the Electric's circuits occurred on March 17, 1867 when a boy clerk at Southampton responded to an enquiry about Irish news from a similarly young colleague at Newport on the Isle of Wight with the following: "Private. Dublin. Fortifications attacked. Two thousand Fenians killed and wounded. Telegraph office burned down. Fleet of Fenians off Liverpool expected to attack that port today." This foolish joke somehow fell into the hands of the Vicar of Newport who read it to his Sunday congregation in good faith. It is not known what happened to the culprits, although the vicar pleaded with the Company for leniency.

In balance to this there were premiums paid for special services, such as working important messages, government proclamations and some foreign news, for example. The fast and accurate transmission of the Queen's Speech on the opening of Parliament each year was one of these, the speed of this often being mentioned in the press. Fourteen days holiday were allowed each year from 1854, and clerks were additionally rewarded for holiday relief and other overtime working. Should a customer require a clerk to work longer than their duty hours they had to pay for the time and the clerk kept the entire amount as a gratuity, this had to be recorded in the books.

James Graves, who joined the Company in 1852, recorded his progress through training at Founders' Court in London:

"In the establishment there is a room set apart entirely for 'learners' in which are connected up in the usual manner instruments in pairs, one representing the sending station's instruments and the other that of the receiving station. Thus 'learners' are enabled to hold conversation with each other in the same room the same as in the instrument rooms the clerks hold communications with stations hundreds of miles distant."

"This 'Learners Gallery' (as it was termed) contained two pairs of needle instruments and one pair of printing instruments at the time that I entered as a 'Learner' which was on the 27th day of December 1852. Well knowing that I should receive no wages till I was competent to work the instruments tolerably well and being very short of funds, I resolved to work as hard as I could at them in order that I might in the shortest possible time be prepared to pass my examination. I strove hard and in a few days I became so far initiated in it that by double needle I could read on an average about five or six words per minute. At the end of the first week I could read ten words per minute. From ten to twelve being the required complement to pass my examination I left that and commenced the second week with single needle. In this I progressed very rapidly and occasionally practised the double needle. At the end of the second week I was prepared to pass the examination which I have since known some learners to be studying for three or even six months, viz. to read twelve words double and six words single per minute. I sent in my request to be examined. As there were no more ready the Examiner would not examine one that week but said I must wait till the following week, when some more could be ready, and in the meantime I was to learn the printing telegraph. This I set about with the same spirit and by dint of perseverance I was able to read and send tolerably by printing at the end of the third week, when having successfully passed my examination in the double and single needle I was removed from the Learner's Gallery into the East Gallery or Instrument Room. On entering this Department I was appointed 'writer' to the Manchester printing instruments. The complication of codes of different kinds puzzled me at first but in two or three days they began to be familiar and I got on very well."

At Founders' Court the clerks worked three overlapping nine hour shifts, from 8am to 5pm, 9am to 6pm and from 11am to 8pm. Only older men, no boys or women, were allowed to work the later shift.

In the Foreign Gallery the instrument clerks all spoke a foreign language, mainly German. In fact English was rarely spoken at all as the first language in this department during the 1850s and 1860s.

Telegraph company clerks working at railway stations shared the privilege of railway employees of having free third-class travel over their particular system.

C F Varley gave details of transmitting and receiving performance of the Company's clerks in the summer of 1862. Using the American telegraph it was possible to send 35 words per minute over 200 miles of No 8 gauge iron wire, however the working average was 22 words, and an hour's work usually being undertaken, with breaks and pauses, at 12 to 15 words per minute. The "average word" was found by experience to be 4½ to 5 letters in length, but the public by then were omitting "a", "of", "the" and "in" from their messages to save on cost. Varley mentioned that the German Austrian Telegraph Union, with which the Company co-operated, insisted that "dampfschifffahrtgesellschaft" (steamboat company), among many other such, be treated as a single word in its tariff.

Apart from operator skill other factors affecting speed were the contact points of the local relays used with the American telegraph becoming burnt and rough, and quarrelling among clerks when too many repetitions of words were needed.

As it required an unusually large number of clerks in London, the *Electric Telegraph Company's Boarding House* at 3 Albion Place, Blackfriars Bridge, was opened in 1854 to lodge single men in its employ and kept in use during the 1860s. It was a short walk over the bridge on the river Thames to Founders' Court.

It formed, too, as a benefit for its clerks on distant stations a *Travelling Library* to provide the latest popular and educational books, which would otherwise be beyond their expense. It was, unfortunately, partly funded by the small fines levied on clerks for errors.

Although the sexes were rigorously separated in the telegraph galleries at Founders' Court and Telegraph Street, to the extent of using separate entrances, in the 1860s both men and women participated in the theatricals and concerts of the *Electric & International Drama Club*. Its sixty members managed regular events every quarter at the Cabinet Theatre, Liverpool Street, King's Cross, London. As well as straightforward entertainment it held benefit performances in aid of incapacitated co-workers and to raise money for the Telegraph Clerks' Provident Fund.

The Electric Telegraph Company contracted with the *Provident Clerks' Mutual Life Assurance Association* of 15 Moorgate Street, City, in 1857 "for the purpose of affording to clerks and others the means of making a provision for themselves in old age, for their families at their decease, and an endowment for their children". The 'Provident' had created the first group life schemes for the protection of employees, including those of the Post Office, the Great Western Railway, other railway companies, and many other large scale employers. It was a voluntary scheme to which any of the Company's clerks might contribute to receive sums in sickness, old age and on death in service. The Electric would provide from one third to one half of their premiums.

Not all companies were as beneficent as the Electric and this led to the charitable, non-profit-making *Telegraph Clerks' Provident Fund*, open to all employees of the telegraph companies not just clerks, being formed in October 1863 "to afford medical advice, medicines and pay in sickness, a provision for old age, and a sum of money at death". Its constitution was approved by an actuary and by the boards of directors of all the telegraph companies. The directors and charitable individuals such as Julius Reuter contributed to its Fund. Selina Oppenheim, Lady Superintendent at the London District Telegraph Company, became secretary to the Fund alongside of her main work. The District also allowed the Fund free use of its Cannon Street premises. The Princess of Wales agreed to become its first Patroness; Her Royal Highness was soon joined by one of her sisters-in-law, Princess Louise, and other noble gentlemen and women.

The Fund provided benefits on incapacity through illness and was agent for government annuities, so providing pensions. Three honorary physicians were recruited and medical prescriptions were made available at cost through an apothecary. The main benefit was the provision of sickness insurance, subscribers to the Fund received 10s 0d a week in the event of illness with free medical attendance or an additional 2s 6d a week, until age 60. There was an additional death-in-service payment of £10. Age 15 to 20 years the cost was 1s 1d a month for sickness and 4d for death benefit, age 20 to 25 1s 2d and 5d, age 25 to 30 1s 3d and 6d, age 30 to 35 1s 4d and 7d, and age 35 to 40 1s 5d and 8d.

There was some criticism of the complexity of its entry criteria from the Magnetic company's employees but the Fund was widely supported with donations as well as subscription by clerks, managers and directors. Subscribing member clerks and employees came from the Electric, Magnetic, United Kingdom and London District companies. At the end of its first year the Fund had seventy-one members, sixty being from the District company in London. There were two beneficiaries during the year. As well as subscriptions and donations, theatrical entertainments were organised to raise additional money for its use, an example was a large summer *soirée* and *conversazione* with music, drama and comedy performed by the clerks at Barnsbury Hall, Islington, in north London on Monday, August 8, 1864.

With the prospect of state control looming, the members of the Telegraph Clerks' Provident Fund voted for its dissolution in March 1869.

The pay and conditions of telegraph clerks were not uniformly held in high regard. The Guildhall Court in the City of London on November 19, 1860 had the case of Henry Thomas Joyce before it. He was charged with stealing £7 15s 2d from his employers, the British & Irish Magnetic Telegraph Company in September, for whom he worked seven years, when a clerk at their station in Lloyd's Rooms, the shipping insurance market. The Aldermen on the bench were surprised that Joyce, an orphan, had first been employed as a Messenger with the Company when aged 12 at 5s 0d a week with a uniform provided, working an eight hour day; then when promoted to Junior Clerk he received 10s 0d a week but lost his uniform, having then "to keep up a respectable appearance... and maintain himself as a clerk". Joyce, an orphan, lodged with his sister, paying her his rent but keeping himself in food and clothing out of his modest wage. The Court expressed strong sympathy with his circumstances but had no choice but to sentence him to twenty-one days imprisonment; members of the public donated money for the benefit of his sister once the case was reported.

C H Curtoys, the Magnetic company's Assistant Secretary and District Manager for London, said that, whatever the opinion of the court as to their pay, they were "besieged" with applicants for jobs as Messengers. In addition the Company had not known that Joyce did not have the support of a family.

The 1860s was a decade of the social *Soirée.* The clerks of the telegraph companies were eager as anyone to participate in these large, genteel events, no doubt encouraged by the District Superintendents who saw their publicity value. On April 6, 1864 the Dean Clough Institute in Halifax, in the West Riding of Yorkshire held their first in the Odd Fellows' Hall, "when upwards of 500 persons sat down to an excellent tea. The spacious room had been tastefully decorated for the occasion with mosaics, banners, festoons, and fabrics of various hues, and mottoes". Clerks of all three national telegraph companies were represented.

After some singing by the ladies "the remainder of the evening was devoted to telegraphic experiments, wires having been fixed in all parts of the room; and these were quite an attractive feature, and were well received. The working of the electric telegraph was superintended by Mr L J Crossley, and between the Hall and Manchester, Hughes' roman type printing telegraph was used, which the United Kingdom Telegraph Company have the sole privilege of working on their lines. Then there was Sir Charles Bright's bell instrument, between the Hall and Leeds; and Messrs Siemens, Halske & Co's ink writing instrument between the Hall and Leeds, London, Bradford, Hull and Manchester; also, Messrs Cooke & Wheatstone's single-needle instrument between the Hall and Sheffield direct. Then there was Messrs Siemens, Halske & Co's dial instrument, and Messrs Cooke & Wheatstone's double-needle instrument from one end of the room to the other. During the evening several messages were despatched by persons in the audience to the various towns already named, and answers were in every case promptly received. One of those questions was to Leeds, and was as follow: "Which town do you think is entitled to be considered the metropolis of the West Riding?" the answer to which was, "Why, Halifax, I should say, of course" (laughter)."

The organisers thoughtfully thanked the companies' local employees and "expressed the obligations the meeting was under to the telegraphic clerks in London, Manchester, Leeds and other places."

Messengers were employed from age ten years. They received 7s 0d a week in 1862. They were not allowed gratuities in duty hours but might keep all payments received from recipients, for cabs and so forth, for work overtime. They were encouraged to take an interest in the telegraph with a view to them becoming clerks.

The boy messengers were the only employees issued with uniform clothing. Those of the Electric Telegraph Company were issued with a coat, trousers and a cap, as well as a leather pouch. The frock coat was in dark-blue with a scarlet collar and scarlet cuff piping, the trousers were grey. The cap was dark-blue with a broad scarlet band and a leather peak, originally a flat-topped military pattern, later in the French-style, a *kepi*. The ETC monogram was embroidered on the cap and collars of the coat, and featured in metal on the pouch.

The 'competitive' Post Office letter-carriers wore a scarlet coat from 1794 until 1860, with a hat rather than a cap. In 1861 the Post Office also adopted dark-blue.

It has to be said that the boy messengers were not generally regarded favourably, being notorious for their "attitude" and, apparently, none too clean in their appearance. One Post Office report claimed that those at the Electric's principal office in Telegraph Street were "a set of irreclaimable scamps" who occupied their spare time "putting [shoe] blacking into the tea of the other boys, or putting mice into the pneumatic tubes, or by bathing in the water tank at the top of the central station on a hot summer's day".

Every clerk was appointed by the Board of Directors through the Secretary's office. They had to sign a Declaration of Secrecy before entering service. The messengers were appointed by the Chief Clerks at stations or by the District Superintendents, but even such a junior post had to be confirmed subsequently by the Board.

In the District company the lady clerks were paid nothing during their training. On achieving five words a minute on the single-needle instrument they were paid 5s 0d for a six-day week; eight words a minute was rewarded with 8s 0d a week; up to a maximum of 10s 0d for ten words a minute. Two weeks annual leave was allowed.

The boy messengers working for the District were originally paid 4s 0d a week. This was changed in 1861 to a piece-rate of 1d a message. They could, it was said, then earn between 2s to 3s a day.

The Postman Calls

The replacement of the telegraph companies' clerks and messengers by Post Office officials provoked a number of code books for use by the general public. The reason is given in the introduction to Robert Slater's 'Telegraphic Code, to ensure secresy in the transmission of telegrams' that appeared in 1870 – "those who have hitherto so judiciously and satisfactorily managed the delivery of our *sealed* letters will in future be entrusted also with the transmission and delivery of our *open* letters in the shape of telegraphic communications, which will thus be exposed not only to the gaze of public officials, but from the necessity of the case must be read by them. Now in large or small communities (particularly perhaps in the latter) there are always to be found prying spirits, curious as to the affairs of their neighbours, which they think they can manage so much better than the parties chiefly interested, and proverbially inclined to gossip." As well as Slater's, there appeared within a few years 'Watt's Telegraphic Cypher', the 'ABC Universal Code', 'Banking Telegraphy', the 'Three Letter Code', and the "most comprehensive and voluminous" of them all - 'Bolton's Telegraph Code' of 1871 with a thousand pages.

Complaints by the public rose from an average one in 2,000 messages under the companies in the 1860s to one in 600 under the Post Office in 1871.

At the parliamentary inquiry on the appropriation of the telegraphs in 1868 Professor Wheatstone strongly advocated public use of his pocket *cryptograph* or cipher machine to counter any possible 'intrusion' by inquisitive postal officials. It was, after all, he carefully pointed out, already used by the government for just such a purpose...

8.] WHAT THE COMPANIES CHARGED

The message pricing policy of the several public telegraph companies was extraordinarily complex and only gradually simplified with the advent of competition and eventual consolidation. It was not until 1862 that a flat rate that charged a domestic message irrespective of distance was introduced – and as this proved consistently unprofitable, to be soon abandoned.

The currency used here is the pound sterling, the '£' or 'L', then divided into twenty shillings, the 's', each of twelve pence, the 'd'. So the pound equalled 240 pence.

a.] Pricing Context

If the pricing policies of the telegraph companies were to appear high and of Byzantine complexity then they must be viewed against the only competitive mode of communication, the letter service of the General Post Office.

Just as the electric telegraph was being introduced during the 1840s the postal system was undergoing revolutionary change from its role in generating revenue for the British government into a market-driven service provider. Under the pre-1840 system, in as much as it can be calculated, for its published accounts were vague in extreme, the Post Office had a profit margin of 68% of income over working expenses; this produced an impressive 3% of the British government's revenues.

It achieved this through a wholly arbitrary and remarkably convoluted pricing policy for its primary task, the delivery of letters.

Table 29

Postage Rates for a Letter 1839

Up to 15 miles	2d
16 to 20 miles	2½d
21 to 30 miles	3d
31 to 50 miles	3½d
51 to 80 miles	4d
81 to 120 miles	4½d
121 to 170 miles	5d
171 to 230 miles	5½d
231 to 300 miles	6d
301 to 400 miles	6½d
401 to 500 miles	7d

The base letter price was for a *single* sheet of paper of a defined size; folded up and sealed for privacy (no envelopes were permitted). All letters were charged by the number of the sheets in them. The distance charges were based on *actual* road mileage, so letters between two adjacent towns that had to go by way of London or other large cities faced increased charges. In most towns, addressees had to collect letters at post offices; local delivery, in those towns that offered it, incurred additional charges. Postal charges were paid by recipients, and, where local delivery existed, letter-carriers often had to come several times to collect the fees.

The cost of sending a single sheet letter from London in England to Edinburgh in Scotland in the 1830s was 1s 1½d, and it took forty-eight hours to be delivered.

The Post Office reform of 1840 introduced the flat rate charge of 1d for any distance, pre-paid, and the postage receipt label or stamp. Letters were delivered by the letter carriers at everyone's door; but they still had to be handed in at Post Offices for mailing. Post boxes into which stamped letters could be dropped for carriage were also introduced, but not until March 1855.

It was from this historic context of long-standing, along with the new postal regime that came in during 1840, that the contemporary public, that is the educated, writing public, made comparisons with on the pricing of the public telegraphs.

b.] **The Earliest Telegraph Pricing**

Before the Electric Telegraph Company established something approaching a national system in 1848 several railway companies offered public messaging.

The Great Western Railways' pioneer short line from Paddington in London to Slough originally charged a flat rate of 1s 0d for any length of message in 1843. By 1846 this had become 2s 0d for a message not exceeding twenty words, with 6d for every subsequent ten words. Answers under ten words were free, answers over ten words were half-rate. Entry to the stations to look at the instruments was 1s 0d throughout this early period.

The London & South-Western Railway adopted a completely different tariff in 1846: ignoring distance, it was based entirely on message length. The cost between any two stations on their line from Nine Elms in London to Southampton and Portsmouth was:

	Message	*Answer*
Under 20 words	3s 0d	2s 0d
20 to 30 words	4s 6d	3s 6d
40 to 60 words	6s 0d	5s 0d
60 to 80 words	7s 6d	6s 6d
80 to 100 words	9s 0d	8s 0d

Spectators wishing to view the instruments paid 1s 0d.

The South Eastern Railway worked the telegraph between London and Dover and over all its branches in 1846. It then charged the following public message rate for up to twenty words from its London Bridge terminus: to Tunbridge 5s 0d, Tonbridge Wells 6s 0d, Folkestone 10s 6d, Dover 11s 0d, Canterbury 10s 6d and to Ramsgate 12s 6d. From twenty to forty words were charged double and from forty to sixty words treble the above rate. The public were not allowed in the South-Eastern's instrument rooms.

As the only railway company retaining control of its circuits after the formation of the Electric Telegraph Company the South Eastern consistently kept a high tariff. On November 17, 1851 the railway grudgingly introduced a flat rate of 5s 0d for a twenty word message and 3d a word, over its entire system, but its rates did include an answer in the original cost.

The Eastern Counties Railway advertised a public message tariff between all of its stations in 1846; for up to thirty words from London to Colchester the cost was 3s 6d, to Cambridge 3s 6d, to Ipswich 5s 6d, to Norwich 7s 6d and to Yarmouth 9s 6d. Thirty word messages to the suburban stations in London from its Shoreditch terminus were 2s 0d. A flat rate of 1s 0d for every subsequent ten words and 1s 0d a mile for delivery was charged.

The Midland Railway in December 1846 worked the telegraph for public messages between the towns of Leeds, Normanton, Sheffield, Derby, Rugby, Tamworth, Birmingham, Nottingham, Newark and Lincoln.

The charge made by the Midland for under ten words was 1d a mile; above ten words and under twenty, 1½d a mile; above twenty words and under thirty, 3d a mile; and for every additional ten words ½d a mile; messengers to deliver the message from any station on foot would be charged at 1s 0d, or by post-chaise at cost. In the case of any message failing through the defect of the instrument or neglect of the railway company's servants the money would be refunded. Messages regarding lost luggage on the railway were sent free-of-charge. This tariff ended in 1848.

c.] **Telegraph Company Message Pricing**

From its inception the Electric company used a message length of *twenty words* for publicising its pricing. The cost of a twenty-word message became the industry norm for determining prices. As well as "words" all numbers and punctuation had to be spelt out. Additions such as underlining, italic text, parenthesis and inverted commas were charged as two words. At this period the delivery of the message within one-half mile of the receiving office was free, but the words in both the sender's and recipient's addresses were charged for. There was also then a minimum charge.

Between 1848, when the major English and Scottish cities were first in circuit, and March 1850 the Electric company charged 1d a mile for twenty words for the first fifty miles (i.e. 4s 2d), ½d a mile for the second fifty miles (i.e. 6s 3d) and ¼d a mile for distances beyond. Half-rate was charged for each additional ten words or fraction thereof. Actual examples of the confusing basic tariff for a twenty-word telegraphic message from London, in place from January 1, 1848 until March 1850, were:

Southampton	5s 6d
Yarmouth	7s 0d
Birmingham	6s 6d
Manchester	8s 6d
Liverpool	8s 6d
Berwick	12s 0d
Bristol	13s 0d
Glasgow	14s 0d
Edinburgh	16s 0d

The maximum charge for twenty words over any distance was fixed at 10s 0d in March 1850; this was reduced to 8s 6d in March 1851, when a "simplified" charge of 3d a word for over twenty words or half-rate for ten words was also introduced.

For important messages *Repetition* was recommended; for a further half-rate charge on the message cost it would be transmitted back to the sender by the receiving office to ensure accuracy.

There was an extra charge on top of repetition for *Insured Messages*. This applied to communications that had monetary value, mercantile buying and selling orders, for example. In 1848 for a premium of 12½ per cent the Electric Telegraph Company would be responsible for losses due to errors in transmission for sums up to £1,000. The maximum premium was 2s 6d which applied to liabilities of £1,000 and over. The premium had reduced to 10% of the liability by 1860 but this was payable with no upper limit.

The Magnetic and United Kingdom companies both had a limit for compensation of £5 for errors in repeated messages, but they charged only a 1% premium for their Insured Messages. In any case, repetition was rarely, and insurance almost never used by the message sending public.

All of the Special Acts authorising the companies had clauses indemnifying them from damages caused by errors in transmission of ordinary public messages. Repetition and Insurance as premium services were there to justify this legal indemnity. Although tested in the Courts the companies were never to be found liable for errors. Public messages with any sort of error were said, in 1853, to be one in every 2,400 sent, which was thought acceptable.

For a single charge of 2s 6d travellers could book carriages, post-horses, refreshments, beds or other accommodations at all towns where the Company had a telegraph station. Lost luggage could also be sought for the same flat-rate.

In the Company's early years, until about 1850 or 1851, before public knowledge and confidence was established, the majority of its messages out of London consisted of bulk news and commercial information carried by contract at a discounted rate, set by negotiation, or for its own subscription news-rooms.

In July 1853 the Electric Telegraph Company re-introduced a 1s 0d message rate for twenty words between its branch offices in London, first used in 1850. They now totalled eighteen: the railway stations at Euston Square, King's Cross, Shoreditch, Fenchurch Street, London Bridge, Waterloo Bridge, Paddington, Blackwall and Highbury; and 43 Mincing Lane; the General Post Office; 30 Fleet Street; 448 West Strand; 17a Great George Street; 89 St. James's Street; 1 Parkside, Knightsbridge; 6 Edgware Road; and London Docks. It now also offered a promotional message rate between its metropolitan offices of 4d for a message of *ten* words at the same time; but this was not continued.

The message rate to and from the London branches and the provinces was the same as for Founders' Court.

In November 1853, as competition began to be felt, the overall pricing structure was again slightly simplified – the charge for a twenty word message under 50 miles became 1s 0d, under 100 miles became 2s 6d, beyond 100 miles it cost 5s 0d. The 3d a word charge for more than twenty words and the half-rate for ten words additional was continued.

Commencing in June 1854, as a further concession, but only in response to competition, the words in the addresses of sender and recipient were sent free-of-charge. At the same time the Electric offered Special Rates for twenty words where the competition was strongest. The 112 miles between London and Birmingham were charged at 1s 0d; and the 210 miles to Liverpool, the 180 miles to Manchester and the 309 miles to Carlisle at 2s 6d. The average message length then was calculated at twenty-three words, of which seven represented the sender's and recipient's addresses.

In August 1855 the Electric and Magnetic companies agreed to fix their national rates to a joint tariff.

For the four-and-a-half-years between July 1855 and January 1860 the cost of a twenty word message on the Electric's circuits, with addresses "free", was 1s 0d within London, 1s 6d within 50 miles, 2s 0d within 100 miles, 3s 0d within 150 miles, 4s 0d over 150 miles and 5s 0d to Dublin in Ireland. The rate within 200 miles was reduced in 1860 to 2s 6d from 4s 0d.

Delivery of the message by messenger on foot, termed at the time *porterage*, was free-of-charge under a half-mile from the receiving office; from a half to one mile it was 6d, from one to two miles 1s 0d and from two to three miles 1s 6d. Delivery "express" by horse-cab was also free under a half-mile; from a half to one mile it was 1s 0d, from one to two miles 2s 0d and from two to three miles 3s 0d.

In 1853 the British Electric Telegraph Company had the following rates for a twenty word message throughout its 42 station network in the north of England and the west of Scotland: under 30 miles 1s 0d, under 100 miles 2s 6d and over 100 miles 5s 0d. The 5s 0d rate applied only to messages to its disconnected station in London, forwarded over the wires of the "old" Electric Telegraph Company. The British company, unlike the Electric company, also levied an additional 6d fee for delivering each message. However, it also marketed a 1s 0d for twenty word rate between six pairs of large cities in its catchment area.

The European Telegraph Company, in concert with the Submarine company, announced the opening of its new line from London to Birmingham on August 13, 1853. Messages between the two cities were advertised at 1s 0d for twenty words, 6d for additional ten words or less. However porterage (delivery) was charged at 6d for the first half mile and six pence a mile beyond that. Messages for the Continent of Europe could be forwarded by post from Liverpool and Manchester to Birmingham, saving 1s 6d.

This line superseded the need to transfer messages to the Continent from the Electric's office to the Submarine company's office in London. Messages "will proceed directly thorough one set of instruments, errors of frequent copying will be obviated, the messages will remain under one management, and all delay between Lothbury and Cornhill will be avoided."

On the same day the Electric Telegraph Company announced that from August 15, 1853 their message rate to Birmingham, and other places within 50 miles of London, would be 1s 0d for twenty words, with no charge for porterage within half-a-mile. It also listed its fifteen offices in the capital from which the rate applied.

The English & Irish Magnetic Telegraph Company introduced a reduced tariff in May 30, 1854 between London, Liverpool, Manchester and Carlisle at 2s 6d for twenty words; and for Birmingham to London, Liverpool or Manchester, and *vice versa*, at 1s 0d. Direct connections were also promoted to Scotland, and Belfast, Dublin, Galway, Cork and Queenstown in Ireland.

The opening of the "Submarine & European Telegraph", the united trading title of these companies, was advertised in Liverpool on May 12, 1854 with a cost for twenty words to London of 2s 6d (previously 5s 0d), Manchester 1s 0d and Birmingham 1s 0d (formerly 2s 6d, an additional ten words now 6d originally 1s 3d). There was no charge for name and address, or porterage for the first mile. The Electric company promptly matched these rates.

The "Submarine & European Telegraph" also promoted much simplified city-to-city rates with just two tariffs for twenty words, either 1s 0d or 2s 6d. But it possessed only a very limited number of public offices: in London at 30 Cornhill, City, 43 Regent Circus, West End, and the House of Commons, as well as in Liverpool, Manchester, Birmingham, Gravesend, Chatham, Canterbury, Dover and Deal.

The European, British and Magnetic companies, singly and as merged, understandably offered message rates broadly comparable to the Electric company's; and just as complex; although it was through their competitive influence that the Electric company gradually reduced its rates throughout the 1850s.

d.] **The Price Cartel 1855**

Once the European company opened its circuit to Liverpool on May 10, 1854 it began a vicious price war with the Electric Telegraph Company. The cost of a twenty word message to London was reduced from 5s 0d to 2s 6d, and messages between Manchester, Liverpool and Birmingham, previously 2s 6d, were reduced to 1s 0d. On its merger with the British company this combative policy was extended: messages from London to Leeds and Hull, formerly 5s 0d, were now charged at 2s 6d, with reductions of from 25% to 40% for distant stations such as Newcastle-upon-Tyne and Glasgow.

In July 1854 the *new* British Telegraph Company, the combined British and European firms, charged the following national message rates for twenty words: under 50 miles 1s 0d, under 100 miles 2s 0d, under 200 miles 2s 6d, under 300 miles 3s 0d, over 300 miles 4s 0d, with no charge for address of sender or recipient, with no charge for porterage under one mile, where messengers were kept, otherwise 1s 0d a mile was charged outside a one-mile radius; and 3d a word extra, or one-half the above rates for any number not exceeding ten words.

The British company's rate in 1855 from London to Belfast was 7s 0d; Birmingham 1s 0d, Glasgow 4s 0d, Greenock 4s 0d, Hull 2s 6d, Leeds 2s 6d, Liverpool 2s 6d, Manchester 2s 6d and Newcastle 3s 0d.

The effect of this discounting was disastrous. The British company was forced to suspend its half-yearly dividend for July 1855. On August 31, 1855 the British Telegraph Company, the English & Irish Magnetic Telegraph Company and the Electric Telegraph Company ended price competition and adopted a common message tariff for Great Britain and Ireland.

Table 30

The Electric Telegraph Company's Average Message Cost

1850	13s 11 ¾ d
1852	6s 3 ½ d
1855	4s 1 ¾ d
1861	3s 9 ¼ d
1868	2s 0 ¾ d

On its inception by merger in 1857 the British & Irish Magnetic Telegraph Company adopted the same message charges as the Electric company had fixed in June

1855. The only exceptions to this were for messages to Ireland, where the Electric had only a limited presence; 5s 0d for twenty words to most of its 83 stations there and 6s 0d to the remote Atlantic coast towns.

The South Eastern Railway Company, with its independent telegraph, reduced its messages rates considerably from January 1, 1856 to something approaching those of the telegraph companies. The rate for twenty words on its own system became 1s 0d within 25 miles, 1s 6d between 25 and 50 miles, and 2s 0d over 50 miles, with a surcharge of 1s 0d applied to messages sent on Sunday. Delivery was free within a half mile, as were names and addresses. The telegraph company rates were applied in addition for messages to the rest of the world. The railway charged four words in code as twenty words!

Eventually, by the mid-1860s, the South Eastern Railway adopted a flat rate charge of 1s 0d for a twenty word message between any of the stations on its own system, and 6d for every extra ten words or part of ten words. Addresses and delivery remained free and the extra charges still applied.

In January 1861, the Electric company adopted a 6d rate for twenty words for all messages between its London stations to combat the new London District Telegraph Company that offered fifteen words for 6d.

The United Kingdom company introduced the flat rate of one shilling for a twenty-word message throughout its system; its rates were 1s 0d for the first twenty words and 3d for each additional five words or part of five words irrespective of distance; with the options of repetition and insurance of messages. It commenced working message traffic in 1861 and from November 1861 the other companies adopted these rates wherever the United Kingdom company opened competing offices. The original shilling rate did not include delivery but by 1862 porterage under a mile was free.

This rate was never remunerative and effective price competition lasted four years, 1861 until 1865.

In the face of flat rate competition in February 1862 the Electric and Magnetic adopted a new common tariff. The charge for messages to any part of Great Britain, not exceeding twenty words, was: within 25 miles, 1s 0d; within 50 miles, 1s 6d; within 100 miles, 2s 0d; within 200 miles, 2s 6d; within 300 miles, 3s 0d; within 400 miles, 4s 0d. Special exceptions were made in the cases of Liverpool, Manchester and Birmingham (i.e. where the United Kingdom company had offices): the charge to these places being 1s 0d per 20 words. For messages of twenty words to distant cities in Ireland: Queenstown, Galway, and Londonderry, 6s 0d; to all other Irish stations, 5s 0d for 20 words (Seven words were allowed in addresses without charge).

Delivery of a message over the first free half-mile incurred an escalating range of fees. By foot messenger a distance of 1 mile added 6d, 2 miles 1s 0d, and 3 miles 1s 6d extra. By Express messenger, fly (hired coach), cab, horse or rail 1s 0d a mile was charged. For forwarding a message by post 1d was added, and by railway parcel in Britain or by road coach in Ireland, 1s 0d.

Messages sent on Sundays were charged 1s 0d extra.

Within Ireland in 1862 the Magnetic company offered similar zone tariffs: 1s 0d, 1s 6d and 2s 0d with a maximum of 2s 6d for twenty words. The Electric company then had, in addition to its cable to Dublin, only a handful of stations in the south, based around Cork, Waterford and Wexford; between which it charged 1s 0d and 2s 0d, with a cheap-rate 6d tariff from Cork to its suburb of Queenstown, copying that of the Magnetic company. It charged 2s 6d for messages to Dublin, the same as the Magnetic, but sent them via England by its South-of-Ireland and Holyhead cables. Both companies then charged a flat-rate of 5s 0d for twenty word messages from Ireland to all of their English stations.

In March 1864 the rate for twenty words from London to Scottish stations was reduced to 3s 0d. Later in that year, in August, the common tariff of the Electric and the Magnetic was reduced and simplified further: for 50 miles or less, 1s 0d; for 100 miles or less 2s 0d; for 200 miles, 2s 6d, and for 300 miles, 3s 0d. The exceptions for London (6d), the stations competitive with the United Kingdom company (1s) and Irish stations remained.

On September 9, 1858, and for several years subsequently, the Channel Islands Telegraph Company and the Electric Telegraph Company charged 3s 0d for twenty words from the islands to Weymouth, where the English cable landed, 4s 0d to Southampton, 5s 0d to London, and 5s 8d to Liverpool, Manchester and Glasgow, and the same costs in reverse, using the country's longest domestic cable. Messages between the islands of Jersey, Guernsey and Alderney were 1s 0d. If sent to England via Paris and the Submarine company's circuits, the charge was 11s 6d, reduced in 1862 to 7s 6d. By 1868 this had become 6s 8d to and from London, and 7s 8d to and from British provincial stations.

The Isle of Man Telegraph Company and the Electric Telegraph Company latterly charged 4s 6d for twenty words between stations on the island and all stations on the British mainland.

In Ireland the British & Irish Magnetic Telegraph Company offered a promotional rate of 6d for a ten word message on its suburban circuits from Dublin to Kingstown and Cork to Queenstown in 1858. This led to:

The exception to the twenty-word standard was to be that initially adopted by the London District company having a uniform 4d rate for its *fifteen* word messages within London, including delivery. In 1861 it increased this to 6d. So the basic charge for fifteen words was 6d; for fifteen words each in message and a reply it was 9d; for twenty words, 9d, each delivered, without extra charge, within half-a-mile of a station. Repetition back to the sender for accuracy was an extra half-rate.

Cynical newspapers claimed its lady clerks in London merely re-wrote a received message on a delivery form, paying boys a penny to take it to the recipient.

The District offered tradesmen the opportunity to have customers place orders by telegraph free-of-charge. The tradesman paying twenty shillings for a package of one hundred messages for this service. It also gave substantial rebates at the year end on business accounts to secure frequent users in commerce and trade.

It launched a similar generous offer for the general public in 1862, continuing it until 1866; one hundred 6d stamps for just one pound, effectively offering a message rate of 2½d for fifteen words within London, approaching the Post Office letter fee of 1d. This was the cheapest rate for a telegraph message *ever* offered in Britain. It permitted for the first time "social messaging" on a wholly personal level, in that trivial domestic matters might be communicated relatively cheaply.

However, even with its basic 6d rate and its 2½d discounted rate for fifteen words, the Company's average message cost during the year 1864 was 7½d.

In 1866, unable to raise the capital needed to repair massive weather damage to its over-house circuits, the London District company temporarily raised its tariff from 6d to 1s 0d for fifteen words. The sixpenny rate was restored for a year but was finally abandoned in May 1867 when its financial state forced it to adopt a rate of 1s 0d for *twenty* words, double that charged by the other companies between their London stations.

Cipher – For messages rendered in apparently random numeric or letter cipher rather than code which substituted dictionary words for phrases the Companies charged each letter as a word. This was necessary due to the extreme difficulty and slowness in truly accurate transmission of such messages. The rate applied to both the Private Keys used by individuals and to the Cryptograph messages sent by the government and police.

The Twenty-Word Message - By the 1860s it was established that the address of the sender consisted, on average, of four words and the address of the receiver occupied eight words. With no less than fourteen words required for the companies' accompanying service instructions by the operators, and with seventeen, the average number of words sent by the public, the total number of words transmitted for each "twenty-word" message was actually forty-three.

e.] **The Last Tariff 1865**

Ending *all* competition in July 1865 the three national telegraph companies, the Electric, the Magnetic and the United Kingdom, agreed to consolidate their tariffs at 6d for twenty words within London, 1s 0d within 100 miles, 1s 6d within 200 miles and 2s 0d beyond 200 miles, including delivery within a half mile. This lasted until the companies ceased working in February 1870.

There were, however, "extras" to this tariff. The most irritating to the public was that there was no 'through rate' to cover messages transferred from one company's system to another. For such, each company charged its segment as a separate transaction. "Thus the charge for a message from Southampton to Accrington would have been 2s 0d for transmission from Southampton to Manchester by the Electric company, and 1s 0d for transmission from Manchester to Accrington by the Magnetic company." By 1868 there were, it is claimed, up to twenty-five telegraph service providers, railway companies and independent telegraphs, that were not part of the national agreement and were entitled to add their own charge to the common rate, usually 6d or 1s 0d. At the Electric company's 350 auxiliary stations on railways which did not customarily handle public messages, the railway station-master was entitled to 6d over the usual rate for providing the service. The domestic cable companies serving the offshore islands all charged a special rate to compensate for their risk.

In balance to this there was a general introduction of a 6d rate for twenty words for messages within the country's largest cities as well as London. This district rate applied to Birmingham, Liverpool, Manchester, Leeds and Edinburgh, among other places.

In 1866 in Ireland, where the Electric company was the competitive interloper, there was a common message tariff broadly similar to that in Britain; twenty words for 6d within Dublin, Belfast and Cork, 1s 0d for up to 50 miles, 1s 6d for up to 100 miles, 2s 0d for up to 200 miles and 2s 6d for other stations. There was a preferential 1s 0d for twenty words rate from all those places where the Electric company's recently opened canal-side circuits worked to Belfast. Above twenty words the sender had the option of half-rate for every ten words or less, or ¾ d a word extra. Ten words were allowed free for the addresses of sender and recipient. A surcharge of 1s 0d was made for any message sent on Sunday. Delivery was as in Britain, free up to half-a-mile, then 6d for every half-mile, 1s 0d per mile for horse or express delivery.

The price-fixing by the major companies was driven by the growing lobby for state intervention.

In comparison, the basic message rate in France, Belgium and Switzerland during the 1860s was one franc, say 10d, for fifteen words, which had to include the addresses, over one zone of about 50 miles. Only four compact countries, Belgium, Denmark, the Netherlands and Switzerland were to introduce a national flat rate. All continental countries charged for the addresses of the recipient and sender. Because of the lack of free addresses and the close zone tariff most messages were far more expensive than in Britain.

As has been stated previously mailing a Post Office letter addressed to anywhere in the three kingdoms cost just 1d, the speed of delivery varying by distance. In London there were twelve collections and deliveries of letters per day; in most country towns six a day.

9.] **THE COMPANIES AND THE NEWS**

The relationship between the press and the telegraph companies in Britain was discrete. Unlike in the United States where the press was extraordinarily active in promoting telegraphy and organising news-gathering and news distribution, in Britain the press was initially cautious and then became hostile. The sole exception to this antagonism was the considerable personality of Julius Reuter.

In the period described, between 1840 and 1870, the British press was divided between that of London and that of the Provinces. The eight or so London daily morning and evening papers were large organisations, with a variety of specialist correspondents. At first confined to the metropolis the railways had just started to distribute the London morning newspapers nationally on the day of issue, much to the detriment of local competition. As with the telegraph the papers showed their helplessness when faced with new technology by ignoring the potential for increased distribution, leaving it to third-parties. In 1845 W H Smith & Son, wholesale news agents, were sending packages of London journals to nine distant cities by railway so that they arrived in the morning, albeit the late morning. The railway companies working out of London joined in, offering subscribers close to their stations the metropolitan papers delivered by their porters in the morning. Both added ¼ d to the 4d or 6d cover price. The papers metaphorically wrung their hands but did nothing for many years. It was to be W H Smith, rather than any newspaper owner, who became a shareholder in and director of the Electric Telegraph Company.

However, all provincial cities and towns throughout the United Kingdom had their own daily paper, many of formidable influence, but these lacked the resources of those in London in regard to news-acquisition. They relied, before 1845, on a mass of corresponding agents in the capital to forward them by post such national and foreign information that they could gather. These agents were rewarded, by the newspapers in the larger towns and cities, with advertising space that they could sell on, rather than money, demonstrating the peculiar "cashless" nature of the newspaper business.

Humbug

"The first duty of the Press is to obtain the earliest and most correct intelligence of the events of the time, and instantly by disclosing them to make them the common property of the nation."
'The Times', February 1852

"Your telegraphic summaries of foreign intelligence will not be used by 'The Times'."
'The Times' to Julius Reuter, May 1853

The first telegraphic newspaper report in Britain appeared in the 'Morning Chronicle' in London on May 8, 1845. It was a prosaic piece recording a meeting of railway proprietors in Portsmouth.

The Intelligence Department

The Electric Telegraph Company organised the first systematic news dissemination service in April 1848. This dealt with just *sports* (horse-racing results) and *exchange* (market price) news. It was subscribed to by provincial papers, news-rooms, clubs and public houses and, before public messages became popular, was the Company's largest traffic for many years.

Charles Vincent Boys, known in Fleet Street as 'CVB', had charge of the "Intelligence Department" of the Company, as it was called, through its entire twenty-two year existence from 1848 until 1870. His age on appointment was twenty-three. By the end of this period 'CVB' was third or fourth ranked in the management of the Electric Telegraph Company, demonstrating the importance of 'Intelligence' to the organisation.

Intelligence provided subsequently, in the mid-1850s, comprised a Parliamentary Summary, Court & Society Gossip, General News, Commercial News, Sporting News, Law Reports and Weather Reports. The information was culled by the Company's superintendent and his four news-clerks from London newspapers and foreign telegrams, and edited into bulletins, at a cost to provincial subscribers in the early years of between £150 and £250 per annum. The Company believed in volume as 4,000 words a day were supplied to newspapers, news-rooms and hotels, increasing to 6,000 words a day when Parliament was in session. The summary was sent to the provinces overnight before 7am with another bulletin at 6pm, as well as updates on prices, shipping and Parliament during the day.

Of particular importance in the earliest days of the Intelligence Department were news-rooms, whether belonging to the Company, to exchanges and markets, to literary and educational associations, to hotels or to individual proprietors. These gave subscribers daily access to a range of printed publications and, from 1848, regular news reports through the day by telegraph before they appeared in the press.

The importance of the news-room may be judged from the *Manchester Athenæum for the advancement and diffusion of knowledge*, founded in 1836. The Athenæum club house at Bond Street included a news-room, a library, lecture rooms, gymnastic and drama clubs. In 1855 it had 1,114 members, mostly working men, who paid 24s 0d a year subscription. The news-room, used principally in the evenings at the end of the working day, was the busiest and most expensive of its facilities. From its total annual income of £1,823 in 1855 the news-room spent £273 on newspapers, on nearly 200 of the Manchester and London dailies, the weeklies, Irish, Scottish and English provincials, and French, German and American journals, and, most worryingly for the newspaper owners, an additional £57 for the latest, almost hourly, intelligence by telegraph. In comparison the Athenæum's large Library spent £82 on new books and magazines.

An example of a typical private news-room, from the resort town of Brighton in 1864, shows that it was "liberally supplied with all the London and local newspapers, reviews, magazines, literary journals, railway records, share lists, army and navy lists, peerages, court calendars, directories and other publications and maps, so frequently required for reference. Electric telegraph news of any importance, and the prices of English and

Foreign funds and railway shares, are received and posted in the rooms at different hours of the day for the exclusive inspection of subscribers. The subscribers to these rooms have also the advantage of Reuter's foreign telegrams, which are regularly received and posted in the rooms." There were writing tables and materials available, too. The subscription in 1864 was annually 26s 0d, half-yearly 15s 0d, quarterly 10s 6d, monthly 6s 0d and for a week 2s 6d.

The depth and regularity of the intelligence provided by the Company to its news-room subscribers from the earliest days is shown below – the aggregation and study of data in market-making is as old as the market itself...

The Electric Telegraph Company's Subscription Room

Exchange Arcade, Manchester, Dec 5, 1848

In the News Room Department, the tables are supplied with the London and Provincial journals, periodicals, prices current, &c. with promptitude and regularity.

In the Intelligence Department, the information brought by the Company's Expresses is regularly posted for the use of the subscribers. The following are some of the principal expresses, and times of their daily arrival, save when otherwise stated:

- Wind and Weather from most of the principal towns in the kingdom, 9.0am
- Morning Express, containing the city and parliamentary intelligence of the preceding evening and general news up to an early hour in the morning, 9.30am
- Liverpool and Hull Shipping, 11.0am
- Liverpool Cotton Market (first report), 12.15pm
- Lloyd's List, 12.30pm
- Leeds, Liverpool and Birmingham Share Markets, 12.30pm
- London Corn and Cattle Markets (Mondays, Wednesdays and Fridays), 12.45pm
- London Share List and Money Market, 1.0pm
- Wakefield Corn Market (Friday), 1.30pm
- Afternoon Express, containing news brought by the Paris and Continental mails, which arrive in London in the forenoon, 2.0pm
- Liverpool Corn Market (Tuesday and Fridays), 2.0pm
- Leeds Corn Market (Tuesday), 2.15pm
- Leeds Cloth Market (Tuesdays and Saturdays), 2.15pm
- Newark Corn Market (Wednesdays), 2.30pm
- Liverpool Cotton Market (close), 2.30pm
- Hull Corn Market (Tuesdays), 3.30pm
- Newcastle Corn market (Tuesdays and Saturdays), 3.0pm
- Liverpool Share Market (close), 3.30pm
- Leeds Share Market (close), 3.30pm
- London Share and Money Markets (close), 4.0pm
- Evening Express, containing any important occurrences which have transpired during the day, 5.0pm

In addition to the above, the arrival of the Foreign and Irish Mails at Liverpool, London, Southampton, Hull, &c. is immediately posted, with a condensed report of the information brought by them; and the arrangements of the company are such that no event of importance can occur without information of it being in Manchester many hours in advance of the ordinary methods of communication.

Subscriptions for the year 1849 may now be paid, admitting to all the company's rooms throughout the kingdom – Single subscription, two guineas; for every additional member of the same firm, one guinea.

The Subscription Room is open from eight in the morning till nine in the evening.

The last and largest of such facilities was the *Lombard Exchange and News Room* that opened for business on January 1, 1869. It occupied the ground floor of the huge City Offices building at 39-41 Lombard Street, on the corner with Gracechurch Street, built in 1868. It possessed a business and news-room of 7,200 square feet, its own telegraph instrument room, a dining-room and luncheon-bar at one end, with a smaller writing room upstairs. Within six months it had a membership of 1,596, each paying an annual subscription of £3 3s, who had access to newspapers, directories and maps, as well as instant telegraphic news and prices. Individuals could also use it as their place of business, able to deal in shares and stock and commodities on its floor. Its message traffic was such that a pneumatic tube was planned to connect with the Electric Telegraph Company's station at Telegraph Street, instead of an overloaded private wire.

Regarding exchange news, the Intelligence Department provided the substantial Stock Markets in Manchester and Liverpool with the London's noon and closing prices from 1848, and took their business numbers for the London newspapers; of importance then were those for railway shares and government funds.

During 1851 the Liverpool Stock Market was complaining about the irregularity of the exchange intelligence it was receiving and negotiated a lower subscription. Early in 1854 the Liverpool market dropped the Electric's exchange service for that of its competitor, the Liverpool-based Magnetic company. In April 1854, the Manchester Stock Market followed suit. It is worth noting that the railway share market on the Liverpool exchange was greater in volume at this time than London, and that Manchester was a strong third in the seven English stock and share markets.

The Electric was quoting the Liverpool, Manchester, Birmingham and Leeds stock market prices as well as those of London in its exchange news circulated to provincial subscribers during 1849; a service seized upon by stock speculators, creating as well a new dealing speciality, the inter-market *arbitrageur*.

It was the sporting press that took to the telegraph with real enthusiasm: 'Bell's Life in London' and other lesser sports papers, dealing with results of races and matches on which wagers were made, were soon sending messages concealed in a private key so that no advantage could be gained by intercepting them. The famous turf editor of 'Bell's Life', William Ruff, contracted with the Electric company in 1852 an annual arrangement by which he and his reporters at the race courses received books of passes to pay for their messages giving results on account, without needing cash. Previously Ruff had used road coaches and pigeons to return results, but "the pigeons were often shot".

Other newspaper reporters also carried pass-books paid for by their papers rather than use cash for sending news by electric telegraph.

An exception was the "aerial telegraph" at Goodwood Races, where the course's owner, the Duke of Richmond, refused to allow telegraph poles on his lands. The Electric Telegraph Company kept 40 pigeons at its Chichester station to carry messages from Goodwood.

The Company was remarkably enthusiastic about supporting horse racing. Special wires were opened in the early 1850s to temporary telegraph offices in the grandstands at the fashionable courses of York, Chester, Doncaster and Epsom, even to lowly Brighton, on race days for press reports, tipsters and betting. But, as with aristocratic Goodwood, the headquarters of racing, Newmarket, would have none of it; messages had to be sent and received at the railway station. The Company even offered specially reduced rates from race courses in September 1853. To further accommodate the market, in November of the same year the Company's R S Culley agreed to replace the unsightly overhead circuits at Chester race course with much more expensive "wires buried in the earth". Coincidentally, C V Boys, superintendent of the Intelligence Department, was said to take a close interest in racing information...

William Ruff provided the telegraph company with all the horse racing results he compiled daily for sending to the provincial press. When the government tried to suppress off-course betting-offices in January 1854 the Electric Telegraph Company stopped reporting racing results for some years.

To fill the need William Wright, sporting printer and publisher, of 9 & 10 Fulwood's Rents, High Holborn, producer of the daily 'London Betting Price Current' set himself up as an "electric telegraph agent". From 1853 he distributed 'Tattersall's Betting and Results of Races' and 'Racecourse Information', the latter with arrivals of horses, scratching, order of running, betting before going to the course, betting on the course, and betting at midday at Beeton's, to private subscribers daily by electric telegraph for well over ten years. Each of Wright's messages, concealed in a private key or code, cost 3s 0d.

By February 1867, the enterprising Wright, now styled "sporting printer, publisher, commission and telegram agency", of the Handicaps Book Office, 16 York Street, Covent Garden, was advertising to bookmakers as "having the telegraph laid on to his premises".

Samuel Powell Beeton, father-in-law to Mrs Isabella Beeton of 'Household Economy' fame, had opened an off-course betting market at his public house, the *Dolphin*, 39 Milk Street, Cheapside, in competition with the 'aristocratic' market at Tattersall's during April 1851. He quickly acquired 200 'members', other publicans, betting-office owners and private betting commission agents, who laid the racing odds personally and by post and by telegraph.

The awful army of racing tipsters, who advertised intensely in the sporting press in the nineteenth century, followed Wright's example in using the telegraph.

In 1854 it was noted how the provincial daily press was served by the Electric's Intelligence Department: "At seven in the morning the clerks are to be seen deep in 'The Times' and other daily papers, just hot from the press, making extracts and condensing into short paragraphs all the most important news, which are immediately transmitted to the country papers to form the second editions. Neither does the work stop there, for no sooner is a second edition published in London than its news, if of more than ordinary interest, is transmitted to the provinces".

The busiest time was on Friday nights when the London and continental news was 'condensed' for the so-called 'Saturday' provincial papers; these weeklies had the largest circulations in the country as they were actually intended to be read on the one day-of-rest, on Sundays. The printing and distribution of papers on the Sabbath was forbidden, if not illegal.

In 1855 the Company came to an agreement with 'The Times' newspaper to receive its news messages from abroad without charge to the sender in exchange for rights to sell them in the provinces.

In 1858 163 of the 1,200 daily and weekly provincial newspapers subscribed to the Electric's Intelligence Department; up from 120 in 1854. It was also forwarding news to news-rooms, hotels and individual journalists. This relatively low up-take was despite rates 25% less than ordinary messages when sent during the day and 50% less when sent at night, with a further 25% discount for delivery to additional addresses in the same town.

By December 1861 the Intelligence Department was contracted to supply information to 175 newspapers and to 99 institutions with news-rooms.

Newspapers in Glasgow, Edinburgh, Newcastle, Manchester and Liverpool leased dedicated circuits at the Electric Telegraph Company's London offices at night, when public traffic was light, by which they could send and receive their own news-copy using the Company's clerks. The Company's messengers delivered the "slips" with the news messages to the newspaper offices. In 1867 four Scottish newspapers each had a special night wire between London and Scotland; the

'Scotsman' and the 'Daily Review' in Edinburgh, and the 'Glasgow Herald' and the 'Glasgow Daily Mail'. Latterly, when other telegraph companies joined the news pool in 1865, the Scottish press preferred the Hughes type printer on their circuits.

In Dublin, by 1869, the 'Irish Times' had a Special Wire, and the 'Freeman's Journal' and 'Saunders's Newsletter' shared the use of a press wire. The 'Scotsman' and 'Glasgow Herald' paid to have the telegraph on their premises, much against the better judgement of the telegraph companies who feared all manner of fraud and deception. The wire for the 'Scotsman' was leased of the Electric company; those for the 'Edinburgh Review' and 'Glasgow Herald' of the Magnetic company; and for the 'Glasgow Mail' of the United Kingdom company. The Dublin wires were provided by the Magnetic.

The Competition

During 1853 the Submarine & European telegraph companies jointly maintained a small *News Department* which contracted with the *Agence Havas*, a general news agent at Paris, to supply them with a summary of continental news in the afternoon at a fixed price. This it distributed to the gentleman's clubs and to some daily newspapers in London. They originally undertook this to generate publicity rather than as a general service. However from March 1855 the British Telegraph Company, which acquired the European concern, continued the provision and extended it to subscribing newspapers in the north of the country, providing a single daily *Telegraphic Despatch* of foreign news from *Havas*.

The Magnetic Telegraph Company managed news on a different model. Firstly, it offered recognised news correspondents a day-rate of 6d for nine words between any two stations or a night-message rate for long despatches of one-tenth that for the public. Secondly, it provided news by contract to newspapers and newsrooms throughout Britain and Ireland at a cost of between ¼d and ½d a line of ten words, providing daily the equivalent of two whole broadsheet newspaper columns of information. It achieved the latter through a *News Exchange* in Liverpool to which all the subscribers contributed and from which a consolidated, common news selection was received in return. It also had paid agents, news-collectors and parliamentary reporters.

The Magnetic provided share, corn, cotton, coal, iron, cattle, provision and produce market prices, information on fairs, shipping arrivals, foreign and domestic news, 'gazette' (government and legal) news and parliamentary reports; much as the Electric's Intelligence Department. It also leased a private wire from London to 'The Freeman's Journal' newspaper in Dublin.

This merged with the British company's News Department in 1857, much improving its foreign sources as it then had access to Paris and the news resources of the *Agence Havas*.

The British & Irish Magnetic Telegraph Company had a special contract with Lloyd's of London, dating from April 1861 for which it was paid £250 per annum. It collected in London details of shipping "casualties" from Lloyd's agents and correspondents in Britain and on the continent, arrivals and departures of shipping at Liverpool, arrivals and departures at Gravesend and at Deal, and received messages from Lloyd's agents throughout the country. As well passing all this intelligence to Lloyd's it was permitted to add its details to the daily public news despatches. In addition, it collected for Lloyd's exclusive use information on European shipping "casualties" in American waters from ships speaking with its coastal stations at Queenstown, Galway and Londonderry.

The Magnetic company performed a great telegraphic news feat during the evening of Sunday, December 27, 1857. President James Buchanan's 13,654 word first annual message was delivered in Washington in America on December 8, 1857. A copy of the speech arrived at Liverpool on the Cunard liner *Africa* at 6 o'clock on December 27. It was telegraphed to London by the Magnetic in 300 minutes, and was in the hands of the printers of the London newspapers by 11 o'clock; appearing in ten whole columns of their Monday editions. This was twice the length of the previous longest message.

The News Combination

The Electric and the Magnetic combined their news operations, continuing the title of *Intelligence Department*, at the latter's new Central Station during January 1859, and, abandoning the *Agence Havas*, contracted jointly with Julius Reuter to buy his foreign news telegrams to transmit to the provinces for £800 per annum. Reuter retained the right to despatch foreign, commercial and shipping news to the much larger and wealthier London daily and evening papers and his private subscribers within fifteen miles of London. In February 1865 the United Kingdom company joined the Intelligence Department pool; the revenues were divided up in proportion to their total public message turnover.

The combined companies issued "Intelligence Instructions" to clerks with its arbitrary two-letter codes for transmitting statistical information such as Share Lists, State of the Weather, Bank Returns of debt, money and coin, the Corn Market and the Cattle Market.

There was a warning code for Special *Express* Messages for news of the greatest importance that gave them priority over all others. The code for so-called 'Expresses' had to be authorised by the department's superintendent from Founders' Court.

The weather was reported from Aberdeen, Belfast, Brighton, Cardiff, Cape Clear, Deal, Dublin, Dundee, Falmouth, Gravesend, Greenock, Hartlepool West, Holyhead, Hull, Leith, Liverpool, Londonderry, Milford Haven, Penzance, Plymouth, Portsmouth, Queenstown, Ramsgate, Shields, Swansea, Valentia, Whitehaven and Yarmouth. Independent of the government's Meteorological Department, it consisted of ten two-letter codes.

Charles Dickens' magazine, 'All the Year Round', during 1868 reported that the Intelligence Department issued "a jumbled piecemeal of items sent from the thirty instruments of the Threadneedle Street office. No sounds heard save the intermittent click of the handles of the instruments, and the shrill, tumultuous rhythm of the bells". Not a ringing endorsement of the companies' news provision – but then Dickens at heart was still a journalist…

The Telegraph Newspaper

From an article also titled 'My Newspaper' in Charles Dickens' magazine, 'All the Year Round', June 25, 1864

I proceeded to a suite of rooms occupied by the sub-editor and the principal reporters. In the outermost of these rooms is arranged the electric telegraph apparatus – three round discs with finger-stops sticking out from them like concertina stops, and a needle pointing to alphabetic letters on the surface of the dial. One of these dials corresponds with the House of Commons, another with Mr Reuter's telegraph office, the third with private residence of the conductor of my journal, who is thus made acquainted with any important news which may transpire before he arrives at, or after he leaves, the office. The electric telegraph – an enormous boon to all newspaper men – is especially beneficial to the sub-editor; by its aid he can place before the expectant leader writer the summary of the great speech in a debate, or the momentous telegram which is to furnish the theme for triumphant jubilee or virtuous indignation; by its aid he can "make-up" the paper – that is, see exactly how much composed matter will have to be left "standing-over," for the tinkling of the bell announces a message from the head of the reporting staff in the House to the effect, "House up – half a column to come".

This refers to the new 'Daily Telegraph' paper, the first mass-market journal in Britain, which had a price of 1d, when 'The Times' was 6d.

The provincial newspaper owners and their parochial editors complained to Parliament that they wanted racing results and not the tedious details of foreign wars and politics that the Intelligence Department provided. The telegraph companies had the papers subscribe to separate contracts, over and above those for intelligence, to receive valuable sporting news and results.

However, according to Edward Bright during 1868 the telegraph companies were supplying bulletins to about 400 subscribers; and the income to companies from these activities was over £20,000 per annum. According to government reports in 1868 the Intelligence Department sent news to 306 subscribers, including 173 newspapers, in 144 towns.

There were then four services provided: 1] *general intelligence*, 4,000 words a day including Reuter's foreign news; 2] *special wires* from the telegraph offices in London over which the papers provided their own news; 3] *sporting news*; and 4] *special messages* at a discounted rate for the newspapers' roving correspondents.

Outside of the daily General Intelligence by subscription the Intelligence Rates by the combined companies for *Special Messages* in 1865 were; between 7am and 7pm, the tariff rates but allowing 30 words rather than 20 words, and half rate for the next 15 words and above rather than 10; between 7pm and 7am, the tariff rates but allowing 40 words rather than 20 words, and half rates for 20 words rather than 10. There was a 200 word limit on copy sent, unless previously authorised by London. To avoid hoaxes prepayment in cash or stamps was required from most newspapers.

In the late 1860s only twenty-four of about 140 subscribing provincial newspapers, thirteen dailies and eleven weeklies, used the Companies' Special Messages, spending in all a paltry £280 a year on such telegrams to obtain news from London.

The nine London papers, the 'Globe', 'Daily Telegraph', 'Star', 'Glow-worm' (sic), 'Morning Advertiser', 'Shipping Gazette', 'Morning Post', 'Pall Mall Gazette' and 'The Times', had annual contracts initially with the Electric Telegraph Company and after 1865 with the combined telegraph companies for *Press Passes*. These were provided in books with tear-off slips that authorised the sender to transmit up to 200 words of news on account rather than for cash. The companies refused to extend this privilege to the hundreds of provincial newspapers as it would have been too open to fraud.

Press Passes on annual contract were also used by the sporting press in London: 'Bell's Life', 'Sporting Gazette', 'Sporting Life', and 'Sportsman'.

The passes were printed on different coloured stock for each newspaper and around six pass books were issued to each paper.

Sporting Intelligence comprised arrivals of horses, order of running, Tattersall's betting, City betting, Manchester betting, latest betting and results of races. It cost subscribers, newspapers, news-rooms and individuals £25 per year, or £6 each for the winter quarters and £9 each for the summer quarters. In addition there was, throughout the 1860s, a Special Contract by which the "indefatigable" Benjamin Sutterby, the Company's principal sporting news reporter, provided a half-column article each day at 10pm. In 1867 and 1868 he wrote for fourteen newspapers; the 'Sporting Life' and 'Sportsman' in London, the 'Daily Post' and 'Gazette' in Birmingham, the 'Yorkshire Post' in Leeds, the 'Courier', 'Mercury, and 'Post' in Liverpool, the 'Courier', 'Examiner' and 'Guardian' in Manchester, the 'Chronicle' and 'Journal' in Newcastle and the 'Daily Telegraph' in Sheffield. For this he earned £400 a year.

There were two types of agreement for *Special Wires* in 1865. By one contract they were available from any of the three central stations of the combined telegraph companies between 7pm and 3am. The companies provided the staff, messengers and stationery. For a circuit under 100 miles length the newspaper had to guarantee an annual expenditure of £400; for under 200 miles an income of £450 and above 200 miles, £500, to Ireland, including use of the underwater cables, £800. The rate charged on these wires was the tariff rate but with 60 words allowed instead of 20, and half-rate for every subsequent 30 words rather than 10 words.

In the other contract, for *unlimited* use of a Special Wire, the charges were: under 100 miles £600, under £200 miles £675, above 200 miles £750, and to Ireland £1,000.

The receipts of the Intelligence Department in 1865 from the Electric & International Telegraph Company's general news contracts was £14,306, from the British & Irish Magnetic Telegraph Company's contracts £9,494 and from Sporting Intelligence £6,000. Special Messages brought in a further £1,684. Their combined costs were £3,769 for collecting general news and £1,019 for sports.

In November 1868 the Intelligence Department was transmitting news to subscribers in: Aberdeen, for the 'Free Press', 'Herald', and 'Journal'; Arbroath, 'Guide'; Banff, 'Journal'; Belfast, 'Banner of Ulster', 'Morning News', 'Newsletter', 'Northern Whig', 'Northern Star' and 'Ulster Banner'; Birmingham, 'Gazette', 'Journal & Daily Post' and 'Midland Counties Herald'; Bolton, 'Chronicle' and 'Evening News'; Bradford, 'Daily Telegraph', 'Observer' and 'Daily Times'; Bristol, 'Daily Post & Mercury', 'Mirror & Times' and 'Western Daily Press'; Brighton, 'Daily News'; Cardiff, 'Cambrian Daily Leader', and 'Western Mail'; Clonmel, 'Chronicle'; Cork, 'Constitution', 'Examiner', 'Herald' and 'Reporter'; Darlington, 'Times'; Doncaster, 'Chronicle' and 'Gazette'; Dublin, 'Daily Express', 'Evening Mail', 'Evening Post', 'Freeman's Journal', 'Irish Times' and 'Saunders's Newsletter'; Dumfries, 'Courier', 'Herald' and 'Standard'; Dundee, 'Advertiser' and 'Courier & Argus'; Durham, 'Advertiser' and 'Chronicle'; Edinburgh, 'Daily Review', 'Evening Courant' and 'Scotsman'; Elgin, 'Courant' and 'Courier'; Exeter, 'Flying Post', 'Gazette', 'Weekly Times' and 'Western Times'; Glasgow, 'Citizen', 'Daily Herald', 'Daily Mail' and 'Morning Journal & Evening Post'; Gloucester, 'Citizen'; Hartlepool, 'Mercury' and 'Herald'; Hereford, 'Times' and 'Journal'; Hull, 'Eastern Counties Herald & Hull News', 'Morning & Evening News' and 'Packet & Times'; Inverness, 'Advertiser' and 'Courier'; Leeds, 'Mercury', 'Times', 'West Riding Express' and 'Yorkshire Post'; Liverpool, 'Albion', 'Courier', 'Dawn', 'Gore's Advertiser', 'Journal & Daily Post', 'Mail' and 'Mercury'; London, 'Daily News or Express', 'Daily Telegraph', 'Echo', 'Globe', 'Glowworm', 'Morning Advertiser', 'Morning Herald or Standard', 'The Star', 'Morning Post', 'Pall Mall Gazette', 'Shipping Gazette' and 'The Times'; Londonderry, 'Guardian', 'Sentinel', 'Standard' and 'Journal'; Manchester, 'Courier', 'Examiner & Times' and 'Guardian'; Newcastle, 'Advertiser', 'Chronicle', 'Courant', 'Journal', and 'Northern Express'; Norwich, 'Norwich Chronicle', 'Norwich News' and 'Norwich Mercury'; Nottingham, 'Express', 'Guardian' and 'Journal'; Perth, 'Advertiser'; Peterborough, 'Advertiser' and 'Times'; Plymouth, 'Western Counties Daily Herald', 'Western Daily Mercury & Journal', 'Western Morning News' and 'Western Daily Standard'; Preston, 'Chronicle', 'Guardian' and 'Herald'; Sheffield, 'Independent' and 'Telegraph'; Shields, 'Daily News' and 'Gazette & Telegraph'; Shrewsbury, 'Chronicle' and 'Journal'; Stafford, 'Advertiser'; Stamford, 'Mercury'; Sunderland, 'Herald' and 'Times'; Taunton, 'Herald' and 'Gazette'; Tralee, 'Chronicle' and 'Kerry Post'; Worcester, 'Herald' and 'Journal'; and York, 'Gazette' and 'Herald'.

The telegraph office at all these places was kept open at night to receive news, whether daily or once or twice a week, dependent on the frequency of the paper.

Separately from the press, the Intelligence Department provided information on annual contract to public and private news-rooms in the provinces, for clubs, hotels, exchanges and institutes. These were each charged around £50 a year.

In 1868 the Electric Telegraph Company published its own view of the news combination:

"For many years the Electric & International Telegraph Company have had an 'Intelligence Department', to which a large and experienced staff of editors, reporters and others is attached, for the purpose of collecting home and foreign news, political, domestic and commercial, and distributing the same to every point at which such information can afford interest. The clubs in London receive, every half hour, intelligence of the general proceedings of Parliament. The provincial news-rooms and subscription-rooms, farmers' ordinaries, and other circles, are supplied by telegraph with news of every occurrence which can affect their interests. A visit to any one of these political or commercial centres will illustrate at once the vast importance, as well as the immense public convenience of this organisation."

"The 'Intelligence Department' of the Electric & International Telegraph Company has very varied duties to perform. Wherever there is any considerable gathering of individuals, whether for a permanent or a temporary purpose, the wires of the Company have to be placed in their midst, and special arrangements have to be made for the conveyance of the intelligence arising from the gathering."

"If an agricultural meeting, a musical festival, or a Social Science Congress is held in any part of the United Kingdom, however distant, information of every day's proceedings has to be collected and conveyed. If a public man of mark addresses his constituents or a public meeting, in any portion of the country, the words which fall from his lips have to be reported and telegraphed to the principal newspapers of the kingdom almost as soon as they are uttered."

"At the present time it is certain that all this information, so important to the public and the world at large, with the greatest expedition, in the best and most comprehensive form, and at the lowest possible prices."

According to William Hunt writing in 1887, in 'Then and Now, or Fifty Years of Newspaper Work':

"At the time of the transfer of the telegraphs to the Government, 168 papers used the telegraph services of the companies, 59 dailies and 109 weeklies. Eight were using special wires, three in Scotland and five in Ireland... The customers of the [Intelligence] Department numbered 355 — newspapers, 168; literary institutions, 38; clubs, 33; exchanges and chambers of commerce, 32: general merchants, 23; corn merchants, 19; hotels, 18; share brokers, 12; banks, 3; Dublin Castle, 1."

It was not until the anticipated demise of the telegraph companies and their news departments during 1865 did the daily provincial press in Britain manage to organise their own domestic news-gathering and distribution service: the *Press Association,* whose name survives today. This is surprising given that a flourishing Provincial Newspaper Society had existed since 1836 and that there were several long-established commercial agencies in London that collected foreign and metropolitan news, forwarding it to newspapers by the Post Office mails in return for advertising space which they sold on for cash to large-scale advertisers in the metropolis.

As might be expected the newspaper owners forming the Press Association in 1865 soon fell to squabbling amongst themselves. The Provincial Newspaper Society, representing the weekly papers, was happy with the telegraph companies' news services so were excluded from the new body. More importantly only newspapers representing the "Liberal Interest" were represented in the Press Association's management. It had to be wound-up and a new, more inclusive, Association created in 1868, grudgingly allowing the weeklies and the Conservatives a voice.

Buying the Press

The Post Office was also conspiring with the press owners with a systematic leaking of policy and promises over the prospective appropriation of the telegraphs. William Hunt revealed in 1885 that their chief conspirator wrote "many letters" secretly to provincial editors. As an example on April 6, 1868:

"I have been in communication with many of your professional brethren on the matter to which you refer, and have told them what I shall be prepared to recommend. It is as follows:

"1. That the newspapers shall appoint their own collector or collectors of news (inasmuch as the Government Department can hardly be expected to know the requirements of the press); and

"2. That we shall transmit the news thus collected at rates which shall be sufficient to cover the cost of working.

"3. That our charges for special wires shall be no more than enough to make the service self-supporting.

"4. That when the bill has become, or seems likely to become, law, the newspaper proprietors shall appoint a small committee to confer with me, and post me up as to the exact wants of each class of paper.

"You will perceive that we can put nothing of this in the bill. If we did we should be accused of bribing the press, and should lose all the value of their support, but I have either spoken or written in these terms to many of your brethren, and they have expressed their satisfaction with my proposals.

"*It is very desirable, however, that my statements should only be mentioned privately and in strict confidence*."

Writing again on June 5, 1869, with details of the highly confidential terms accepted by the Electric Telegraph Company, the conspirator added:

"I shall be able, I hope, in a few days to send you some more precise information, but if in the meanwhile you like to use the substance of this letter I think you can do the measure good service. I will ask you, however, in that case to *put the case in your own words and not to mention my name."*

The innovative and independent Intelligence Department, a "large and experienced staff of editors, reporters and others… for the purpose of collecting home and foreign news, political, domestic and commercial, and distributing the same to every point at which such information can afford interest", was dissolved in 1870 at the instance of the Post Office.

Its manager, C V Boys, contrived to be both effective in business and a *bon viveur*. He was associated with the theatre, as well as horse racing, and supported newspaper and thespian charities. He negotiated a substantial pension from the government and received a testimonial in 1870 for his services to the Intelligence Department from his noble, journalist, acting and telegraphic friends consisting of a fine clock and a library of books. He was then age forty-five.

The Press Association ensured that the direct provision of information to public and private news-rooms – regarded as competitors – by the Post Office Telegraphs was prevented. When requested to service the rooms it quoted annual costs of £113 rather than the Intelligence Department's £50. By these actions the Press Association, the creation of the leading critics of the telegraph companies, was established as a monopoly provider of news to the provinces and began its distribution service immediately afterwards using the Post Office Telegraphs with an incredibly cheap message rate that bore no relation to the costs; in London it used messengers.

There is no independent history of the Press Association and its secretive, subsidised news monopoly.

Only one of the existing commercial news-agents, William Saunders of 112 Strand, London, who had set up as a "stereotyping and general reporting agency" as recently as 1863 saw the opportunity that the telegraph offered and was willing to challenge the omnipotent Press Association in 1870. But it was not until November 1872 that the enterprising Saunders managed to separate his telegraphic news agency from the "hard-copy" distribution business as *Central News*, of 2 Telegraph Street, Moorgate, supplying articles and reports "to newspaper proprietors and to the managers of clubs, news-rooms and exchanges; also to private persons". He took on many of the skilled writers and reporters of the Intelligence Department.

Reuter?

I sing of one no pow'r has trounced,
Whose place in every strife is neuter,
Whose name is sometimes mispronounced
As Rooter.

How oft, as through the news we go,
When breakfast leaves an hour to loiter,
We quite forget the thanks we owe
To Reuter.

His web around the globe is spun,
He is, indeed, the world's exploiter:
'Neath ocean, e'en, the whispers run
Of Reuter.

'St James's Gazette' 1859

Foreign News Agency

Julius Reuter developed the telegraphic foreign news-agency in London from October 14, 1851 onwards by means of a network of contacts on the Continent of Europe. A German by birth and connexion, he gained experience initially in selling twice-a-day foreign stock prices and exchange rate information in printed circulars derived from telegraphic and postal sources in Paris, Amsterdam, Berlin, Brussels, Vienna and Athens to businesses in the 'City' of London from his two-room "Continental Telegraph Office" at 1 Royal Exchange Buildings. He soon realised the value of news.

The Submarine Telegraph Company, then having a monopoly of European traffic, appointed J Reuter 'General Agent for the Continent' upon the opening to the public of their cable to France on November 13, 1851, to assist correspondents in sending and receiving messages. Despatches from foreign parts for London could be safely sent care of "Reuter Calais".

Reuter opened "Continental Telegraph Offices" at Exchange Buildings in Liverpool in June 1852, and at Exchange Arcade Buildings, Manchester in July 1853, as well as at Calais in France and Ostend in Belgium, in careful concert with the arrival of the Submarine telegraph connection across the Channel to Europe. These offered quotation of funds and exchange, and prices of bullion from Amsterdam, Berlin, Frankfort, Hamburg, Madrid, Paris, Petersburg and Vienna. To these he added the latest prices and the state of the markets of corn, metals, colonial produce, silk, cotton, tallow, political news, &c., from Alexandria, Amsterdam, Antwerp, Bremen, Breslau, Calcutta, Danzig, Genoa, Hamburg, Königsberg, Leghorn, Odessa, Rio de Janeiro, St Petersburg, Stettin and Trieste.

Oddly, the Continental Telegraph Offices in Liverpool and Manchester were operated in Reuter's birth name of 'S Josaphat'. These offices prospered, providing British stock market and continental *bourse* data to newspapers and private subscribers, abandoning the Josaphat name at the end of 1854, finally adopting the Reuter instead of the "Continental Telegraph" by-line.

The Liverpool and Manchester offices were also providing foreign news by telegraph to several journals in the north of England and Scotland during 1854, well before Reuter was accepted by the London papers. The 'Belfast Newsletter', Edinburgh 'Caledonian Mercury', 'Glasgow Herald', 'Leeds Mercury', 'Liverpool Mercury', 'Manchester Times' and the 'Preston Guardian' all subscribed to Reuter's earliest continental news service, benefiting from his German and Austrian contacts during the war in the Crimea.

The 'Daily News', a newly-established journal in London, originally edited by Charles Dickens, began to publish Reuter's foreign market information, with the "Continental Telegraph" by-line in January 1855. The Submarine Telegraph Company furiously pointed out that it and the International company carried the information from Europe and that there was no such concern as the "Continental Telegraph". The 'Daily News' ignored the complaint and continued to use the Continental by-line for Reuter's economic data until 1858.

Initially rejected by the self-regarding attitude of the London press his metropolitan business from 1852 until 1858 was primarily in the supply of mercantile intelligence and news of commercial value to private subscribers in the City of London for £8 8s per month. Reuter contracted all of his message business to the *International Telegraph Company* and their new cables to Holland in September 1853 in return for a modest discount. The International company shared his rooms in Royal Exchange Buildings for a couple of years, before merging with its parent, the Electric Telegraph Company. At the beginning of the following year he negotiated an additional rebate of 50% on the public rate for transmitting foreign news on their cables.

In addition to his mundane financial and mercantile bulletins for the commercial community in London, Reuter was providing the newspapers of Europe with telegraphic news from Britain, America and from all the distant places with which London, Liverpool and Glasgow traded.

But it was not until 1858 that Reuter was able to commence a trial scheme of foreign news telegrams over the public wires to the London press by offering a two-week free trial and £30 a month thereafter. On October 8, 1858 the 'Morning Advertiser', a daily newspaper published by the Licensed Victuallers and widely distributed in their public houses and inns, took Reuter's first foreign news telegram; the other papers followed its example within days. The 'Times', joining with Reuter on October 13, was charged 2s 6d for twenty published words with a credit, or 5s 0d if no credit was given to Reuter. The other papers in London negotiated different rates, eventually on term rather than piece prices. Reuter also sold news telegrams to the Electric Telegraph Company's Intelligence Department for sending to the provinces, as well as selling them direct to the larger provincial papers with London offices.

During 1862 of the widely-circulated London papers, 'The Times' was paying £100 per month, the 'Morning

Herald' and the 'Daily Chronicle' £83 6s 8d, the 'Daily News' £75, the 'Daily Telegraph' and the pioneering 'Morning Advertiser' £66 13s 4d, for Reuter's foreign news messages.

The politics of 1860s, with countless wars in Europe, America and Asia, gave enormous impetus to news collection and hence to Reuter's business. From 1859 he quickly established a pool for collecting and distributing international news with Havas in France, Wolff in Prussia, Stefani in Italy and Ritzau in Denmark.

In the papers Reuter's news messages were always called *telegrams*, introducing that word to the public.

Reuter was one of the first users of the new Universal telegraph for internal messages between his City offices in 1860 and by the mid-1860s was using it to transmit foreign news over private wires to the offices of the major London newspapers, replacing printed circulars and manifold (carbon) copies.

His firm had a day office at Royal Exchange Buildings, open from 10am to 6pm; a night office at Finsbury Square, open from 6pm to 10am; and a West End office at Waterloo Place, midway between the City and Parliament, all connected by telegraph.

Already by 1861 the Waterloo Place office had its own wires provided by the *Universal Private Telegraph Company,* with instruments in the editor's rooms of the main daily and evening newspapers in the Strand and Fleet Street supplying foreign news. The papers eventually included the 'Daily News', 'Daily Telegraph', 'Echo', 'Globe', 'Morning Herald', 'Morning Post', 'Morning Star', 'Pall Mall Gazette', 'Standard', 'Sun' and, of course, 'The Times'. This office had thirty telegraph circuits in August 1861; eighteen for newspapers and for Reuter's service use and twelve for the foreign ambassadors to London. It had its own private circuit to access the Electric Telegraph Company's cables to the Continent. It was truly a communications "hub".

Reuter promoted with C W Siemens the *South-Western of Ireland Telegraph Company* in 1863, to connect the city of Cork with Crookhaven, on the isolated southernmost point of Ireland, where metallic containers with news-messages were collected from the Cunard steamers from America. His news agency then promoted its own cable from Lowestoft to Norderney in Hanover, with connecting land lines in Germany, in 1865 as a speculation. He leased the public traffic rights to the Electric Telegraph Company.

When Reuter's original contract with the combined telegraph companies' Intelligence Department expired on January 1, 1865 he negotiated a new five year agreement. Under this he received £3,000 per annum, a substantial increase from the original £800, the companies having exclusive rights to sell and distribute his news telegrams to the provinces outside of a fifteen mile radius of Charing Cross in London.

In 1865 the news agency was incorporated as a joint-stock enterprise called *Reuter's Telegram Company*. By this time he was charging each of his London newspapers an average of £1,000 a year for his foreign news.

Julius Reuter also promoted and then became a director of the *Société du câble trans-atlantique Français*, an Anglo-French intercontinental telegraph, in 1867 so that his news agency might get priority access to American news-sources.

In 1869, as the telegraph companies were being appropriated, to maintain his business Reuter contracted to provide the Press Association with foreign telegrams for exclusive use in the British Isles outside London, and to disseminate Press Association news overseas.

Reuter's foreign news monopoly did not go unchallenged. The *Telegraphic News Association*, with a joint stock capital of £50,000, was established at 90 Cannon Street, London, on October 6, 1864. It began to circulate despatches from New York in January 1865, but ceased trading a month later. The *Universal Telegram Company* commenced with an even larger nominal capital of £100,000, at 4 Skinner's Place, Size Lane, London, "conveying to or from all parts of the globe, news, intelligence, &c.," on October 28, 1864. It, too, had a short life, such was Reuter's strength.

It should be noted that the London newspaper press, the strongest critics of the telegraph companies' news services, were very quick in adopting the Universal telegraph (q.v.) internally and on private wires between their editorial offices and their news-providers, such as Reuter. However their hostility to the companies by then was such that they were coy about admitting it – going to the length of censoring their titles from the Universal company's newspaper advertising of its list of customers in 1860.

10.] THE COMPANIES AND THE WEATHER

Weather has been preoccupation of the British for centuries. Britain has "more weather" than most countries, its seasons are less stable and the seasonal elements more subject to violent change than continental climates. The weather was clearly vital to Britain's core economies of agriculture and overseas trade, particularly when shipping was primarily driven by sail. Its study has occupied men and women in both rural and urban communities to a surprising degree; nineteenth century investigators gradually revealed the existence of an immense regional meteorological archive.

It was the 'Manchester Examiner' newspaper that, during August 1847, organised the very first weather reports by electrical means; "The Corn Market and Telegraph. The weather having been lowering and occasionally wet in the neighbourhood of Manchester during the last two days, and still showery this morning, the anxiety of the commercial classes to know how the agricultural districts were affected, led us to inquire if the electric telegraph was yet extended far enough from Manchester to obtain information from the eastern counties. By the prompt attention of Mr Cox, the superintendent, inquiries were made at the following places;

and answers were returned, which we append: Normanton, fine. Derby, very dull. York, fine. Leeds, fine. Nottingham, no rain, but dull and cold. Rugby, rain. Lincoln, moderately fine. Newcastle-upon-Tyne, half-past 12, fine. Scarborough, quarter to 1, fine. Rochdale, 1 o'clock, fair. A glance at the map of England will show that the weather is fine in the chief districts of agriculture east and north of the midlands."

The preoccupation was such that during November 1848, within two years of its creation, the Electric Telegraph Company was sending "weather reports from above forty places in England" to its private subscription news-rooms in Edinburgh, Glasgow, Hull, Liverpool, Leeds, London, Manchester and Newcastle.

And then the 'Daily News' in London, of which Charles Dickens was the first if short-lived editor, began publishing the first regular public weather reports in June 1849. These reports were collected from correspondents on a printed form and forwarded to London by railway express.

It soon became clear to the many individuals interested in the weather that the systematic collection of data, initially for weather maps and then for actual weather forecasts, could be made possible by the electric telegraph, by which data from many distant parts could be brought to one place for analysis in minutes.

In addition to this realisation, new organisation was being applied to meteorological science; on April 3, 1850 the British Meteorological Society was founded in succession to two previous organisations, one dating from 1823. It was not itself a large body growing gradually from 170 members in 1851 to 200 in 1856 and 300 in 1864; drawn from science and the professions, and including several women, but it was to have great influence. Its organising power was its secretary James Glaisher, the Superintendent of Magnetism and Meteorology at the Royal Observatory, Greenwich.

A surprising number of people connected with the telegraph were members of the Meteorological Society by 1862; William Andrews of the United Kingdom company, C T Bright of the Magnetic company, E B Bright of the Magnetic, Samuel Canning of the Atlantic Telegraph, Edwin Clark of the Electric company, Latimer Clark of the Electric, R S Culley of the Electric, J S Fourdrinier of the Electric, Nathaniel Holmes of the Universal company, R S Newall, the submarine cable maker, Julius Reuter, J O N Rutter, who introduced the electric burglar and fire alarm, S W Silver, the maker of cables and insulators, and C V Walker, the telegraphic superintendent of the South Eastern railway who had been a member from its foundation.

At the Great Exhibition of 1851, inspired by this new interest in meteorology, the Electric Telegraph Company used its circuits to collect the wind direction, the state of the weather and the state of the barometer from sixty-four places about the country at the Crystal Palace at 9am each day between August 8 and October 11, 1851 and recorded them on a great meteorological chart with moveable symbols and arrows displayed on its stand. The Company also printed its Weather Map every day on a press by the chart and sold them to visitors for 1d a copy.

Then in 1859 Admiral Robert Fitzroy introduced a system of Meteorological Telegrams. Weather readings from the coasts along an area bounded by Nairn, Helder and Skuddernaes in the north and north-east, by L'Orient and Rochefort in the south, and by Galway, Valentia and Cape Clear in the west were collected twice a day and telegraphed to a Meteorological Office in London. Here they were inscribed on maps and weather patterns determined. This enabled a day or even two days notice before dangerous winds reached the British seas and ports, as Fitzroy declared 'forecasting the weather'.

Each of the fifteen international coastal reporting stations was equipped with a standard barometer, a wind vane, a dry thermometer and a wet thermometer. At 8am and 1pm every day the station master would transmit the readings of these instruments to London reduced to six groups of five figures. This compressed data included current air pressure, dry temperature, wet temperature, direction of wind, force of wind, cloud, character of weather and sea disturbance, as well as changes since the last report in the direction of wind, highest or lowest temperatures and air pressures.

As the system developed by 1860 'The Times' newspaper was publishing daily weather forecasts, and by 1861 the *Meteorological Department* of the Board of Trade was co-ordinating the world's first weather service. It was a modest organisation for collecting and diffusing weather data; its annual budget was just £4,600 and the department employed ten people; a scientific officer, an office manager, a telegraphic clerk, a reductions and discussions clerk, a records and stores clerk, a translation clerk, a meteorological instrument clerk, an optical instrument clerk and two messengers. Its offices were at 2 Parliament Street, Westminster.

Each day except Sunday, during 1862 the Department was receiving twenty domestic weather reports each morning, ten additional reports each afternoon and five reports from Europe.

The Meteorological Department issued daily weather forecasts and "double forecasts", two-days in advance, to six daily newspapers, a weekly newspaper, Lloyd's ship insurance market, the Admiralty, the Horse Guards (Army headquarters) and the Board of Trade.

From September 1860, after verification at Kew Gardens, the meteorological instruments, comprising a barometer, a wind vane and two thermometers, for collecting the data were placed in the care of the clerks of the Electric, Magnetic and Submarine Telegraph companies. The clerks "gradually and well acquired the duties asked for (then perfectly new), which are now continued with extremely creditable regularity and precision". The companies' clerks read the instruments and transmitted the short cipher groups summarising the data twice a day to the Meteorological Department. The companies discounted the common message rate by one third for this traffic in the public interest. Competent clerks received 3s 0d extra a week for this work from the Board of Trade.

During 1864 *Storm Signals* advising of the severest weather from the Meteorological Department were transmitted by the Electric Telegraph Company to 161 interested parties in 65 places on the coast; and by the Magnetic Telegraph Company to 51 parties in 24 other towns. The recipients were primarily collectors of customs, harbour-masters and those in equivalent positions, including yacht-clubs. In addition the companies' telegraph offices forwarded Storm Signals to their nearest Coast Guard. Included in the distribution by the Electric were Lloyds' insurance market, the 'Shipping Gazette' and the Crystal Palace in London; by the Magnetic, the Ministry of Marine in Paris, the island of Heligoland and the Hanse town of Hamburg.

Starting in 1861 the Coast Guard of the Admiralty on receiving this information had exhibited "cautionary symbols" in public places at coastal towns. In 1862 this covered 130 places, up from 50 in the previous year. When it received the Storm Warnings at ports by telegraph it had hoisted signals in the form of cones and drums on prominent sea-front masts and yards to warn mariners of anticipated foul weather. The Storm Signals were remarkably effective in saving lives and hulls, but were later abandoned as fishermen and other sea-goers objected to the disruption of trade.

In 1870 the telegraph companies' reporting stations in Britain and Ireland were, from north to south, at: Thurso, Wick, Nairn, Aberdeen, Leith, Shields, Scarborough, Yarmouth, Ardrossan, Greencastle, Holyhead, Liverpool, Valentia, Roche's Point, Pembroke, Scilly, Penzance, Plymouth, Portsmouth, and Dover. To which were added reports from London by the clerks in the Meteorological Department, and from Heart's Content in Newfoundland, provided by the clerks of the Atlantic Telegraph Company and transmitted to London without charge.

The following newspapers eventually published the Department's forecasts by 1870: 'Daily News', 'Echo', 'Express', 'Globe', 'Lloyd's Shipping List', 'Observer', 'Pall Mall Gazette', 'Shipping & Mercantile Gazette', 'Standard' (morning and evening editions) and 'The Times' (1st and 2nd editions).

There was some disruption when the Post Office took over the telegraphs in that year; its new offices would not accommodate the meteorological instruments and its staff were stopped from providing data. In many instances volunteers, teachers and retired sailors, had to replace the telegraph companies' clerks.

In competition with the Meteorological Department, as a free public service and, more importantly, to draw in passers-by, the Electric Telegraph Company introduced a *Wind & Weather Map* at its domestic offices in January 1861. This featured twenty-three coast stations each with a small coloured disc attached, on which were printed the points-of-the-compass and indicators of the wind and weather, fine, strong, rain, and so on. The disc had two rotating hands, one red indicating the wind direction, one white showing the state of the weather. Every day at 8am the twenty-three stations telegraphed their wind and weather to the Central Station where the information was collated and distributed to the several offices so that they could adjust the disc symbols on their maps by 10am.

The *Daily Weather Map Company* was promoted in September 1861 as a joint-stock enterprise with a capital of £4,000 from the offices of the 'St James's Chronicle', at 110 Strand, London. It anticipated selling 5,000 maps a day on a subscription of 4s 0d a month or £2 2s a year, collecting by telegraph and printing weather information from sixty-four stations in England and Ireland. It was not simply a map; it was 'The Daily Weather Map, and Journal of News, Literature and Science'. The prospectus announced "Besides the *Map*, the publication will contain two pages of letterpress, presenting a carefully prepared epitome of the news of the day, foreign and domestic, with original articles upon topics relating to commerce, agriculture, literature, and popular science. In this department the columns of the *Weather Map* will furnish the means of intercommunication between all classes of scientific public at home and abroad, and provide a medium through which all discoveries can obtain a wide and immediate publicity. It will thus supply what science has long wanted, and the vast increase in the number of its professors and students so amply deserves, a Daily Organ."

The sets of recording instruments were made by the eminent craftsmen, Negretti & Zambra, to the Greenwich standard of quality and distributed to the stations, and the master Map engraved. The firm published two Weather Maps using the same ingenious system of circular symbols for each station that the Electric Telegraph Company had introduced at the Great Exhibition, but was unable to reach its break-even circulation of 3,000 or gain sufficient advertising support. It was projected by James Glaisher, Thomas Sopwith, J W Tripe, Nathaniel Beardmore, Henry Perigal and G J Symons, all active members of the British Meteorological Society. The Weather Map was designed by Thomas Sopwith, grandfather of the British aviation pioneer, and the moveable weather symbols made by the printer George Barclay.

11.] **THE COMPANIES ABROAD**

The acceleration in communication brought about by the electric telegraph is most vividly illustrated in the links with territories abroad, especially when divided by oceans. Britain was a commercial nation, built upon trade; its interests in the nineteenth century were world-wide. But even in 1852, when steam and iron had been long applied to create regular lines of ocean navigation the time-scales for communication were immense. A letter from London took 12 days to reach New York in the United States; 13 days to Alexandria in Egypt; 19 days to Constantinople in Ottoman Turkey; 33 days to Bombay in India; 44 days to Calcutta in Bengal; 45 days to Singapore; 57 days to Shanghai in China; and 73 days to Sydney in Australia. From this state of affairs, within twenty years, the telegraph companies created links that allowed messages to be sent to all of these places in *minutes*.

As with most other matters connected with their operation the telegraph companies were secretive in regard to foreign traffic: between 1851 and 1866 this essentially meant communication to the continent of Europe by way of the English Channel and the German Bight.

The British government, unlike in the domestic market, was to intervene extensively, and expensively, in the development of foreign telegraphy apparently for reasons of strategic communication. This was undertaken primarily by the granting of subsidies in the form of guarantees of interest, ranging from 4½% to 6%, on the capital of telegraph and cable companies. It also involved itself in directly commissioning cables, in subsidising foreign government lines, and through lines constructed by the British-Indian government.

Europe

Outside of Britain telegraphy was the first technology to have successful international regulation, as the necessity for cross-border interchange of message traffic was obviously essential.

The first such international regulatory body was the *Deutsch-Oesterreichischen Telegraphenverein*, the German-Austrian Telegraph Union, which was created by the Treaty of Dresden on July 25, 1850, allowing direct circuits between Austria, Prussia, Bavaria and Saxony.

Throughout continental Europe electric telegraphy was a monopoly of the state, several of which states, France and Austria being notable, only grudgingly permitting any public access for messages. This situation ostensibly allowed uniform regulation and agreement. However, in true European fashion, *two* conventions were convened to regulate international telegraphy. The first convention was based on an expansion of the original German-Austrian Telegraph Union, and was signed in Berlin on June 29, 1855 encompassing Austria, Prussia, Holland, the German Confederation (i.e. the smaller German states), Russia, Turkey and the Italian States (except Sardinia). The second was signed in Paris on December 29, 1855 between France, Belgium, Spain, Sardinia and Switzerland. The two conventions adopted differing zone tariffs for out-going, revenue-generating messages. The American telegraph was the sole instrument used, recognised by both agreements.

In addition to these conventions the German-Austrian Telegraph Union negotiated access agreements with France and Belgium (October 1852 and again in June 1855) and with Switzerland (October 1858). Britain, Denmark, Norway and Sweden were not party to either of the telegraph conventions but despite this were in connection through bi-lateral treaties with one or other of the signatories.

The conventions affected Britain in that:

- The traffic of the two Submarine Telegraph Companies (one having monopoly rights to France, the other having rights to Belgium) was primarily regulated by the Paris Convention. Between 1859 and 1865 it also was to have cables landing in Hanover in Germany and Denmark.
- The messages of the Electric Telegraph Company, whose cables landed in Holland and Hanover, were regulated by the Berlin Convention.

In Britain these continental connections were known as 'German' via The Hague, 'Belgian' via Ostend, and 'French' via Dover. Whichever company the sender used in Britain they, ostensibly, had the option of specifying the route based on printed tables held at the telegraph offices. The criteria could be expense - the 'German' route was invariably cheaper, or speed - the 'Belgian' route was more direct and so could actually be quicker into the German states, and the 'French' quicker than the 'Belgian' to Southern Europe.

Regarding the market in Great Britain, the European Telegraph Company's limited number of domestic offices offered access to the Continent from November 1852 via Calais and Ostend. The European company was a satellite promotion of the Submarine Telegraph Company. To these connections were added those of the British company in the north of the country in September 1854. In 1857 these inland circuits, linked to the Submarine's, were united with those of the English & Irish Magnetic company. The original Electric Telegraph Company's much larger range of domestic circuits were connected to Europe from May 1853 via The Hague in Holland.

The Submarine Telegraph Company maintained offices for messages in Paris, Brussels and Antwerp before the common adoption of the American telegraph on its and on all of the Continental circuits in 1855. Similarly, the Electric & International Telegraph Company had offices in The Hague and Amsterdam, before handing traffic over to the *Rijkstelegraaf* in Holland in 1859. It also maintained third-party telegraph agents in Berlin, Vienna, Hamburg and Trieste for the convenience of foreign merchants and others trading with Britain.

For a period, in the mid-1850s, people like Reuter became 'consultants' to mercantile houses in London in managing the complexities of foreign telegraph traffic. In 1853 he, after being the sole agent for the Submarine Telegraph Company in London, received a 7% discount for directing such messages exclusively through the circuits of the International Telegraph Company, the Electric's cable-operating subsidiary.

The dominant Electric Telegraph Company would generally refuse traffic designated for the 'French' route, giving preference to its own Dutch cables. Only the Magnetic, through the Submarine company's French, Belgian, Hanoverian and Danish cables, had a choice, albeit a short-lived one, of all three connections.

So as far as telegraphy from Britain was concerned the Electric company sent and received the majority of messages for Holland, Germany, Scandinavia, Russia and Turkey, whilst the Submarine company served France, Belgium, Spain, Portugal and Italy, through to Egypt. However both companies could send messages addressed to any connected country, relying on its continental associates to retransmit them appropriately.

Table 31

Deutsch-Oesterreichischen Telegraphenverein

The German-Austrian Telegraph Union was the Electric Telegraph Company's great ally in Europe

Union Stations in Europe in 1862

Austria	239
Prussia	197
Bavaria	49
Saxony	26
Hanover	36
Württemberg	65
Baden	65
Mecklenburg	15
Netherlands	63
Total	755

There were other, local, stations in these countries; the Union managed 4,494.9 'geographical miles' of line and 9,633.2 'geographical miles' of wire in 1862. The geographical or nautical mile equals 1 minute of arc along the Earth's equator, or 6,080 feet.

Statistics from 'Encyklopädie der Physik' XX Band, 1865

The Electric company quickly established good relations within the 'German' sphere, for example when the German-Austrian Telegraph Union amended its rates on November 12, 1855 these were extended to Britain so that messages to Austria, Prussia, Saxony, Bavaria, Wurttemberg, Hanover, Holland and Russia were allowed five words for the address free-of-charge and pre-paid answers up to ten words at half-rate. By 1855 it had an indirect circuit through to Constantinople in Ottoman Turkey. This utilised a line erected by French contractors for the Ottoman government, in support of the Crimean campaign, between Semlin on the Austrian border, to Sofia, Adrianople and the Turkish capital. A direct line was opened to public traffic on May 2, 1858. Political problems between Austria and Sardinia and between the Italian states prevented extension into Italy. The Magnetic and the Submarine companies only reached Rome and Naples in 1855 through French influence, and required the laying of an Adriatic cable to the Balkans to reach Constantinople in 1859.

Effective from January 1, 1866 an agreement made at an International Telegraph Conference in Paris during the previous year united the working of twenty-one state systems in Europe. Britain, with the largest telegraphic traffic and just about to create the circuit to the Americas, was excluded from this convention.

The late-coming United Kingdom Electric Telegraph Company obtained access to the Continent in 1868 by way of the Great Northern Telegraph Company of Copenhagen, through Denmark.

India and the Far East

For Britain by far the most important foreign connection was that to its territories in the Far East. By 1868 the electric telegraph had reached out to Rangoon and Moulmein in Burmah; and the major Indian cities of Calcutta and Bombay had been in regular if slow and somewhat unreliable communication with London since January 27, 1865.

Although Britain was not involved in them the 1860s saw a series of conflicts in Europe that disrupted the technological advance of telegraphy to the East.

The Italian Wars of Unification commenced in 1859 when the French Empire in support of Kingdom of Sardinia (which included Piedmont (Turin)) expelled the Austrians from Lombardy (Milan), in return seizing Savoy and Nice. In 1860 and 1861 a military expedition united the Kingdom of the Two Sicilies (Naples and Sicily), the Duchies of Tuscany, Parma and Modena, and the Papal States of Umbria, the Marches and Romagna with Sardinia to form the Kingdom of Italy. Through the military support of Prussia the new Italian state acquired Venetia from Austria in 1866. Finally Rome was incorporated into Italy in 1871 with the withdrawal of the French Imperial protectorate that had existed since 1848. Italy was a battleground for most of the decade.

The French ensured that the absorbed Italian states abandoned the German-Austrian Telegraph Union for the Paris Convention on telegraphy in 1862, and messages from Britain for Rome, Naples, Malta and Alexandria then *all* passed through the Submarine Telegraph Company's circuits, hence by way of Savoy.

Central Europe was also a battleground. There was a bitterly fought uprising in the Russian General-government of Warsaw in 1863. Prussia and Denmark fought over Schleswig-Holstein in 1864, the former being the victor. This was followed by a war between Prussia and Austria and their allies in 1866 which culminated in the absorption by Prussia of the smaller German states in North Germany, including the former British viceroyalty of Hanover.

The East India Company's Telegraph

Until 1858 the East India Company managed political, financial and military matters in the Indian peninsular, Ceylon, Burmah and Pegu on behalf of the British government and the Indian principalities. William O'Shaughnessy, a doctor in its service, according to his own account, had been experimenting with electric telegraphy since 1837 and, independently of European and American experience, developed his own system for use in India by the late 1840s. O'Shaughnessy was given permission by the Bengal Presidency of the Company in 1851 to construct, as "a national experiment", a line of electric telegraph from Calcutta to Kedgeree, a distance of 80 miles, by way of stations at Bishtapore, Atcheepore and Diamond Harbour. It was opened for government and company service, and for the use of subscribers in the shipping and mercantile communities, on October 6, 1851.

In this trial he successfully used circuits of iron rods and simple, locally-developed electrical technology, using current reversers and galvanometers.

The Governor-General of India, Lord Dalhousie, was sufficiently impressed by O'Shaughnessy to have the East India Company extend his system from Calcutta to Agra, from Agra to Bombay, Agra to Peshawar, and Bombay to Madras; linking the Company's three administrative departments or Presidencies, Bombay, Madras and Bengal. By November 1853 the East India Company had expended £110,000 on telegraphy, adding Simlah and Lahore to its circuits, totalling 3,150 miles of line for its private use.

Dalhousie also had O'Shaughnessy sent to London in 1852 to present to the Court of Directors of the East India Company his ideas on electric telegraphy. The Court, however, had already taken the subject into consideration and had commissioned a report of the engineer Francis Whishaw. Whishaw recommended and they initially accepted the use of underground circuits of copper wire insulated with gutta-percha and buried in wooden sleepers treated with arsenic to prevent attack by insects. The Court however, endorsing Lord Dalhousie's recommendation, appointed O'Shaughnessy the Superintendent of Telegraphs for India with full powers over technical matters.

Once in England O'Shaughnessy thoroughly researched the current progress of telegraphy. Commencing in May 1852 the East India Company began an elaborate series of test and trials at its military depot at Warley, near Brentwood in Essex. O'Shaughnessy had between three and four thousand yards of iron wire erected on posts, training the Company's sappers and miners in telegraph construction. He intended to have poles in India fourteen feet high and a furlong (one-eighth of a mile) apart, with especially thick iron wire. The poles were to be fixed with iron screw-piles. For underground circuits he had the sappers and miners lay ten thousand yards of copper wire insulated in gutta-percha resin in wooden sleepers treated, as Francis Whishaw recommended, with arsenic to make them proof against ants.

On October 5, 1852 the chairman, Sir James Hogg, and members of the Court of Directors arrived by Special Train on the Eastern Counties Railway at Brentwood to review O'Shaughnessy's activities, proceeding to Warley with an escort of cavalry. They were then to make a decision on laying 3,000 miles of telegraph circuits in India, by their own army. Stores were being assembled at Warley for shipment anticipating commencement of construction in January 1853.

There was an emphasis on simplicity and robustness of equipment for Indian service. Heavy-gauge iron wires suspended from earthenware insulators on iron posts were then agreed for the new lines. The posts were set much farther apart than in Europe or America, and the wires suspended much higher above the ground. The strength of the wire ostensibly to protect circuits against the weight of inquisitive monkeys and their height to allow the passing of elephants; so the press said. To test the strength of the planned circuits to the directors one of the Company's soldiers threw a rope over the trial line and hauled himself up to the wire.

The actual instruments to be used had yet to be decided. The patentees of several telegraph systems were present on October 5 to demonstrate their systems: Thomas Allan, Alexander Bain, Frederick Bakewell and Jacob Brett all attended the Company's directors on Warley Common. The "show" was stolen by Samuel Statham of the Gutta-Percha Company who used his novel fuse to detonate explosives electrically over long distances. O'Shaughnessy, after an exhaustive review of all available telegraphs, decided to abandon his own indigenous telegraph system substituting that used in the United States which better reflected conditions in India, selecting the rough and ready American telegraph, with its simple key and clockwork register.

To complete the events of October 5, 1852, after a late afternoon "cold collation" Sir James Hogg, O'Shaughnessy and the Court thanked their soldiers for all their efforts and returned to London on the Special Train.

The East India Company's improved telegraph was opened for public messages on February 1, 1855. In preparation for this a school for European telegraphers was opened at Gresham House, Old Broad Street, London, to familiarise them with the American telegraph. The initial intake was 40 trainees; this was raised almost immediately to 72. By the following year there were 4,250 miles of line, with 46 stations.

In pursuit of simplicity the Company adopted subsequently the American acoustic receiver or "sounder". Shaughnessy opened instrument workshops, under Mr Faulkner, to manufacture American sounders for use on Indian circuits, at one-tenth of the cost of Siemens & Halske's finest recording instruments with their complex clockwork. The site he chose for this new technology in 1857 was Bangalore, where the successors of this enterprise flourish to an immense degree today.

The East India Company was dissolved in 1858 at the end of the mutiny of elements of its military force and India became a British viceroyalty. The British-India government appointed William O'Shaughnessy to be Director-General of Telegraphs. His system was further expanded to 10,994 miles of line with 136 stations by 1859, in which year 170,566 public messages were sent.

Unfortunately by May 1861 the administration of the India telegraphs fell into the hands of a superannuated army officer, Major C Douglas, who proved to be a master of self-serving inertia. Worse still, he appointed other ill-equipped army officers to district superintendencies, neglecting the welfare of the Indian employees and gradually undoing the economies and efficiency of O'Shaughnessy's telegraph system. It was not until July 1865 that the India government managed to dismiss Douglas for his continued incompetence.

In June 1861 the Chambers of Commerce in India reported that 8% of its members' telegraph messages were "unintelligible, contained important errors or so delayed as to be useless".

Trust in the India Government Telegraphs was depleted further in early 1861 when two former clerks, George Pecktall and William Allen were engaged by opium speculators in Bombay to interfere with messages from China affecting the trade. According to the 'Bombay Gazette' of February 27, 1861, "enormous sums of money" were made from their activities.

The telegraph wire from Galle, where the China mail steamers touched to deposit commercial messages regarding the opium business, passed through Sattara and Poona on the way to Bombay. The miscreants cut the wire four miles out of Poona and inserted a railway telegraph and a battery, reading the incoming messages, which they sent by post their sponsors in Bombay, before changing and re-transmitting them to suit their speculative interests. Foolishly they failed to restore the circuit when they ceased their operation; the line break was investigated and the fraud discovered.

By 1863 the Indian telegraphs had 14,500 miles of line, reaching as far east as Rangoon in Burmah. But its services under government control had become slow and unreliable, with a large and highly-paid European bureaucracy overseeing a demoralised Indian staff.

During 1863 the Electric & International Telegraph Company in England projected the *Oriental Electric Telegraph Company* to construct 4,000 miles of public line sharing those circuits already built along the Indian railways for their own service, and successfully united the railway companies in its support. But the government in London forbad this competition to its monopoly in September 1864.

Overland to India

Each domestic telegraph company contracted for its own circuit through the foreign state-owned wires to the east. However competition initially only ran to Constantinople, the capital of Ottoman Turkey, where the British had laid an underwater cable to cross the Bosphorus from Europe to Asia in 1856.

The Electric's primary eastern circuit, the oldest dating from the circuits erected in 1855 for the Crimean war, went from London to The Hague, to Berlin or Frankfurt, Vienna, Belgrade (then in Turkey) on to Constantinople. Transcription of messages took place at either Berlin or Frankfurt, and again at Vienna and Belgrade.

The principal eastern route of the Magnetic company was created in 1859 and extended from London to Paris, Turin, down the east coast of Italy, across the Adriatic Sea by submarine cable from Otranto to Valona (then an Ottoman city) hence to Salonika and to Constantinople. Messages were transcribed at Paris, Turin, and Otranto or Valona before reaching the Turkish capital. The Imperial French authorities, it was claimed, "inspected" foreign through-traffic on this circuit, even diplomatic messages.

By 1859 the Electric had two alternate circuits available through to Ottoman Turkey: the so-called *Austrian* route, by way of Vienna, Pressburg, Pesth, Szolnok, Debrezin, Klausenberg, Karlsberg, Hermanstadt, Kronstadt, Bukarest, Rustchuk, Giurgiovo, Shumla and Lule to Constantinople. The alternative was the *Serbian*, its original route, also from Vienna but by way of Agram, Peterwardein, Belgrade, Nissa, Sophia, Phillipopolis, Adrianople and Lule to Constantinople.

The Electric Telegraph Company contracted with the Netherlands government, who were members of the German-Austrian Telegraph Union. The Company claimed to have no direct dealings with the Union or systems that the Union connected with. It reconciled its foreign message account every three months with, and passed on complaints from customers to, the Dutch. The Union similarly settled the message accounts with its connections and relayed on the complaints. Accounts were generally well-kept but complaints were rarely responded to, and where the cost of the message was reimbursed by the Company it was without much hope of recovery. It was sending messages from London to Vienna and Constantinople through Frankfurt, in preference to the circuit from Berlin to Vienna as Union traffic between the two capitals was intense and foreign messages were low in priority. The need for manual transcription had been eliminated by 1865 and the Company could telegraph Constantinople directly, but only at night when continental domestic traffic was limited. For this reason, too, the Union commonly held the Company's traffic for manual transcription at Frankfurt and Berlin, giving preference during the day to its own messages.

An Indo-Ottoman Telegraph Convention between Britain and Turkey in 1860 was to secure an exclusive overland circuit from the Austrian-Ottoman border to Basrah in Turkish Arabia. It was planned to comprise a land line from Constantinople to Scutari, Izmid, Angara, Sivai, Diarbekir, Mosul, Baghdad and Basrah on the Gulf, as a roadside overhead or pole line from Scutari to Baghdad, and a novel "subfluvial" (river-bottom) cable hence down the river Tigris to Basrah and Fao where it would connect with an ocean cable to India. As with other government telegraph works the Convention lines were prolonged in their completion; they took five years to be fully implemented.

The initial stage proceeded relatively quickly. British engineers supervised the construction of the overhead line from Constantinople to Baghdad and this was opened on June 10, 1861.

The subfluvial cable from Baghdad to Basrah was, after much dispute with the Ottoman authorities, substituted by an overhead circuit as the British government's engineers claimed that the river-bottom cable would cost twelve times as much as wires on poles.

The Convention line eventually opened throughout in January 1865, for Indian traffic through from Constantinople to Baghdad in Mesopotamia and to Fao at the head of the Persian Gulf, where the British-India government underwater cables to Kurrachee had landed in 1864. The Indo-Ottoman line ran nearly 2,000 miles on poles, and used Greek or Armenian operators. It was financed in great part by a grant from the British India government as part of the convention.

The British India government cable extended in sections 300 miles from Kurrachee to Gwadur, then 400 miles to Musandam, 400 miles to Bushire and finally 150 miles to Fao. W T Henley's Telegraph Works Company contracted for the cable-making and laying in December 1862. The works were completed west from Gwadur to Fao on April 8, 1864 and east to Kurrachee on May 14, 1864.

The short cable between Europe and Asia had been repaired three times since its construction in 1856, but was finally abandoned in 1860 - message traffic across the Bosphorus then being carried out by steamer. Then, as part of the Convention, two short underwater cables dedicated to Indian traffic were added with two more beneath the Bosphorus for Ottoman use.

On March 1, 1865 the Submarine Telegraph Company and the British & Irish Magnetic Telegraph Company, in contractual alliance, offered message rates from their offices in Britain *via* Constantinople to the principal cities of India, Burmah and Ceylon.

In the east the British-India government created the Indo-European Telegraph Department in 1863 to build a line across Southern Persia from Khanaquin on the Ottoman border to Bushire where its cables were to land and in 1868 to build a land line from Bushire to Gwadur and Kurrachee in India.

The service through the Ottoman Turkish territories was terrible, with long delays and garbling of text; an alternative through Russia's governmental wires became equally execrable when entering Persian state circuits, as both involved operators transcribing unfamiliar languages and foreign scripts. The "circuit" from London to Calcutta was opened on January 27, 1865; but only once in 1866 did a message get through in under twenty-four hours, they regularly took several days to transit the government wires in Europe and Asia.

The Electric had on average 30 messages a day for India and received a maximum of 175 during 1865, after the first land circuit to Calcutta opened, before the submarine lines were created. The speediest message from India was received in 1 hour 50 minutes, but most took between a day-and-a-half and nine days, allowing for a five hour time difference between London and India.

Similarly the Submarine company, by its concessions, dealt with the French and Belgian governments, but not the networks with which they were conjoined. In 1863 it was sending messages to Constantinople by way of Paris, Munich and Vienna, or by Paris, Turin, Otranto, Valona and Belgrade. The choice was made by the French authorities. If the message was sent through Brussels it was forwarded by way of Berlin and Belgrade. Two-thirds of its messages were then by way Paris and one-third through Brussels. The longest transmission time to India in 1865 was 17 days, the shortest 17 hours. The average transit time for the 20 or so messages for India that the Submarine company transmitted daily was 48 hours.

In 1865 the Electric company was handling 67% of outbound and 98% of inbound traffic with the Far East; the Submarine company had 29% of outbound and 2% of inbound messages. The source of 4% of outbound messages was not known. In parenthesis, it can be added that the statistical situation was reversed for messages through southern Europe, where the Paris convention ruled; the Submarine company dominating to Spain, Portugal, Italy and Egypt. However, errors and delays caused the Submarine's chairman to declare in 1866 that "We would much sooner not have Spanish and Portuguese messages at all."

From 1864 the British government looked to sponsor much more secure and reliable communications with India and Australia, by other land-lines and, eventually, by a series of wholly British-owned and operated ocean cables.

This need was brought home by the disruption of telegraph traffic to both Constantinople and Alexandria in the 'Seven Weeks War" between Prussia and its allies, including Italy, and Austria and its allies in the summer of 1866. No messages could be sent through Germany or Italy whilst hostilities lasted, around two months.

The Electric Telegraph Company and Siemens & Halske projected the *Indo-European Telegraph Company* in 1867 to overcome these problems. It was to be a land route through the Prussia, Russia and Persia, where its continental promoters, Siemens & Halske, had strong influence. It was completed from London to join with the cables to India in the Persian Gulf in 1870, using the English language throughout. Its history can be found under the chapter 'Competitors & Allies'.

Although its capital was mainly English, provided by the directors of the Electric, the Indo-European Telegraph Company was essentially a German concern. In the later part of the nineteenth century it was regarded by the British government as being protected by Russia in Persia, so untrustworthy for official messages.

Distant Australia was served in the late 1860s by sending telegraph messages from London to Galle in Ceylon where they were taken by mail-boat to Adelaide in South Australia.

Underwater to India

There were to be several lines of approach by British companies to link London with the cities of India by submarine cables. This divided into two elements, west of Alexandria in Egypt to Europe and east of Alexandria to India. It was to be chaos; with the governments of Britain, France, Austria, Sardinia, Turkey and Egypt, not to mention the Court of the East India Company, intervening. A telegraph to India was, however, to be ultimately successful with a long series of underwater cables, scarcely touching foreign territory only after 1870 solely through the efforts of British public companies.

The first difficulty to overcome was the crossing of the Mediterranean Sea: there were three routes planned to Alexandria on the route to India; from southern France; from Constantinople; and from Austria – with several variations, branches and diversions.

In 1854 John Watkins Brett projected the *Société du télégraphe électrique Méditerranéen*, known better as the "Mediterranean Electric Telegraph", incorporated under French law, simultaneously in Paris, Turin, capital of the Kingdom of Sardinia; and London, England; to connect France, Corsica, Sardinia and the major French colony of Algeria by underwater cables. As with the cable of 1851 across the Channel the ownership of the new concession was vested in the *Société Carmichael et Compagnie,* a private partnership. The construction and operation was let to the separately organised Mediterranean Electric Telegraph with a joint stock capital of £300,000 on which 4% was guaranteed by France on £180,000 and 5% by Sardinia on £120,000 for fifty years. The connection was a six-core cable from Spezia to Corsica (75 miles), land lines across Corsica (128 miles), from there to Sardinia by cable (10 miles), and across that island (200 miles). There was to be a 125 mile deep-water cable from Sardinia to Secali in Africa. These were to be made by Glass, Elliot & Company of London, their first large project. An underground circuit was to lead west to Algiers for French traffic and another east to Alexandria in Egypt for British messages to India. It was intended to imitate Brett's Submarine company, the only other foreign telegraphic concession granted by the French Empire, but it did not repeat that success. The Africa cable failed over several attempts and the *Société Carmichael et Cie* abandoned its landing rights to the French government in 1856; the operating Company itself became entirely French as the *Société du télégraphe électrique sous-marin de la Méditerranée,* surviving until early February 1867, when it was finally declared bankrupt.

The *Mediterranean Extension Telegraph Company* was then promoted by John Watkins Brett in London to serve British interests in the extreme south and east of Europe during August 1855. In 1857 it had a capital of £120,000 in twelve thousand shares of £100 and was intended to connect Alexandria in Ottoman Egypt with Europe, by way of Malta, the Royal Navy's chief station in the Mediterranean, for which it was to receive a guarantee of interest of 6% from the British government. However it ended up connecting Cagliari in Sardinia, where the original concession terminated, with the islands of Malta and Corfu, with two cables made by R S Newall & Company. The latter island was then a British possession, part of its protectorate of the Ionian Islands off the Greek coast. When the original Mediterranean concession was surrendered, the Extension company added a 70 mile cable, made by Glass, Elliot & Company, from Malta to Sicily, hence to mainland Italy and the state circuits in Europe, in September 1859. It also had Glass, Elliot lay a cable, its fourth, from Corfu to Otranto in southern Italy in 1861.

The Mediterranean Extension Telegraph Company eventually possessed an office in London, a central station at 27 Strada Stretta, Valetta, Malta, and stations at Corfu, Naples, Cagliari and Turin. In 1858 it had a tariff of 10s 6d for twenty words between Cagliari and Malta and Malta and Corfu when it managed 7,512 messages.

At the eastern end of the Mediterranean, on May 14, 1855 Lionel Gisborne negotiated a 50 year concession of the Ottoman Turkish government for a cable connecting Constantinople and Alexandria in Egypt. The Ottoman government was to pay an annual subsidy of £4,500 for twenty years, and receive in return free message rights for four hours in every twenty-four.

To work this Gisborne formed the "Eastern Telegraph Company" on September 25, 1855 to make the cable from the Dardanelles, for Constantinople, to Alexandria, with a monopoly of landing rights for cables to Alexandria from any place in the Turkish dominions. The raising of capital for this was difficult and the company was nearly abandoned in November 1855. However Gisborne negotiated a further concession on February 28, 1856 of the Pasha of Egypt for the company to make a telegraph in his territories between Alexandria, Suez and Kossier, and Kossier and Aden on the Indian Ocean, with a dedicated circuit for Indian traffic. There would be no Egyptian subsidy but all public messages would have to use the state telegraph offices. Even this enlarged concession failed to attract capital, although Gisborne retained the rights.

The company had to be reconstructed and a new concern, the *Levant Submarine Telegraph Company,* was created in London by Lionel Gisborne and R S Newall, the cable manufacturer. It obtained a new fifty-five year concession of the Ottoman Turkish government on January 10, 1857 to connect the capital Constantinople with its territories of Crete, Palestine and Egypt.

During June 1858 Newall laid 600 miles of underwater cable based on a hub on Scio (Chios). This Aegean island was connected by cable to the Dardanelles, where there was a land line to Constantinople; to Candia on the then-Turkish island of Crete; and to Smyrna, the main commercial city on the Ottoman Anatolian coast. Two further cables, made by Newall for the Greek government in June 1859, linked Scio to the Aegean island of Syrah, then the chief port for Greece, and from Syrah to Athens, the Greek capital. The principal office continued to be on Scio, with a director and six clerks, handling considerable traffic from Trieste in Austria through Athens to Smyrna and Constantinople. Adolf Buffleb, a former employee of Siemens & Halske, was the Levant company's General Manager and Electrician on Scio in the mid-1860s.

The Levant company planned, but failed after three attempts, to make a long cable from Candia to Alexandria, the port of the Ottoman Pashlic of Egypt, on the way to the Red Sea and India. It also planned, but failed to make, a cable from Candia to Jaffa in Palestine. In these R S Newall, then in financial difficulties after underwriting the costs of both the Levant and Red Sea cables, substituted a cheaper hemp and tar outer covering for the iron wire armour originally specified.

Six years later the Levant company, without Newall's help, contracted with the British government to lay a series of short cables, 74 miles in total length, between the Ionian islands of Corfu, Santa Maura, Ithaca, Zante and Cephalonia; to join at Corfu with the Extension company's cable.

During 1857 John Watkins Brett was in Vienna. On September 17, 1857 he announced that he had contracted with the Imperial & Royal Austrian government to build a cable from Ragusa on the Adriatic coast to Alexandria. In return he would receive £500,000 – two-thirds in cash for construction and one-third in shares of the *Austrian Submarine Telegraph Company* that was to be formed to work the circuits. The Austrian government would own the three-core cable but the company would have a 50 year concession to work it with the American telegraph for a guarantee of interest of 6% on its capital for twenty-five years. Official British and East India Company messages were to have priority before those of the Austrian, Ottoman and Egyptian governments; for which privilege the Treasury in London paid half of the guarantee of interest.

The actual line was intended to run from the port of Cattaro to Ragusa, Corfu, Zante, Candia and Alexandria in Egypt with a branch to Seleucia in Palestine. However the Ottoman authorities were not disposed to grant landing rights to Alexandria without a collateral cable connection with Constantinople; as agreed in Gisborne's original concession.

All this left the British government ostensibly with three choices through the Mediterranean to connect with India - 1) the Austrian route from Ragusa to Alexandria (which had a branch added to Constantinople at Ottoman insistence); 2) Gisborne's route from Constantinople by way of Candia to Alexandria; and 3) Brett's route from Cagliari through Corfu to Alexandria.

To add to this choice the Kingdom of Sardinia had already proposed on June 16, 1855, in return for a British subsidy, to make the cable from Cagliari to Malta and Alexandria. Gaetano Bonelli, the Sardinian director of telegraphs, repeated the offer on February 18, 1858.

Not being satisfied with this already confused state of affairs in 1859 the British government also sought tenders for a *direct* Malta to Alexandria three-core cable from the Mediterranean Extension Telegraph Company and from R S Newall & Company. Brett quoted between £440,000 and £450,000 with a 4½ % annual guarantee of interest. Newall refused to quote for a direct circuit but suggested a coastal cable joining the towns along North Africa for £460,000 with a new connecting wire from Malta to Cagliari for £65,000. The cost to the government for these would be over £20,000 a year in guarantees, compared with £15,000 a year for the Austrian route.

Not one of these government-sponsored lines was completed through to Alexandria!

East of Alexandria, guided by William O'Shaughnessy, its Superintendent of Telegraphs, the East India Company had already planned to build its own cable from Kurrachee in India to Bussorah or Kornah in Ottoman Turkey at the head of the Persian Gulf; a further riverine cable laid safely on the bed on the Tigris up to Baghdad; and a land line from Baghdad to Aleppo and Seleucia or Scutari on the Mediterranean Sea. As already noted, this line was later taken up by the Indo-Ottoman Telegraph Convention of 1860.

In competition the *European & India Junction Telegraph Company* was promoted in July 1856 to construct a land line from Seleucia on the Mediterranean coast to Aleppo and Jaber Castle and Kornah "to unite the lines of the English and continental telegraph companies with the cable of the Hon East India Company from Kurrachee to the head of the Persian Gulf". The government in London and the East India Company jointly offered a guarantee of interest of 12% (!) on its capital of £200,000. These generous terms were accepted by the company on February 3, 1857.

The British Parliament in London authorised the Company a capital of £200,000 in twenty thousand shares; half to be allocated to the scrip holders of the Euphrates Valley Railway Company, in proportion of one share of the telegraph company for every five shares in the railway. James Carmichael of the Magnetic and Submarine companies in Britain, and several directors of Indian railway companies were on the board of directors.

The British Treasury was to guarantee £12,000 annually for twenty-five years, or as much as necessary to make the dividend to 6 percent, with a similar amount from the East India Company, on its completion from Seleucia to Kornah, on the confluence of the Tigris and Euphrates rivers. The line was to follow the Euphrates Valley Railway from Seleucia and Aleppo to Jaber Castle, then down the Euphrates river to the Persian Gulf. There was then a line of steamers running down the two rivers to the Gulf.

It was dependent on the completion of the planned cable by the Levant Submarine Telegraph Company from Candia on Crete to Jaffa; lines from Beyrout to Seleucia; and a connection to the Mediterranean Extension Telegraph Company at Corfu; or of the Austrian cable from Ragusa to Crete, Alexandria and Jaffa. However, the Ottoman government rejected the company's proposals in the following September on the grounds that it was, effectively, a British government-owned concern. Instead the Turks decided in September 1857 to build their own line from Constantinople through Scutari, to Mosul and Bussorah on the Persian Gulf.

The East India Company announced on August 28, 1857 that it would guarantee £20,000 a year for a telegraph cable to India by way of the Red Sea. But it made it clear that it would not support financially any works west of Alexandria. In response to this the *Red Sea & India Telegraph Company* was promoted as the first attempt to create a 'British' route to India in August 1858 with concessions of the Ottoman Turkish government and its Pashlic of Egypt for through, independent traffic rights. The concessions were those obtained by Lionel Gisborne in 1855, with the support of R S Newall; in the same manner as the Levant Telegraph Company, with which the Red Sea concern intended to connect. It had a capital of £800,000 of which £700,000 was called-up for 200 miles of land line between Alexandria and Suez and 3,048 miles of underwater cable between Suez, Kossier, Suakin, Aden, Hallani (Kooria Mouria Islands), Muscat and Kurrachee in India in six segments. The British government provided shareholders with an unconditional 4½% guarantee for 50 years. Although not submitting the lowest bid the construction contract went to R S Newall & Company. The line to India was laid on April 12, 1860, but as with the contemporary circuits laid in the Atlantic using Newall's armour, the cables in the Red Sea failed. As they had worked sporadically the state had to continue to pay the guarantee. No traffic to London was ever achieved; although, rather prematurely, the Red Sea company announced on September 9, 1859 messages rates for twenty words from all the Electric Telegraph Company's offices in Britain to Suez, 17s 0d; Kossier £1 4s; Suakin £1 14s; Aden £2 13s; and to all stations in India £2 17s.

Lionel Gisborne, the projector, concession-holder and managing director of both the Levant and Red Sea companies died on January 8, 1861, age 38.

Lionel Gisborne and his brother Francis were not related to Frederic Newton Gisborne, who pioneered electric telegraphy in Newfoundland and Canada. Of closely similar ages the former were born and educated in St Petersburg, Russia, the latter in Broughton, Lancashire, England.

The Red Sea company, however, completed the essential two-wire land-line from Alexandria to Suez in April 1859 that was eventually transferred to a new *Telegraph to India Company*.

The *Telegraph to India Company* was formed in 1861 to assume the rights of the disastrous Red Sea & India Telegraph Company connecting Alexandria in Egypt with Bombay in India. It anticipated raising and repairing the later company's cables. It raised a small capital of £45,000 and despatched the Electric Telegraph Company's senior engineer, Latimer Clark, to Alexandria in January 1862, to be followed by a cargo of 200 miles of replacement cable sent around Africa by ship to Suez. With the eager co-operation of the Viceroy of Egypt, Clark quickly re-established the 220 mile two-wire land line from Alexandria though Cairo to Suez and repaired the initial 200 mile length of underwater cable from Suez to the Island of Jubal at the mouth of the Gulf of Suez by March 7, 1862. A marine telegraph station was established on Jubal to take messages for Europe from the passing steamers of the Peninsular & Oriental Steam Navigation Company travelling to and from India. This little outpost soon turned a profit, sending 2,457 messages by July 2, 1862, earning £170 a week. The Company anticipated using the Arabic language on its land lines and training Egyptians in the use of its instruments. The rest of the ambitions of the Telegraph to India Company proved fruitless - Clark and his assistant J C Laws spent many months surveying and lifting the old cables but found them all irreparable before returning to England in the summer. There was then a half-hearted attempt by Telegraph to India, late in 1862, to create the *Syrian Telegraph Company*, using land lines to connect its circuit at Cairo with El Arish and Beyrout, with a view to reaching Diarbekhar and Constantinople, raising another £50,000 in capital. That scheme came to nothing.

The abbreviated line from Alexandria to Jubal enabled the Telegraph to India Company to pay 5½% on its £45,000 capital. The 200 miles of additional cable intended for repairs were sold as surplus. In December 1862 the Jubal station was abandoned as the P&O steamers stopped calling, claiming that it was too dangerous an anchorage, and the Alexandria to Suez land line was leased to Glass, Elliot & Company, the operators of the British government's Malta to Alexandra cable for £2,500 per year.

Latimer Clark, surveyed the whole Red Sea route to India in 1862. Shortly afterwards he engineered the government's alternative cable through the Persian Gulf to India. In 1866 an *Oriental Telegraph Company*, the second concern of that name, proposed to take over the Indian rights but it did not proceed beyond issuing a prospectus. The Suez land line, later still, was acquired by the Eastern Telegraph Company.

With the failure of the multitudinous alternatives the British government paid £436,283 for a 1,400 mile inshore underwater cable between Malta, Tripoli, Benghazi (these latter being Ottoman Turkish cities in North Africa) and Alexandria, opened on September 1, 1861, leasing its operation to Glass, Elliot & Co., its constructors.

The Malta & Alexandria telegraph was project managed by Lionel Gisborne and Henry Charles Forde, a civil engineer. They divided the work between the Gutta-Percha Company (the insulated core, £133,841), Glass, Elliot & Company (armouring, shipping and laying the cable, £252,205), and Siemens & Halske (landlines £1,682, instruments, £4,902). Gisborne and Forde and Siemens & Halske took an additional £18,811 for "superintendence". The government in Britain contributed £261,247 and British India £174,493 to the cost. Message rates were 30s 0d for twenty words from Malta to Alexandria; by March 1862 it was carrying 6,000 despatches a month, which earned £12,000. The land circuit through the strife-torn Italian states was slow and inaccurate; the Italians refused to allow Glass, Elliot to use skilled English operators.

Communication was disrupted on May 30, 1864 when the powder magazine at the Ottoman arsenal in Tripoli blew-up, killing "only 150" soldiers. Glass Elliot's telegraph station was levelled but it proved possible to rescue the instruments from the debris.

The problems with the line through Italy from France to the Malta cable continued. The Italians had dismissed their English-speaking clerks in 1864. Disputed messages sent by the Italian circuits between London, Egypt and the Levant multiplied; "as there were so many required their lines were quite 'blocked-up' by them". Instead of addressing the problem the Italians responded by abolishing cheap-rate repetition on November 14, 1864, making recipients pay the full tariff for a new message and a reply.

The government's Malta - Alexandria cable and those of the Extension and Levant companies were acquired in 1868 by the newly formed *Anglo-Mediterranean Telegraph Company* which was to connect Britain with Egypt by the most direct route and to consolidate the fragmented telegraph interests in the Middle Sea. It also had leased a 1,300 mile land line from Modica in Sicily to Susa in Savoy on the Italian-French border to avoid use of troublesome Italian domestic circuits.

Table 32

Cable Company Stock & Share Prices 1861 - 1868

Only companies in which stock or share trades occurred in the period are included in these lists

From 'The Electrician'

For week-ending December 20, 1861

	Paid	*Range*
Red Sea & India Telegraph Company		
Shares	£20	£18 to £19
Mediterranean Extension Telegraph Company		
Shares	£10	£3½ to £4½
Telegraph to India Company		
Shares	£1	13s 6d to 22s 6d

For week-ending October 24, 1862

	Paid	*Range*
Mediterranean Extension Telegraph Company		
Shares	£10	£3 to £4
Telegraph to India Company		
Shares	£1	5s 0d to 10s 0d

For week-ending May 1, 1863

	Paid	*Range*
Mediterranean Extension Telegraph Company		
Shares	£10	£3 to £4
Telegraph to India Company		
Shares	£1	5s 0d to 12s 6d

From 'The Investors' Manual'

For month ending October 15, 1864

Capital	*Paid*	*High*	*Low*
Mediterranean Telegraph Company			
12,000 Shares	£10	£3¾	£4

For month ending October 28, 1865

Capital	*Paid*	*High*	*Low*
Allan's Trans-Atlantic Telegraph Company			
15,000 shares	£8	£4 ½	£2½
Atlantic Telegraph Company			
350 shares	£1,000	Last trade £600	
5,634 shares	£20	Last trade £4 18s	
Mediterranean Extension Telegraph Company			
12,000 shares	£10	£4¼	£3¾
3,200 shares	£10	Last trade £10	

From 'The Railway News'

For week-ending October 27, 1866

	Paid	*Range*
Anglo-American Telegraph Company		
Shares	£10	£15¾ to £15¾
Mediterranean Extension Telegraph Company		
Shares	£10	£2 to £3

From 'The Investors' Manual'

For month ending October 26, 1867

Capital	*Paid*	*High*	*Low*
Anglo-American Telegraph Company			
60,000 shares	£10	£17⅞	£17⅜
Atlantic Telegraph Company			
£462,860 stock	£100	£35	£25
600,000 shares	£100	£77½	£68
Mediterranean Extension Telegraph Company			
12,000 shares	£10	£2½	£1¾
3,200 shares	£10	No market	
Telegraph to India Company			
45,400 shares	£1	Last trade 8s 0d	

For month ending October 31, 1868

Capital	*Paid*	*High*	*Low*
Anglo-American Telegraph Company			
60,000 shares	£10	£22¼	£20¾
Atlantic Telegraph Company			
£462,860 stock	£100	£31	£32
600,000 shares	£100	£84	£78
Anglo-Mediterranean Telegraph Company			
26,000 shares	£10	£10¼	£9¾
Mediterranean Extension Telegraph Company			
12,000 shares	£10	£4⅝	£3⅞
3,200 shares	£10	No market	
La société du câble transatlantique Français			
50,000 shares	£8	£5 ½	£2
Telegraph to India Company			
42,400 shares	£1	Last trade 8s 0d	

Of note is the expansion and increased sophistication of the market for intercontinental cable companies between 1861, where there was little trade in such risky ventures, and 1868, when there was substantial confidence in their value and profitability

---

In July 1867 the proprietors of the Anglo-American Telegraph Company, flush with the success of their two long cables between Europe and America, launched the *Anglo-Indian Telegraph Company,* looking for a capital of £1,000,000 to connect Britain with Bombay, by way of Italy, Egypt and Aden. It came to nothing.

The secure cable route to India and Australia was eventually completed in 1872 by a series of British firms that soon merged to form the *Eastern Telegraph Company*:

• *Anglo-Mediterranean Telegraph Company,* laying a direct cable from Malta to Alexandria

• *British Indian Telegraph Company,* laying a cable from Suez to Aden and Bombay

• *Falmouth, Gibraltar & Malta Telegraph Company* – laying a cable to connect those places

In 1872 the Eastern Telegraph Company with a paid-up capital of £3,400,000, owned 8,860 miles of cable, leased 1,200 miles of land line and had 24 stations.

The Eastern also acquired in 1872 the *Marseilles, Algiers & Malta Telegraph Company*, a British concern that had finally completed the difficult cable between France and its principal colony of Algeria, with an extension onward to Malta for British use. Many attempts had been made to join Marseilles with Algiers by telegraph but success only came coincidentally with the end of the French Empire in 1871. Of the 300 mile cable, 86 miles had been made by W T Henley in 1867 to cross the Behring Strait between Siberia and Russian America (Alaska) before the project was abandoned. Nothing was wasted!

Separately but in connection with the Eastern company by 1872 were the:

• *British Indian Extension Telegraph Company* laying a cable from Madras in India to Penang and Singapore on the Malay peninsular

• *British-Australian Telegraph Company*, laying cables from Singapore to Batavier, from Java to Sumatra, and from Banjoewangie to Port Darwin, Australia, as well as long land lines across the Dutch islands of Java and Sumatra

• *China Submarine Telegraph Company*, laying a cable from Singapore to Hong Kong

These three soon consolidated into one concern.

Telegraph messages from London to India were latterly subject to a revenue-sharing pool; "Via Eastern", the cable, took 60%, whilst "Via Teheran", the Indo-European land line, took 40% of the income.

America

The first proposal for connecting Europe and America electrically was that of the *Ocean Telegraph Company*, projected in London in the summer of 1852 by C W and J J Harrison of Surrey in England. It had a capital of £500,000 and proposed an elaborate route using a series of cables from Britain to North America. Its prospectus showed that it intended to lay a cable from Caithness in Scotland to Kirkwall on the Orkneys, another to Lerwick on the Shetlands, then to Shorshaven on the Faroes, to Reikiavik on Iceland with a land-line to Sneefelds, a cable to Graah's Island in Kioge Bay in Greenland, a land-line to Juliana's Hope, crossing the Davis Straits from there to Byron's Bay in Labrador, with a long land-line across Quebec and Lower Canada to the United States. The appalling terrain of the route suggests the use of an atlas in its planning rather than survey on the ground. It was to have a total circuit of 2,500 miles of which from 1,400 to 1,600 were to be submarine. A cable branch was proposed from the Shetlands to Bergen in Norway with a land-line to Christiania, Stockholm, Gothenburg and a short cable to Copenhagen. The Ocean Telegraph Company intended to acquire a Royal Charter to protect its shareholders, but although it was periodically mentioned in London and Washington until 1856, when it sought the same subsidy as the Atlantic Telegraph Company, it did not proceed beyond publicity.

The brothers Charles Weightman Harrison and Joseph John Harrison carried on a very large family business in the way of nursery- and seeds-men at Larkfield Lodge, Richmond, Surrey, and Downham, Norfolk, which had been selling florists' flowers and herbaceous plants nationally since 1834; in connection with which they also published 'The Floricultural Cabinet' magazine. They were more than electrical dilettantes, their first patent was provisionally registered on October 15, 1852 "for the invention of improvements in protecting insulated telegraphic wires" which led to their interest in ocean telegraphy. The brothers acquired further patents for an electro-motor in 1854, for a form of electric light in May 1857 and insulation for telegraph wire in October 1857. They sought capital in 1857, unsuccessfully, for a joint-stock company to exploit the electro-motor. C W Harrison went on to become a dedicated electrical engineer, engaging in the introduction of electric light in the 1870s, before becoming a coal exporter in South Wales.

The *Atlantic Telegraph Company* was projected in a prospectus issued on November 6, 1856 by Cyrus Field, J W Brett, E O W Whitehouse and C T Bright to construct a telegraphic cable between Ireland and Newfoundland. The Company obtained a Special Act of Parliament with a capital of £350,000 in 350 shares each of £1,000. The Company had offices at 22 Old Broad Street, London EC and 10 Wall Street, New York. As well as Brett and Bright, the Magnetic company contributed George Saward as secretary.

Cyrus Field was a dynamic papermaker from New York in America who became the cable's leading and most determined protagonist. John Watkins Brett had been involved in promoting submarine telegraphy since 1845. Edward Orange Wildman Whitehouse had devised and patented a new telegraph apparatus that could connect the continents; demonstrated it to Brett and had it endorsed by Field and Morse in America. Charles Tilston Bright was then engineer to the British & Irish Magnetic Telegraph, and without question was the most experienced cable engineer in the world.

The British & Irish Magnetic Telegraph Company took a majority of the shares sold in Britain. It also built a new overhead, roadside circuit from its line at Killarney in Ireland to serve the proposed new cable-end on Valentia Island.

The British and United States Governments each guaranteed the Company £14,000 per annum once the cable was successfully completed, reducing to £10,000 each when the dividend achieved 6% per annum. A tariff of £2 10s for twenty words between London and New York was anticipated to be necessary. In return for the subvention the Company was obligated to carry government traffic free-of-charge.

Unlike most companies mentioned in this work, the story of the Atlantic and its successor is one of the management of technology rather than commerce.

Although the Americans subscribed just eighty-eight of the 350 shares they had a disproportionate intervention in the great cable's construction and laying. This led to a catastrophic series of failures in project management; at the Americans' insistence, to accelerate laying, the cable manufacture was rushed through without quality controls; storage facilities were unprepared and inadequate; the manufacturers, R S Newall in Gateshead and Glass, Elliot in London, were given poor specifications which led to the winding of the armour from one being clockwise and that from the other anti-clockwise; and proper testing of the insulation was omitted. There was no co-ordination of the electrical apparatus, so that the operators in Newfoundland did not know what those in Ireland had, or what electrical sources they used.

Not *all* of the subsequent failures can be blamed on the Americans however. The engineer and promoter, the youthful Charles Bright, whose role clearly should have involved the specification and management of the cable, exercised a distant responsibility. He, allegedly, proposed – based on his own experience and on the scientific recommendations of Thomson and Faraday, that an expensive thick copper core worked by small galvanic batteries ought to be used. Instead the views of Wildman Whitehouse, supported by Cyrus Field and S F B Morse, held sway and a cheaper thin copper core with instruments driven by powerful induction coils was adopted. Bright's actual contribution seems to have been limited to assisting in the design of the cable-laying machinery, principally the work of the mechanical engineer, Charles de Bergue in Manchester. Just about every other matter was left to Whitehouse.

Manufacture of the core and armour of the 2,700 miles of cable still took from February until July 1857.

The cable was laid by two ships starting from the middle of the ocean sailing east and west. After an abortive start on August 7, 1857, a cable was completed between Valentia Island off Ireland and Heart's Content Bay, Newfoundland on August 5, 1858. The insulation of the cable failed irreparably on September 1, 1858.

The Atlantic Telegraph Company had to raise a further £112,860 in share capital in London during 1858 to cover the outstanding costs of its expeditions. It then had to find £75,000 to release itself from several obligations that it had entered into with "third parties", the four promoters in London and New York.

The four promoters had awarded themselves one-half of all profits above 10% for their efforts. This was commuted by the Board in 1858 to £75,000 in new shares: Field 37½%, Brett 37½%, Bright 16²/₃% and Whitehouse 8¹/₃%; all pocketed as if fully paid-up.

There was a Committee of Inquiry commissioned by Parliament in London. The many engineers and scientists consulted reported in detail on the technical failings, proposed substantial remedies and otherwise endorsed the feasibility of the cable in 1861.

The *North Atlantic Telegraph Company* was proposed by the American T P Shaffner, a former member of the Morse Syndicate, to adopt the island-hopping route of the Ocean Telegraph Company from Scotland to Orkney, the Faroes, Iceland and Greenland to Labrador or to Belle Isle on mainland Canada, after the failure of the first Atlantic cable. Shaffner launched the company in London and New York in 1859; however confidence in the ultimate success of the long cable was such that it survived only as a shell without capital.

James Wyld, MP and geographer to the Queen, had first acquired a concession of the Danish government for landing rights on Iceland and Greenland in 1852. He was displaced by Shaffner's offer, after promoting the *British & Canadian Telegraph Company* with the civil engineer, Thomas Page, but he contrived to re-acquire the rights in autumn 1865.

The "Northern Line", as it was called, was taken very seriously after the failure of the 1857 Atlantic cable. James Wyld promoted Acts of the British Parliament and the Canadian Legislature that were passed to raise capital to build the line as the *British & Canadian Telegraph Company* (*Northern Line*) during 1859 and 1866. The government in London authorised the 'British North Atlantic Telegraph Expedition' led by the Arctic explorer, Captain Sir Leopold McClintock RN, which set off in August 1860 on HMS *Bulldog*. Suitable points for cable landing were discovered at Thorshaven and Westermanshaven on the Faroes, at Reikiavik on Iceland, at Julianshaab on Greenland, and at Hamilton's Inlet on Labrador in Canada. But it came to nothing as events finally overtook the concern…

The domestic service providers were fully aware of the potential of the American market. From May 1860 the British & Irish Magnetic Telegraph Company worked in concert with the Atlantic Royal Mail Steam Navigation Company an interim scheme to have public telegraph messages put aboard its heavily-subsidised liners working to Halifax and New York at Galway in Ireland. This saved many days in transit time, particularly as the ships would receive messages almost up to the moment of sailing. It was extended to the ports of Queenstown and Londonderry when the two major steamship lines, Cunard and Inman, agreed to participate. Their fast vessels picked-up and dropped news and public telegraph messages in an exciting procedure using brightly-coloured, waterproof metallic canisters and nets, whilst merely slowing down their speed. The Electric Telegraph Company began a similar service to Canada and America from Queenstown in 1862.

By 1863 the Atlantic Telegraph Company had been reorganised. The Americans were entirely displaced from the Board of Directors, which now comprised directors of the Electric and Magnetic companies and representatives of the London investors. The technical department was in the hands of Cromwell Varley, who replaced Charles Bright, supported by a Consulting Committee consisting of William Fairbairn, William Thomson, Charles Wheatstone and Joseph Whitworth.

In America, somewhat forlornly, advocacy of the cable was left in the hands of Cyrus Field, who never lost his confidence in the project. He travelled repeatedly across the ocean between New York and Liverpool to encourage its prospects, and ensured that the long circuit between desolate Newfoundland and the United States, which he owned, was maintained ready for connection.

The Company issued a new preference capital in London of £600,000, on which the British government guaranteed an 8 per cent dividend "on the completion and during the working of the Cable". Rather than the original £1,000 certificates the capital was democratically divided into £5 shares. Profits above 8 per cent were to go to paying 4 per cent on the 1857 shares, after that to be divided *pro rata* between the two stocks.

The long and bloody war in America had necessarily postponed progress on the Ireland to Newfoundland cable but in June 1865 further additional capital for its resurrection was arranged by the Atlantic Telegraph Company by means of £250,000 in 8% preference shares. This had to be undertaken through the *Credit Foncier & Mobilier of England*, of 16 and 17 Cornhill, London, the largest of the new financial intermediaries set up solely to promote joint-stock operations after the Companies Act of 1862. One-fifth of the new shares were allocated to shareholders in the Credit Foncier and Mobilier, one-fifth to those of the Imperial Mercantile Credit, one-fifth to the Atlantic Telegraph Company, one–fifth to the Telegraph Construction & Maintenance Company, and one-fifth to the public. The chairman of the Credit Foncier & Mobilier, James Stuart Wortley, was also chairman of the Atlantic Telegraph Company. Its principal personality was Albert Grant, the greatest speculator of the age, who failed catastrophically in the 1870s. The finance company, of course, took a large percentage of the stock launch in fees and discounts for organising the placement.

The newly created firm, the *Telegraph Construction & Maintenance Company*, a merger of Glass, Elliot & Company and the Gutta-Percha Company, engaged to lay the Atlantic Telegraph Company's cable. Bearing in mind scientific opinion special care was applied to the manufacture and materials of the cable and TCM took entire responsibility for project management. The cable was to be laid in one length which required the employment of the only vessel capable of carrying such a load, the 18,000 ton *Great Eastern*.

The *Great Eastern* set off from Valentia on July 15, 1865 steaming west paying-out cable. On August 2 the cable broke in the deepest water. The site of the loss was optimistically buoyed and the ship returned to England.

The Atlantic Telegraph Company immediately proposed to raise yet more capital to complete the great project. It was to do this through the issue of preference shares bearing interest of 12%! However its constitution, embedded in its 1856 Act of Parliament, did not authorise any further issue of shares or creation of debt above that already existing and it stalled.

James Wyld reappeared like the genie from the lamp in the autumn of 1865, along with Thomas Page, with a revival of the *North Atlantic Telegraph Company*, promoting the "northern line" through Iceland and Greenland. He employed Lewis Cook Hertslet and Nathaniel John Holmes, two former colleagues of Page's, to manage, to engineer and to promote 'his' new North Atlantic company throughout the country.

The Great Northern Telegraph Company of Copenhagen eventually took over the Danish concession in 1869, but did not proceed with it.

Confidence in the direct cable was sufficient for contributors to be found to raise a further £250,000 through a new concern, the *Anglo-American Telegraph Company*, quickly formed under the liberal provisions of the Companies Act of 1862. It was a new creation unrelated to the Atlantic concern, and selected the old established firm of American merchants and bankers, J S Morgan & Company, of 22 Old Broad Street, London, to manage its flotation. This firm's board, once again excluding any American influence, except the London-domiciled George Peabody, included Richard Glass and Daniel Gooch of Telegraph Construction & Maintenance, as well as Henry Bewley of the old Gutta-Percha Company. The new Anglo-American company, in which (the reader is asked follow closely here) the Telegraph Construction & Maintenance Company was by far the majority shareholder, was contracted to act as agent of the Atlantic Telegraph Company in laying and operating the cable. In return, Anglo-American was to receive £125,000 annually from the cable's revenues and another £25,000 annually from the revenues of the New York, Newfoundland & London Telegraph Company, which owned the landing rights in North America – a pleasing 25% reward for the risk.

Their confidence, or possibly, their arrogance, was such that Telegraph Construction & Maintenance not only took the contract for making and laying the cable but provided 2,400 miles of new cable in addition to the 1,070 miles left from the previous year, enough for *two* spans of the ocean, a total of 4,000 tons.

Once again the *Great Eastern* steamed west from Valentia on July 13, 1866 paying-out as she went and arrived at Heart's Content Bay, Newfoundland on July 27. The Atlantic cable was complete.

On August 31, 1866 the *Great Eastern* had returned to the mid-Atlantic and once there its crew found and grappled the 1865 cable! TCM joined it to the remaining wire in its hold and the *Great Eastern* returned to Heart's Content on September 7. The second Atlantic cable was complete.

The Telegraph Construction & Maintenance Company received £190,000 for its work and £55,000 paid in quarterly instalments to guarantee that the two cables remained in good working order. It was also, remember reader, the largest shareholder in the Anglo-American Telegraph Company, which operated the two cables.

With the success of the two cables the old Atlantic Telegraph Company, on September 9, 1866, attempted to modify its authorising Act of Parliament and raise £1,200,000 in new capital with which to buy-out the rights leased to Anglo-American. It failed to find backers in the prevailing financial climate and was condemned to being a vassal of the latter company.

By 1868 the Anglo-American Telegraph Company was paying a $33^1/_3$ per cent per annum dividend. The confidence of the original promoters of 1856, in particular the long-suffering Cyrus Field, was vindicated.

But Anglo-American's confidence overreached itself when it promoted the *Anglo-Indian Telegraph Company* to lay a series cables from Italy through Egypt to India. It could not raise the immense capital required.

La société du câble transatlantique Français was promoted in 1867; despite its title it was created under the Companies Acts 1862 and 1867 in London as an English joint-stock company. It was better known as the French Atlantic Telegraph. The *Société du câble* had a capital of £200,000, issued in ten thousand shares of £20 or 500 francs, to make a cable between Brest in France and the tiny French island enclaves of Sainte Pierre et Miquelon, off Canada, connecting hence by another cable to the United States at Duxbury, Massachusetts.

Paris, like London, was not disposed to give any control of the cable to the United States by landing it on their territory. Not least because of their unwillingness to contribute to the main cost of either project, as well as the belligerence of its government.

The twenty-year concession for the sole rights to the cable was granted by the Emperor to Emile Erlanger and Julius Reuter on July 6, 1868.

Times had changed since 1850 when the Submarine Telegraph Company was created to connect England and France. The ambitious French Empire of Napoleon III needed British capital and technology in this and many other industrial and commercial enterprises. The Anglo-Saxon and German states were regarded as imperial competitors, but unlike France they had experienced manifold industrial expansion. As well as needing capital from London, a market then in chaos, it had to commission English engineers and electricians, mostly from the Electric & International Telegraph Company and the Telegraph Construction & Maintenance Company. It also needed the *Great Eastern*.

The *Société*'s constitution was complex. There was an "Honorary Committee in France", that represented the Imperial government; the Foreign Minister and three Senators. It addition there was a Board of Directors in Paris under *Contre-Amiral* Lacapelle, composed of bankers and investors, including Emile Erlanger, loan contractor to the Confederate States of America during their Civil War. Of course, there was a Board of Directors in London, chaired by Robert Lowe, MP. This, too, consisted of investors rather than those from the telegraph industry, including Julius Reuter and the banker William Henry Schröder. Curiously, John Henry Schröder & Company in London had also been a lead banker to the Confederate States.

The 'Confederate' connection with the Great Cable was of long standing. Among the few advocates in Washington of government support for the 1857 expedition were Senators Judah Philip Benjamin of Louisiana, and Stephen Russell Mallory of Florida, who became, respectively, Secretary of State and Secretary of the Navy in the government of the Confederate States. In 1866 J P Benjamin was a lawyer of some eminence practising in London.

The French Atlantic Telegraph had offices at Bartholomew House, Bartholomew Lane in the City of London and at rue Taitbout 20 in Paris. Its "General Superintendent" was James Anderson who had managed the two successful Atlantic cables and who was a director of the British-Indian Submarine Telegraph Company. William Thomson, Latimer Clark and Cromwell Varley, among other British technicians, controlled the mechanical and electrical aspects – all remarkably safe pairs of hands. Robert Slater was company secretary.

Its manufacture and laying by Telegraph Construction & Maintenance and the *Great Eastern* went without hitch. The French Atlantic Telegraph, the third Atlantic cable, was completed in July 1869 and was the longest in the world until the Pacific was spanned.

The advance of technology was such that Cromwell Varley was able to have this exceptionally long cable 'self-repair' itself using the current to seal damaged insulation; prolonging its life by several years.

As the Electric and Magnetic companies in Britain were contracted to use the cables of the Anglo-American Telegraph Company, the *Société du câble* agreed with the Submarine Telegraph Company and the United Kingdom Electric Telegraph Company for them to send and receive messages for America from all of their offices in England and Scotland. This brought about an instantaneous reduction in the cable tariff when the longest of all circuits opened on Sunday August 15, 1869!

With the collapse of the French Empire, the Anglo-American Telegraph Company acquired the capital of the *Société du câble trans-atlantique Français* in 1872. After laying a short cable across the Channel to connect the West-of-England with Brest it worked the cable as one with its system, to the chagrin of the French.

The *Great Eastern* steamship was to lay five successful cables across the Atlantic Ocean between 1866 and 1874. In between which expeditions she also steamed around the Cape of Good Hope in Africa to India, to lay the cable between Bombay and Aden and into the Red Sea during February 1873, to complete the submarine line between London and Calcutta.

The United States had to wait until the end of the century to have an Atlantic cable land on its territory. Both Britain and France ensured that the western ends of all their cables landed in Canada until then; with only secondary cables or land lines connecting to America.

Smart Cyrus & the Electric Medal

"The American Parliament has passed a resolution of thanks to Mr Cyrus Field, for having made the Electric Telegraph between England and the States, and has ordered a Gold medal to be struck, in honour of Mr Field's single-handed feat. This is quite right. Punch would be the last man to deny that "alone Field did it". We are not quite sure whether he let the water into the space called the Atlantic Ocean, but we know that he invented electricity and telegraphy, and after years of solitary experiments, perfected the Cable which is now laid. He carried it in his own one-horse gig from Greenwich to Ireland, and having previously constructed the machinery for paying it out, launched the 'Great Eastern' by his unaided efforts, lifted the rope on board, and consigned it to the deep with his own hands. Mr Field tied on the Newfoundland end with great neatness, and then ran on with the continuation, and never sat down, nor even blew his nose, until he despatched the first message. Therefore, the medal is his, and the reverse also. But in concession to the ignorant prejudices of the world, might not just the most modest space, say the rim, bear in faint letters the names of Gisborne, Glass, Elliot, Anderson, Canning, and one or two more, who stood by, with their hands in their pockets, and saw the smart Cyrus perform the Herculean task. Anyhow, we do give the ground on which this end of the Cable rests. But we would not press the request, if it would hurt American feelings."

Mr Punch in March 16, 1867 on another manifestation of the 'Morse Syndrome'

Politics and Telegraphy

In May 1865 the French Foreign Ministry organised an International Telegraphic Conference in Paris from amongst the state monopolies in Europe; Austria, Baden, Bavaria, Belgium, Denmark, France, Greece, Hamburg, Hanover, Italy, Norway, Netherlands, Portugal, Prussia, Russia, Saxony, Spain, Sweden, Switzerland, Turkey and Württemberg. This was a political-diplomatic initiative between states intended to integrate the decisions of the Paris and Berlin Conventions of 1855. It forbad public telegraph companies from its deliberations so the United Kingdom and the United States, without state monopolies, were excluded from this and subsequent telegraphic conferences for years.

The Conference's outcome was a general system of price-fixing based on a zone tariff between the nations, and the setting of the French franc as the common accounting currency. By 1865 the American telegraph was already the standard apparatus in Europe so little technical decision-making was necessary; the Hughes printing machine was added to the international standard by 1872. A substantial permanent bureaucracy was inevitably created at Bern in Switzerland after the final eclipse of the French empire in 1870.

It would, of course, be cynical to suggest that the exclusion of the United Kingdom from the International Telegraph Conference influenced the government's intention to appropriate the companies.

The short-sighted decision to exclude public telegraph companies was immediately undermined by British capital financing cross-Europe land lines to India, the Danish lease of lines to China and Japan, and by the immense growth of company-owned underwater intercontinental cables that circumvented state monopolies. It was only at the International Telegraphic Conference in Rome in 1871 that public telegraph companies were permitted to contribute to but not to vote on the deliberations.

Table 33

The Cable Companies

Compiled by Sir James Anderson in 'Statistics of Telegraphy' 1872

1] Anglo-American Telegraph Company
Capital £1,675,000, dividend 10%, two cables, Valentia to Heart's Content, 3,750 miles

*2] Anglo-Mediterranean Telegraph Company**†
Capital £430,000, dividend 15%, two cables Malta to Alexandria, 1,900 miles

3] British Australian Telegraph Company
Capital £650,000, dividend 5%, two cables, Singapore to Batavia, Banjoewangie to Port Darwin, 1,639 miles

4] British-Indian Extension Telegraph Company
Capital £468,500, dividend 8%, two cables, Madras to Penang, Penang to Singapore, 1,809 miles

5] British-Indian Submarine Telegraph Company†
Capital £1,187,500, dividend 7½%, two cables, Suez to Aden, Aden to Bombay, 3,283 miles, land lines (2) Alexandria to Suez, 454 miles

6] China Submarine Telegraph Company
Capital £534,600, dividend 6%, two cables, Singapore to Saigon, Saigon to Hong Kong, 1,506 miles

7] Cuba Submarine Telegraph Company
Capital £160,000, dividend 0%, one cable, Santiago to Batabano, 520 miles, land line Batabano to Havana, 30 miles

8] Falmouth, Gibraltar & Malta Telegraph Company†
Capital £700,000, dividend 7¾%, four cables, Porthcurno to Lisbon, Lisbon to Gibraltar, Gibraltar to Villa Real, Gibraltar to Malta, 2,430 miles

9] Great Northern Telegraph Company of Copenhagen
Capital £400,000, dividend 8⁷/₈%, six cables, Newbiggin to Sondervig, Hirtshalts to Arendal, Moen to Bornholm, Bornholm to Libau, Peterhead to Egersund, Grislehamn to Nystad, 1,070 miles

10] Great Northern Telegraph China & Japan Extension Company
Capital £600,000, dividend 0%, three cables, Vladivostok to Nagasaki, Nagasaki to Shanghai, Shanghai to Hong Kong, 2,139 miles

11] Government Indo-European Telegraph
Five cables, Fao to Bushire, Bushire to Jask (2), Jask to Gwadur, Gwadur to Kurrachee, 1,721 miles

12] Indo-European Telegraph Company
Capital £425,000, dividend 0%, land line Emden to Teheran, 5,360 miles

13] Marseilles, Algiers & Malta Telegraph Company†

Capital £200,000, dividend 4%, two cables, Marseilles to Bona, Bona to Malta, 825 miles
14] Mediterranean Extension Telegraph Company
Capital £152,000, dividend 3%, three cables, Alga Grande to Malta, Pozallo to Malta, Otranto to Corfu, 189 miles, land lines, Corfu to Sidari, Alga Grande to Modica, Pozallo to Modica, 37 miles
15] Panama & South Pacific Telegraph Company
Capital £320,000, dividend 0%, one cable planned, Panama to Tumbez, 1,100 miles
16] Société du câble transatlantique Français
Capital £1,250,000, dividend 12%, three cables, Salcombe - Brest - St Pierre - Duxbury, 3,433 miles
17] Submarine Telegraph Company between Great Britain and the Continent of Europe
Capital £418,640, dividend 15%, seven cables, Dover to Calais, Dover to La Panne, Ramsgate to Ostend, Folkestone to Boulogne, Beachy Head to Dieppe, Beachy Head to Havre, Jersey to Pirou, 343 miles total plus it managed the cables from Lowestoft to Zandvoort (2) and Lowestoft to Norderney
18] West India & Panama Telegraph Company
Capital £598,910, dividend 0%, fifteen cables, Santiago to Jamaica, Jamaica to Aspinwall, Jamaica to Porto Rico, Porto Rico to St Thomas, St Thomas to St Kitts, St Kitts to Antigua, Antigua to Guadeloupe, Guadeloupe to Dominica, Dominica to Martinique, Martinique to St Lucia, St Lucia to St Vincent, St Vincent to Grenada, Grenada to Trinidad, Trinidad to Demerara, 2,688 miles total, and land lines across the islands, 275 miles

Total length of cables: 37,795 miles

* The Anglo-Mediterranean company also owned 1,300 miles of landline from Sicily to France
† These formed the Eastern Telegraph Company

12.] **THE COMPANIES' FOREIGN OPERATIONS**
Since the separate British companies used differing systems no direct electrical connection was possible between them or consequently overseas; foreign traffic therefore involved transcription, i.e. manual 're-writing', just as the original German-Austrian Telegraph Union did. However by the year of the continent-wide conventions, 1855, the European states commonly used the basic American telegraph for international traffic, adopting what came in time to be called the 'European Alphabet' or 'Continental Cipher' for messages. This code, actually a cipher, was markedly different from the American code in allowing for diacritical marks and other complexities.

The continental telegraph system remained electrically incompatible with British domestic telegraph apparatus. However, the Submarine Telegraph Company from 1855 maintained a direct electrical connection between its offices in London and Paris and Brussels using the American key-and-writer. It had previous used the two-needle instrument over the same circuits. It also connected with the Magnetic's circuits at their common office in Cornhill, London, by which transcription from all of that concern's country-wide offices could be managed internally; they united head offices at Threadneedle Street in 1857. Transcribed messages off the Electric company's circuits for the 'French' route were received on account by hand from Founders' Court.

Table 34

Prices in Europe 1854
The cost of a twenty word message from Europe in 1854 in Thalers and Gröschen

Via >	Hague	Ostend	Calais	Brussels
Königsberg				
To London	7-5	9-10	10-0	-
To Glasgow	7-5	11-2	12-2	-
Berlin				
To London	5-25	8-0	8-20	-
To Glasgow	5-25	9-22	10-22	-
Munich				
To London	5-25	7-10	8-0	8-1
To Glasgow	5-25	9-2	10-2	10-3
Trieste				
To London	6-15	8-20	9-10	9-11
To Glasgow	6-15	10-12	11-12	11-13

The Hague route used the new cables of the Electric Telegraph Company; the Ostend, Calais and Brussels routes used the circuits of the Submarine Telegraph Company and the British Telegraph Company. Königsberg was Prussia's most eastern city, near to Russia. Trieste was the principal port for Austria-Hungary.

One thaler was worth about three shillings

Statistics from 'Der Telegraph als Verkehrsmittel', Dr Karl Knies, Freiburg, 1857

The Electric company's cables to Holland became operational in 1853 with a direct electric connection between London and Amsterdam via The Hague using its own needle instruments. Little or no transcription traffic was henceforth sent via the Submarine company's French and Belgian cables. Transcription from the British to the continental system then initially took place at Amsterdam; but in 1854 Siemens American inkers or writers and in 1855 Varley's double-keys were installed at Founders' Court for submarine traffic. The Company now had electrical connection with all of the continental and eastern circuits from London, reducing the need for error-inducing transcription of messages by foreign clerks. On the opening of this line in June 1853 the Electric adopted the "European Alphabet", the dot-and-dash cipher used on the continent, for all of its printers and for the single-needle instruments.

International messages were a major source of income – not being subject to as much public and press scrutiny as domestic traffic. There were contractual relationships between the continental cable companies and the telegraph companies. The Magnetic had sole rights to use the Submarine company's cables to France, Belgium and Germany, but only benefited from the domestic segment of the message, the Submarine company having the lion's share. The Electric had its own cables (formerly the International company's) to Holland – so profitable that they were dubbed the "sheet anchor" of the business in the late 1850s. It also contracted, along with the Indo-European Telegraph Company, to use the new Norderney cable for public messages to Europe and the Far East; Julius Reuter retaining the rights for news messages. The new Norderney cable was already paying 19% on its capital for Reuter in 1868.

Table 35

The Submarine Telegraph Company in Europe

Rates from France in June 1854 for a twenty-five word message. The Company offered rates to twelve stations in "England" with five tariff zones

Zone 1 – 10 francs (London and Dover only)
Zone 2 – 11.25 francs
Zone 3 – 12.50 francs
Zone 4 – 13.25 francs
Zone 5 – 16.25 francs

Similar messages to Ireland cost from 16.25 to 22 francs. Each extra ten words were at half-tariff.

Message Rates from Belgium in 1854 were broadly similar, but for twenty words, charged in addition to the domestic tariff:

Zone 1 – Ostend to London or Dover, 10 francs
Zone 2 – Dover to Birmingham, Brighton, Cambridge, Gloucester, Portsmouth, Southampton or Yarmouth – 2 francs 25 cents *extra*, and 1 franc 62½ cents for each additional ten words.
Zone 3 – Dover to Hull, Manchester, Newcastle-upon-Tyne, Derby, Edinburgh, Glasgow or York, 6 francs 50 cents *extra*, and 3 francs 25 cents for each additional ten words.
Delivery was charged at 1 franc 25 cents *extra*, except in London where it was paid by the recipient.

Statistics from 'Der Telegraph als Verkehrsmittel', Dr Karl Knies, Freiburg, 1857

International messages were a major source of income – not being subject to as much public and press scrutiny as domestic traffic. There were contractual relationships between the continental cable companies and the telegraph companies. The Magnetic had sole rights to use the Submarine company's cables to France, Belgium and Germany, but only benefited from the domestic segment of the message, the Submarine company having the lion's share. The Electric had its own cables (formerly the International company's) to Holland – so profitable that they were dubbed the "sheet anchor" of the business in the late 1850s. It also contracted, along with the Indo-European Telegraph Company, to use the new Norderney cable for public messages to Europe and the Far East; Julius Reuter retaining the rights for news messages. The new Norderney cable was already paying 19% on its capital for Reuter in 1868.

The original charges of the Submarine Telegraph Company in December 1851 for a twenty word message to Paris were:- from Dover 15s 0d; from London 17s 6d; from Birmingham, Brighton, Cheltenham, Coventry, Gloucester, Newmarket, Norwich, Oxford, Portsmouth and Southampton, £1 0s; and from Chester, Edinburgh, Glasgow, Holyhead, Liverpool, Manchester, Newcastle, Nottingham, Sheffield and York £1 2s 6d. Apart from messages originating in Dover these were transcribed in London from the circuits of the Electric company. Messages were being transmitted to arrive the same day from London and Liverpool to Paris, Havre, Vienna, Trieste, Hamburg and Ostend. The longest circuit available from England, with the perils of transcription, at the end of 1851 was to Cracow in Austria.

The Electric Telegraph Company's rate for twenty word messages on August 15, 1853 from all stations in Britain by the new Holland cables was advertised as: Amsterdam 8s 4d; Antwerp 11s 6d; Berlin 17s 6d; Bremen 13s 6d; Breslau 19s 6d; Dantzic 19s 6d; Florence £1 12s 2d; Frankfort-am-Main 15s 6d; Hague 7s 6d; Hamburg 15s 6d; Hanover 15s 6d; Strassburg 19s 6d; Leghorn £1 10s 2d; Lübeck 15s 6d; Milan; 19s 6d; Pressburg £1 1s 6d; Rotterdam 8s 4d; Trieste 19s 6d; Venice 19s 6d; and Vienna 19s 6d. The Electric had no access as yet to either France or Belgium.

In April 1854 the Submarine Telegraph Company adopted the following pricing for twenty word messages by way of Calais, or twenty-five words through Ostend, the minimum message lengths:

Amsterdam	16s 0d
Antwerp	12s 0d
Berlin	22s 0d
Bordeaux	16s 6d
Brussels	12s 0d
Budapest	24s 0d
Copenhagen	24s 6d
Dantzic	24s 0d
Dresden	20s 0d
Frankfort-am-Main	24s 6d
Genoa	24s 0d
Hamburg	22s 0d
Havre	12s 0d
Lemberg	26s 0d
Marseilles	18s 6d
Milan	20s 0d
Paris	12s 0d
Prague	20s 0d
Rotterdam	14s 0d
Trieste	22s 0d
Turin	22s 0d
Vienna	22s 0d

At this time no tariff was available by this route to the southern Italian states, to Rome and Naples for example. Multiples of the charges for twenty or twenty-five words were applied up to one hundred words.

It was not until the following year, 1855, that Rome at 20s 0d and Naples at 40s 0d, as well as Madrid at 28s 8d, were added to its network.

Portugal was only connected to the rest of Europe in October 1857. The Submarine company's rate from London to Lisbon was 18s 6d for fifteen words and 6s

0d for every additional five words; to Oporto, 19s 0d, and 6s 6d. Five words were allowed for the address free-of-charge, so the message rate was actually for twenty words.

The Submarine company stated that its share of all these prices from stations in Great Britain was 8s 0d for the segment to either Calais or Ostend, the balance going to the state-owned circuits in Europe that the message had to pass through. Repetition, the repeating back of the message to the sender as a guarantee of accuracy, was charged double-rate to France and one-and-a-half-rate to the rest of Europe. Delivery was also extra in France, but free elsewhere. One small difference between the charges of the Electric and Submarine companies was that the Electric refunded all pre-paid reply charges that were unused whilst the Submarine deducted 25% of the amount.

The Mediterranean Extension Telegraph Company completed its cables between Cagliari, Malta and Corfu at the end of 1856. On December 31, 1857, the Submarine company offered rates of £1 6s for fifteen words and 8s 8d for extra words to Malta, and £1 17s and 12s 4d for Corfu, with five words free for the address, from London.

Just as in Britain the course of continental wires was complex: the traffic from Paris to Milan in 1854 was worked by way of Brussels, Berlin, Vienna and Trieste. With the need of several transcriptions a message occupied twenty-four hours in transit. Milan was then a city of the Austrian empire.

In June 1858 the Electric & International Company's Continental Rates for a twenty word message from London via The Hague were:

Amsterdam	6s 0d
Antwerp	7s 6d
Berlin	11s 0d
Brussels	7s 6d
Bremen	8s 6d
Christiania	18s 0d
Constantinople	33s 6d
Copenhagen	12s 0d
Genoa	15s 6d
Hamburg	10s 0d
Königsberg	13s 6d
Malta	31s 0d
Memel	13s 6d
Odessa	31s 6d
Paris	11s 0d
Riga	25s 6d
Rotterdam	6s 0d
St Petersburg	31s 6d
Stockholm	18s 0d
Trieste	12s 0d
Vienna	12s 0d

Well before the completion of either the land line or the cable to the Far East the Submarine and Magnetic companies marketed a combined telegraph and steamer message service. On January 14, 1860 a twenty word message, exclusive of five words free for the address, could be sent by three alternate routes to places in Australia from any office in Britain and Ireland.

By Calais and Malta to	
Adelaide	£3 14s 3d
Ballarat	£4 1s 9d
Geelong and Melbourne	£4 2s 9d
Sydney, Hobart & Launceston	£4 5s 9d
By Calais and Marseilles to	
Adelaide	£2 14s 0d
Ballarat	£3 1s 6d
Geelong and Melbourne	£3 2s 6d
Sydney, Hobart & Launceston	£3 5s 6d
By Ostend and Trieste to	
Adelaide	£2 15s 0d
Ballarat	£3 2s 6d
Geelong and Melbourne	£3 3s 6d
Sydney, Hobart & Launceston	£3 6d 6d

This immensely complex scheme worked in concert with the telegraphs of France, Belgium, Italy and Austria with the message being carried onward by the British mail steamers and the Austrian Lloyd steamers as well as by the several state telegraphs in Australia.

A land line to India had been patched together using an assortment of government circuits and cables from Europe through Ottoman Turkey by the beginning of 1865. Message costs for Indian cities were £5 1s for twenty words. Of this the Electric Telegraph Company shared 3s 6d, the German-Austrian Telegraph Union 10s 6d, the Ottoman telegraphs £1 8s and the British India government cables and telegraphs £2 19s.

The Magnetic and Submarine companies charged exactly the same rate as the Electric from London to Calcutta, receiving a share of 2s 6d from messages out of London and 3s 6d for messages from country stations.

The joint price structure from March 1, 1865, of the Submarine Telegraph Company and the British & Irish Magnetic Telegraph Company from all their stations in Britain and Ireland by way of Constantinople and the Persian Gulf was:

To Calcutta, Bombay and Madras	£5 1s 0d
To Rangoon and Moulmein (Burmah)	£5 5s 0d
To Colombo, Point de Galle, Kandy and Mannaar (Ceylon)	£5 8s 0d

This was for twenty words including address and signature; ten words extra at half-rate. Messages for Singapore, China and Australia could be forwarded by mail steamer from Point de Galle.

The India rate was fixed by the London government.

On completion of the Indo-European Telegraph Company's circuit from London to Calcutta in 1870 the cost of a twenty word message to India was reduced to £3 10s or £1 17s for ten words.

For messages to the Continent addresses were generally charged for in 1859, they were free only in Denmark, Norway and Sweden. Costs via Belgium were based on a fifteen word message; via France on twenty-five words including five words for the address. There was an additional flat rate charge where the message had to be forwarded to a station of a railway telegraph rather than to one on the state-owned circuits. All porterage had to be pre-paid. English language was acceptable to nearly all continental destinations, the understandable exceptions being small, rural offices. Commercial cipher was forbidden to the German states but otherwise allowed at special cost. Repetition for accuracy and pre-paid return messages were all allowed.

The Submarine Telegraph Company reported in 1860 to the government that its share of the message cost, that is just from Britain to the coast of France, had reduced from 8s 0d on twenty words in 1854 to 5s 0d in 1859, and to 2s 6d from London and 3s 6d from the rest of the country in 1860. Its revenue on its circuits to the coasts of Belgium, Hanover and Denmark was 6s 0d on twenty words. Of course, to these charges had to be added the expensive segment within Europe.

The Submarine's tariff on April 1, 1860 was simplified, with a rate of 7s 3d for twenty word messages to Paris, Antwerp and Brussels, and 8s 0d to Hamburg, Copenhagen, Altona and all stations in Hanover and Denmark, extra words being 4½d each. These rates were covered by pre-paid Frank Stamps for the first time; the stamps also included values for ten word messages.

Elsewhere the Submarine's new rates in 1860 were 5s 0d to Boulogne and Calais, 10s 0d to Nantes and Lyons, and 11s 0d to Marseilles in France. For Russia it was 17s 0d to Riga, 19s 6d for St Petersburg and Odessa and 20s 6d to Moscow; to Italy 12s 0d to Genoa and 15s 6d to Leghorn; to Ottoman Turkey 20s 6d to Constantinople and 27s 6d to Smyrna; and to Malta 31s 3d. Circuits to Egypt and India were shortly anticipated.

The 1860 reduction in charges, claimed by the Submarine company to be "50%", increased half yearly messages to June 30 from 79,503 in 1860 to 104,593 in 1861, but receipts were reduced by £4,236.

When the Mediterranean Extension Telegraph Company opened its new cables on February 28, 1861, it appointed the Submarine and Magnetic companies' its agents in Britain. The charge for a twenty word message from London to Malta via Sicily was 17s 6d, and to Corfu via Otranto 18s 6d. An extra 1s 0d was charged for messages from the rest of the United Kingdom.

Later in the year, on November 16, 1861, the British government's cable to Alexandria was opened and was also worked in concert with the Submarine and Magnetic companies. A twenty word message from London to Alexandria in Egypt cost 46s 9d, to Tripoli 26s 9d and to Benghazi 36d 9d. From other places in Britain 1s 0d was added. Messages forwarded by steamer from Suez to India, China and Australia required 2s 0d more.

However, as with domestic telegraphy, foreign message costs from the United Kingdom continued to fall markedly. The Submarine Telegraph Company in January 1862 introduced a simplified tariff to continental Europe charging 7s 6d for twenty words *inclusive of addresses* to most countries in western Europe, additional words were charged at 4½d each. Its competitors in Britain fell into line with similar reductions.

In 1862 the Submarine company's tariff for twenty words, including the recipient's address, to distant stations listed Alexandria in Egypt 46s 9d, Athens 32s 0d, Bucharest 16s 0d, Constantinople 19s 6d, Corfu 16 9d, Moscow 19s 0d, St Petersburg 18s 6d, Smyrna 26s 6d, and Taganrog in Southern Russia 30s 6d.

Other common destinations were Barcelona 9s 6d, Bergen 19s 6d, Cadiz 13s 0d, Christiania 17s 6d, Helsingborg 11s 6d, Madrid 10s 6d, Malta 16s 9d, Naples 11s 0d, Palermo 12s 0d, Seville 13s 0d, and Warsaw 13s 6d.

As an additional measure of security and efficiency the repeater devised by C F Varley of the Electric company in 1855 with automatic repetition (i.e. direct point-to-point working) was introduced into the longest overland continental circuits, initially through northern Europe to St Petersburg, and then on the dedicated lines to Turkey and India, thus avoiding the perils of transcription by non-English speaking operators. This also enabled the introduction of automatic telegraphy with tape perforators, rotary transmitters and fast receivers on the Indo-European company's long circuits.

The United Kingdom company eventually, in 1868, contracted to use the Great Northern Telegraph Company of Copenhagen's newly-laid cable between Jutland in Denmark, and Newbiggin in Northern England; giving it access to the Continent through Danish state circuits. In the following year it also connected with the Great Northern's Norwegian cable at Peterhead in Scotland. The Company transcribed the messages from its American and Hughes circuits at its offices in Newcastle-upon-Tyne and Aberdeen on to Wheatstone's automatic telegraph used by the Great Northern. In the following year, 1869, the United Kingdom company came to an agreement with the French Atlantic cable to handle all their traffic from England and Scotland to America by way of Paris.

The "European Alphabet" or dot-and-dash code was hence used by *all* of the British telegraph companies for their foreign traffic.

Through these connections it was possible by 1868 to communicate from virtually any telegraph office in Britain and Ireland with any office on the continent of Europe, and to the Levant and to India.

Intercontinental

The American cables of 1866 between Valentia in Ireland and Newfoundland, off Canada, connecting to the United States; and the later Mediterranean and Indian cable companies, were corporately and operationally independent of the domestic telegraph companies and did not contribute directly to their income; the domestic companies earning only from their inland segment. There were no direct electrical circuits between the domestic companies' wires and the intercontinental cables, all messages were transcribed at the cable companies' offices in London. A dedicated leased-line ran from London to the cable-end for America, crossing the Irish Sea using the London & South-of-Ireland Direct

Telegraph Company's cable from Abermawr in Wales to Wexford in Ireland. A private wire was leased of the Electric Telegraph Company by the Falmouth, Gibraltar & Malta Telegraph Company in 1870 from the common office of all the Mediterranean and Indian cable companies at 66 Old Broad Street, London to Penzance in Cornwall, where it connected with the Malta company's own 10 mile long line to the cable-end of the intercontinental eastern circuits at Porthcurno.

To facilitate transcription between domestic and intercontinental circuits the Electric company allowed the Anglo-American Telegraph Company a room at its premises in Telegraph Street in London with instruments and a short local circuit to the cable company's City office. It later granted similar facilities to the Indo-European Telegraph Company and was to construct a pneumatic tube for messages to connect with the British India Telegraph Company's station in London.

Of the domestic telegraph companies, the Magnetic's board of directors, its engineers and its management were intimately involved in the promotion and creation of the world-wide underwater cable network, as befitted their initial connection with the original Submarine Telegraph Company.

But there was a little secret revealed only in the composition of the scientific commission appointed by Parliament to investigate the failure of the first Atlantic cable in 1858. Its report and recommendations on insulation and instruments submitted in 1863 laid the foundation for *all* subsequent oceanic cables: the members were Cromwell Varley, Charles Wheatstone, Edwin Clark, Latimer Clark, George Bidder (all connections of the Electric company), Douglas Galton (an army engineer for the government), William Fairbairn (an eminent engineer and a director of the Universal company) and George Saward (for the Atlantic Telegraph Company). It had been the Electric's knowledge that had quietly rescued the American cable.

On its completion in 1866 the cost for messages over the cables of the Atlantic telegraph between Britain and the United States was 20s 0d (240d) a *word* for a minimum of ten words. The cost reduced quickly during the first year to ten words for 4s 0d (48d) a word.

Despite, or in ignorance of, this tariff W H Seward, the "Republican Richelieu" and American Secretary of State since 1861, sent a 760 word message to the Emperor of the French on November 26, 1866 insisting that it be encrypted. The primitive cipher used engrossed the message into 3,722 telegraphic "words"; it cost $19,540.50 to transmit, three times Seward's annual salary. It took the Anglo-American company's agents in America five years and a law suit to obtain payment.

The opening of the French Atlantic cable from Brest to St Pierre and Duxbury in America in August 1869 saw rates from Britain plummet. The United Kingdom Electric Telegraph Company, the French cable's agents, offered 10 word messages for 40 francs or 32s 0d, and 4 francs or 3s 3d for each additional word, by way of Paris. The Electric and Magnetic companies, for the Anglo-American Telegraph Company, countered on the same day with a price of 30s 0d for ten words, 3s 0d for extra words.

The performance of the intercontinental telegraph was vividly illustrated on Saturday, December 21, 1867. At a banquet to celebrate Charles Wheatstone at the Polytechnic in Regent Street, London, the chairman, the Duke of Wellington, sent a message of fifty words to the American President, Andrew Johnson, in Washington. It took just nine minutes and thirty seconds to cross the Atlantic and arrive at his residence. The President's reply of fifty-nine words took twenty-nine minutes to transmit back to Regent Street and was received as the assembly were still at dinner. After these formalities were over the assembled scientists sent a message of twenty-two words from the Polytechnic in London to the telegraph station at Heart's Content in Newfoundland. It was sent at nine o'clock; the reply of twenty-four words was received at ten past nine!

When the Electric company's former secretary, Henry Weaver, took over management of the Anglo-American Telegraph Company he eliminated minimum message length, charging simply by the word in 1871. One word messages were then possible. The other cable companies immediately adopted his price model.

On the dissolution of the telegraph companies in 1868 many, if not most, of the best managers, electricians and engineers, and even the more adventurous clerk-operators, left to serve the underwater cable telegraph firms in Britain and overseas rather than take employment with the Post Office. Technical direction of the new national telegraphic system was to be left to a railway signal engineer.

The Telegram Agency

With the coming of the intercontinental cables, and more especially after the establishment of the state telegraph monopoly, a new species of business appeared to manage the messaging business of large mercantile concerns. Firms engaged in distant foreign trade soon became aware of the immense costs that regular telegraphic correspondence incurred.

The telegram agency, as their name implies, acted as intermediary between the message sender and the telegraph company owning the lines. Its purpose, essentially, was to save the sender money. It required little or no capital to set up, needing little more than a rented office and stationery.

From the foundation of his firm in 1851 Julius Reuter had managed the messages of private subscribers in London, on the continent of Europe and eventually, after 1870, in all corners of the world. His offices in London, Liverpool and Manchester advertised from 1853, "Messages forwarded with rapidity and correctness of translation, to every part of the continent". In the 1860s Reuter was handling diplomatic traffic for many embassies and plenipotentiaries in London. The private message business remained a significant part of *Reuter's Telegram Company*, underpinning its news and intelligence products, for many decades. Several other, much lesser, concerns entered the public telegram agency business from the mid-1860s, broadening their customer base to the general public.

The nature of the telegram agency was *consolidation*;

• The first task was the assembly of a *Register* of clients, whose names and addresses were then reduced to a single word for telegraphic messages.

• The second task was the creation of a network of *Agents* abroad, in all the centres of business throughout the world, able to accept messages and to use the Register. These would accept and forward messages as part of their other business on a commission.

• The third task was taking the plain language text from subscribers and *Encoding* or rather abbreviating it by the use of proprietary code books into a few words.

• The fourth task was *Packing* all the subscribers' encoded texts into as few as possible messages for each foreign destination.

• The fifth task was passing of the packed messages to the cable company for actual transmission to their destination, usually once or twice a day.

The key operational element was the reduction of ordinary language into as few telegraphic "words" as possible. For business there were to be introduced an immense range of code books that reduced common (and more complex) phrases and instructions into single words; these covered many hundreds of alternatives in volumes of up to a thousand pages. Of course, many firms settled on the common code for their trade and undertook their own encoding. This was done, it should be said, not for reasons of confidentiality, but for those of economy.

As regards 'packing', the consolidation of several foreign messages into one, this was condemned by the telegraphic world, in particular by the International Telegraph Conventions of Vienna (1868) and Rome (1871). In Britain the Anglo-American Telegraph Company, the Indo-European Telegraph Company, and the Eastern Telegraph Company Limited, that monopolised intercontinental traffic and operated a price cartel, also complained bitterly to the General Post Office regarding the practice of 'packing'. However the legitimate use of codes by many of their main users, by and large, concealed any 'packing'. The telegram agency, in addition to this hostility, had to work a cash business as no telegraph company would grant it credit or allow it an open account.

The first independent 'packer' was the *General Telegram Agency*, a trading title of Messrs Pope, Rée and McLean, of 11 Throgmorton Street, City, and 2 Circus Place, Finsbury Circus, in 1869. This evolved into *McLean's Telegraphic Bureau* by 1874, specialising in public and news messages to America, with offices at 39 Lombard Street. Eventually James McLean concentrated on news, and his agency became the London correspondent of Associated Press of New York by 1877.

One of largest of this new category of communication business was the *Oriental Telegram Agency*. This was the initiative of Robert Valentine Dodwell, who had a long history as a telegraph engineer with the Magnetic Telegraph Company in Manchester and Liverpool and on his own account in the north-of-England. In 1872, along with George Ager, Dodwell published 'The Social Code', in 230 pages, one of the first code-books intended for use by ordinary travellers, emigrants and tourists. By early 1873 the Oriental Telegram Agency had a central office at 140 Leadenhall Street, City, and branches at 35A Moorgate Street, City, London; 61 Prince's Street; Manchester; Batavia Buildings, Hackins Hey, Liverpool; and 29 Waterloo Street, Glasgow, a new branch was opened at 45A Pall Mall, St James's, in January 20, 1874. Dodwell, as managing director, had previously created a network of corresponding agents in India, China and Australia. He recruited a former colleague at the Magnetic Telegraph Company in Manchester, George Hine, as company secretary and manager.

The Oriental Telegram Agency's public tariff for May 1873 was Annual Subscription 5s 0d; messages to India, 5 words 15s 0d, 10 words £1, each additional word 1s; to China, 5 words £1 1s, 10 words £1 10s, each additional word 2s, and to Australia, 5 words £2, 10 words £3, each additional word 3s. It would have different rates for mercantile clients. Later it offered free registration of addresses in Britain and abroad.

The comparative message rate for the Eastern Telegraph Company, operating the cable between London and India, and for the Indo-European Telegraph Company, working the land-line across Europe to India, was for 10 words, £2, for each additional word 4s 3d.

To expand their business, the proprietors of the Oriental agency looked west and established the separate *Antilles Telegram Agency* in 1873 at the same addresses it used in Britain. It recruited Agents in the West Indies, extending quickly through Central and Latin America, and, for a period, to North America, wherever the new telegraph cables touched.

The *Telegraph Despatch & Intelligence Company*, with offices initially at 80 Cornhill, City, London, launched its prospectus for capital in 1872, it lasted until January 26, 1877. It intended to purchase James McLean's original telegraphic news agency, whose connections included the American Press Association, the New York Commercial & Financial Bureau and the American Packing Business, for £2,500 in February 1872.

The news business was soon surrendered to the all-encompassing Julius Reuter and it then introduced a public message service. It offered "Travellers' Telegram Tickets" in August 1872, for America, 5s 0d, India £1 1s and Australia, £1 10s, from its office at 1 Royal Exchange Buildings, City, from Grindley & Company, India bankers, 55 Parliament Street, Westminster and H S King & Company, India agents, 65 Cornhill, City, and from other passenger agencies, redeemable at its correspondents abroad. With some nerve it petitioned the Post Office in 1873 to allow its advertising for cheap rate foreign messages in all domestic telegraph offices, and to have the Post Office forward messages at cost to its London office.

The Telegraph Despatch company's message rates in January 1874 were, for the addresses of sender and recipient to India 10s 0d, extra words 4s 0d; to Singapore and China, addresses £1, extra words 6s 0d; to Japan, addresses £1 10s, extra words 8s 0d; and to Australia, addresses £2, extra words 10s. It closed its offices for business in December 1876.

The *Anglo-Continental Telegram Company*, 3 Crown Court, Old Broad Street, City, was commenced in 1870 by Richard Wilhelm Otto Rochs and Edward Calley Manico, a couple of individuals unconnected with the telegraph industry but having language skills. They had offices in London and Constantinople; providing daily news telegrams from Paris, Berlin, Frankfort, Vienna, Amsterdam and Hamburg to subscribers paying from £10 to £50 per annum, as well as handling their private messages. In financial trouble after three years trading, Rochs and Manico promoted the *Universal Telegram Company,* a joint-stock concern, the second firm of that name, in March 1873 which was to purchase the business of Anglo-Continental. The promotion failed and they were both made bankrupt on August 3, 1873.

The failed Anglo-Continental business was acquired by Robert Dodwell in October 1873 as a private transaction and became the *Cable Telegram Company*, with an office at 127 Leadenhall Street, City and branches, shared with the Oriental agency, at 45A Pall Mall, and 4 Crown Court, Threadneedle Street, London, and Batavia Buildings, Hackins Hey, Liverpool.

Otto Rochs of Anglo-Continental was appointed by Dodwell as manager of the Oriental Telegram Agency. The Oriental and Antilles agencies successful expanded their public and mercantile encoding and packing network throughout India, China, Australia, Japan, New Zealand and the Brazils, eventually to all of South America over four years.

However, after a court case between Dodwell and the other directors the Oriental, Antilles and Cable agencies failed in May 1876. An *Oriental & American Telegram Company* took over, managed by Otto Rochs, but without Dodwell's direction, that too failed in July 1878.

The last and longest-lasting agency was the *Commercial Telegram Bureaux*, started by John Jones, a publisher and printer of trade circulars for the American and Indian textile markets in Liverpool sometime early in 1890. Jones moved to London and used his connections to create a worldwide network of telegraphic bureaux or agencies that collected and collated valuable trade information for the mercantile interest in Britain, Europe, India, Australia and America. It, too, managed the telegram business of mercantile houses using its own abbreviating code to reduce intercontinental cable messages costs. It opened offices at 11 Tokenhouse Yard, City, London. It became *Comtelburo* in June 1900, continuing as a very successful publishing firm and telegraphic agency. It was acquired by Reuters in 1944.

13.] **RAILWAY SIGNAL TELEGRAPHY 1838-68**

To complete a view of telegraphy in Britain between 1838 and 1868 it is necessary to review railway signal telegraphy, which was introduced and developed in Britain during the period. This technology, to be clear, was intended to manage railway traffic and to prevent accidents; and is quite different from messaging. It is inextricably linked with railway signalling where the driver of the locomotive is authorised or forbidden to proceed by substantial line-side optical signals. The commonest of these visual signals was the *semaphore*; flat wooden arms atop tall poles, hinged at one end to work up and down, devised by the engineer Charles Hutton-Gregory in 1841.

As Captain Mark Huish, General Manager of the London & North-Western Railway, was to write (rather elaborately, and with his customary awareness of economy) in March 1854: "If only one collision of a passenger train, with its sickening accompaniments of suffering, to say nothing of its heavy expense, were prevented by free use of the telegraph, the immunity would be cheaply attained, and the cost of the improvement be amply compensated."

The concept of "telegraphic railways" was proposed by W F Cooke in 1842. Railway signal telegraphy did not change in essence from Cooke's initial concept. In this each line of railway was divided into sections or "blocks" of several miles length. Entry to and exit from the block was to be authorised by electric telegraph and signalled by the line-side semaphore, so that only a single train could occupy the rails. Without electric telegraphy block signals could also be worked by a simple time-delay, allowing a period to elapse before the next train was permitted to enter. The catastrophic risks of this need not be elaborated.

Even in 1841 Cooke was keen to introduced automatic electric signalling, with "engine warners" inset into the railway track to indicate the passing of trains on the needle apparatus, as well as relying on railway police and signalmen to work the instruments. Unfortunately, he was never to achieve this.

During the same year, 1841, Alexander Bain patented a "railway controller", connecting two locomotives electrically by means of metal conductors set between the rails. If the first engine stopped it automatically signalled the following one, should the signal be ignored a bell was sounded, then as a last resort a weight was released to cut off the steam, stopping the other train.

In the first form of railway signal telegraphy the company merely used the ordinary messaging instruments at its passenger stations, as there were then only external ground-frames with the levers that worked the semaphores, rather than enclosed signal-boxes, to send and receive abbreviated messages. This had great weaknesses in that the working of the telegraph was separate from the working of the signals, and in relying on the memory of the recipient as to the state of the rails ahead of and before any traffic, the message being momentary and not permanent.

a.] **Cooke's Railway Signal Telegraph**
In W F Cooke's original railway telegraph signalling system a single-needle telegraph was adapted to indicate just two messages: 'Line Clear' and 'Line Blocked'. The signaller would adjust his line-side semaphores accordingly. As first implemented in 1844 each station had as many needles as there were stations on the line, giving a complete picture of the traffic. This was far too elaborate, and a sequence of single-needle instruments adopted, one pair for each "block", working both directions of the railway. To be effective it required the telegraph clerk to keep a record book to register all the signals received. It was used in single pairs of instruments in several locations throughout Britain as a "cheap and inefficient" solution for well over ten years, until signal-boxes were generally introduced.

In later years Cooke's single-needle block railway signal, with a record book or a writing slate for each section, was used in tandem in signal-boxes with a separate single-needle 'speaking' telegraph for railway messages, alongside of the levers working the semaphore signals. This was to be, along with Highton's similar arrangement, the commonest train signalling system for over a century.

In addition to this the Electric Telegraph Company from its earliest days installed Wheatstone's *magnet-and-bell*, the earliest acoustic telegraph, line-side for railway signalling that worked without any batteries. In this a small magneto-electric machine, with twin coils and a lever-action, was in simple circuit with a distant electric bell to advise the signalman at the block semaphores by a series of beats. The Eastern Counties; Eastern Union; London & North-Western; Midland; South Staffordshire; York, Newcastle & Berwick; and York & North Midland all used the magnet-and-bell signal. The Eastern Counties possessed forty-nine and North-Western thirty-four out of a total of 114 magnets-and-bells in 1854; it was only applied to manage isolated sections, especially tunnels and single lines of way, on all of these railways. It was known from its impressive acoustic action as the "thunder pump". The last magnet-and-bell was apparently still in use on the Edinburgh & Glasgow Railway in the 1860s, where it had a code for fifteen different signals.

b.] **Edwin Clark's Railway Signal Telegraph**
The Electric Telegraph Company's Edwin Clark devised improvements in the single-needle signal system of the London & North-Western Railway in March 1854 with his proposals for a block system. He said:

"The following conditions should, I think, be insisted upon in any application of a telegraph to railway purposes:"

"1st The machinery employed must be of the most simple and evident description, and not liable to derangement, and easily repaired."

"2nd The signals must be simple and few, and so distinctive that no mistakes can occur."

"3rd No dependence must be necessarily placed on the memory of the person in charge, and signals should be permanent and not temporary, or liable to misconstruction or neglect from the absence of the attendant."

"Lastly, and more particularly, no accident should be actually caused by derangement of the apparatus, or the absence of the signalman, but such absence or derangement should merely cause the delay of a train."

Clark believed in, what would be called today, fail-safe operation and, unlike in the Electric company's public circuits, continuous currents to maintain a permanent reminder of the state of the block in front of the signalman. He used two Cooke & Wheatstone two-needle telegraphs, one for each line, up and down, in two-mile sections devoted entirely to signalling. A deflection to the left indicated '*train on line*', a deflection to the right '*line clear*', and no current meant '*line blocked*', which was then to be considered a danger signal. The block instrument would normally show line clear, and would be changed to train on line when a train passed. When the train left the block, the instrument would signal back as line clear. In this system, unlike its single-needle predecessor, the signal was permanently displayed until changed by the operator. The drop handles could be locked in any position by means of a pin. An alarm bell was used to call attention of the signalmen. The telegraph wires were looped down certain poles, where they could be cut, so that the instruments then indicated line blocked and raised alarm. Each telegraph was worked in concert with a three-position semaphore signal on a tall post to visually communicate with the train crew at the commencement of the block.

The system was described in its earliest form in 'Civil Engineer & Architect's Journal' during 1857: "Among the more recent improvements adopted by the London and North-Western Company for securing perfect safety of travelling over their line, has been the establishment of a 'special train telegraph,' with signal stations every two miles. At each station a policeman is on duty night and day, in whose watch-box there is a telegraph dial with a single needle. By inclining the needle to the left hand, the person in charge gives notice to the next station that a train had passed on to the two miles of the road entrusted to his special care; while inclining it to the right hand would show that the train had passed off that portion of the line. There were in fact but two signals, 'train on' and 'train off,' but as it might happen that an accident occurred upon the two miles of road between the telegraph stations, the guard and breaksman (*sic*) were instructed instantly to sever the 'special train wire,' which has the effect of placing the needle at each adjacent station in an upright position. The policeman on duty at once becomes aware by this movement that something is wrong, and can act according to circumstances."

Clark's so-called "Two-Mile Telegraph System" was installed in 1855 between Euston Square and Rugby, 83 miles, with signalling blocks actually 2½ miles in length. However there was no electrical signalling hence to Liverpool and Manchester at all, at this time.

The instruments were controlled by the railway company's signalmen at both ends of the block, not by telegraph clerks. This had a counter defect in that there was no "speaking telegraph" between the signal boxes, and advice as to the state of the rails, traffic, weather and other conditions could not be communicated.

The success of the "Two-Mile Telegraph" was illustrated before a Parliamentary Committee on Railway Safety by the London & North-Western Railway company director P S Pierrepoint with an event in which he participated in February 1858. He was travelling on the train between London and Rugby when an iron girder on a bridge fractured and fell blocking the line. An off-duty railway policeman witnessed the failure and ran onto the track and cut the "down loops" on one of the telegraph poles. Both lines were then "blocked" and two trains halted before reaching the fallen bridge, including that carrying Pierrepoint.

Railway telegraphy for traffic control and safety, for a great many years continued to be based on the common single-needle instrument. Subsequently signal telegraphy went its own way with specialised instruments. New apparatus was designed by independent electrical engineers such as Edward Tyer, C V Walker, Charles Spagnoletti and William Preece. This led to the situation in 1863 where each of the nine great railway lines from London used a different electrical signal system.

Although virtually all railway companies adopted the electric telegraph for local messaging, its use for direct traffic control was both limited and variable in 1858. Even the London & North-Western Railway Company used it only on the first hundred miles out of London. The Eastern Counties Railway, one of the first and largest adopters of the telegraph, had just the three miles of track out of its Shoreditch terminal directly controlled by telegraph. The London & South-Western Railway then had no tracks under electric management. In contrast the South Eastern Railway had most of its traffic monitored through the innovations of its telegraph superintendent, C V Walker, from the early 1850s.

By the 1860s there was a strong opinion, after a series of accidents, that using message telegraphs was not safe enough as it was open to interpretation by the signalmen. The railway companies then encouraged simpler, definitive indicators, absolute signals as to the state of the line, to show whether or not it was occupied, and having them put solely in the hands of its signalmen.

By 1868 there were four new systems in use on British railways, as well as many derivatives of the single-needle system which remained the commonest method of controlling traffic and safety. In principal each of these had a visual line-indicator element and a very simple acoustic messaging element and the instruments were installed in signal-boxes along with the levers that worked the line-side train-signalling semaphores:

c.] **Edward Tyer's Pointer Signal Telegraph**

This was the earliest dedicated railway signal telegraph. It was derived from Edward Tyer's patents of 1852 and 1854, originally developed and used on the South Eastern Railway, and over time was adopted by several other railway companies in Britain and France.

Before that was widely introduced the young Edward Tyer had become involved with the promotion of a joint-stock firm to manufacture a much more ingenious and elaborate system of train control.

The Railway Electric Signals Company, legally created in France as the *Compagnie des signaux électriques pour les chemins de fer* 'System Tyer', was a promotion of the directors of the Submarine Telegraph Company, itself a French-domiciled firm. Launched in England on July 6, 1855 the Signals company had an authorised capital of 1,500,000 francs or £60,000 in shares of 25 francs or £1.

It was formally incorporated as a *Société française en commandite* in Paris on May 2, 1856. The four *gérants* or directors were Sir James Carmichael Bt and Frederick Cadogan of the Submarine company, and Jonathan Hopkinson and Thomas Winkworth of the Commercial Bank of London. The system developed by Edward Tyer had been used for the previous eighteen months to July 1855 on the North Kent line of the South Eastern Railway, on parts of the *Chemin de fer du Nord* and of the *Chemin de fer St Germain á Paris*. Tyer received 10,000 shares all paid-up for his patents and expenses and all net profits beyond 10% on the capital, for their use in Great Britain, France and Belgium. The concern was also known in France as *Winkworth et Compagnie*, from the name of its principal *gérant*.

It should be noted that for a period in mid-century Great Britain and the Empire of France effectively had mutual legal recognition of their commercial and industrial corporate entities.

The 'System Tyer', based on his patents of 1852 and 1854, was remarkably sophisticated. It proposed a station signal instrument, an engine indicator, and a bell or acoustic telegraph. The station instrument and the engine indicator were improved in 1854; and new designs introduced for insulators, *paratonnerres* (lighting protectors), batteries and an electric fog signal.

In 'The Times' of January 18, 1854 Tyer himself gave a description of the system to be promoted and made by the Railway Electric Signals Company:

"Mr Tyer proposes, by the agency of voltaic electricity, to accomplish the following objects: 1) That the train itself upon entering any station, shall give notice to the station it last left that the line is so far clear; 2) that, upon quitting a station, the train shall transmit a signal to the next station in advance, directing attention thereto by sounding a bell; 3) the transmission of signals from any intermediate point between stations, so that an alarm can be given, and assistance obtained, in the event of a break down, or other stoppage of the line; 4) that the engineman may be signalled from the station he is approaching at any distance deemed requisite, auxiliary signals and fog detonators being thus rendered unnecessary. The inventor proposes to arrest the attention of the driver by causing his apparatus to sound the steam whistle; and his plan of signals includes a self-acting register, kept at each station, of the exact signals received."

"The various objects are accomplished by two contrivances – the one for establishing communication from the train to the stations either side of it, the other for signalling from the station to the driver of an approaching train. The first contrivance consists of a treadle spring, which, when pressed by the flanges of the carriage wheels in their passage over it, and establishing an intermediate circuit of electricity through the wire extending to the station, sounds a bell and moves an index on a dial plate there. The second contrivance is a pair of brass plates, forming double inclined-planes, about six feet long, and fixed upon the rails, so that metal springs beneath the frame of the engine come in contact with them, when the voltaic circuit is again completed, and signals at once indicated to the driver by an index on his locomotive, by the sounding of his whistle or even by cutting off steam."

"The whole apparatus can be applied at any required points; can be adapted to the existing lines of telegraph, and possesses the advantage of being self-acting. The cost for each set is stated at from £50 to £60. The arrangement of treadles has been satisfactorily tested on the South Eastern Railway, and of signalling the driver on the Croydon line."

These arrangements, virtually automatic in operation, were far beyond the appetite or understanding of railway management at the time.

The prospects of the Company were terminally affected on Sunday, June 28, 1857 when a fifteen carriage train was run into from behind at the Lewisham station of the North Kent line. The accident killed eleven people and severely injured thirty more. The experimental Tyer signal arrangements were absolved of responsibility but the Company sold no more systems. The subsequent government investigation of the signal telegraph stated "It appeared to be the most perfect plan that possibly could be devised for safety by the prevention of a collision."

The criminal court case that followed was provided with a detailed description of the signal telegraph apparatus on the double-tracked North Kent railway in 1857: the dial had two compartments, in each of the compartments were two indicators, one bearing the words 'Stop all down' and 'Clear all down', and the other 'Stop all up' and 'Clear all up'. Over the instrument was placed on one side a gong for the down trains and on the other a bell for up trains, by the striking of which the attention of the signalman was attracted. The needle on the dial indicated that a train was about to pass up or down from one of the stations on either side. On receiving this the signalman returned an indication to the station from which the message had come, notifying that the line was 'clear' or 'stopped', and turned the line-side semaphore as necessary. The court's opinion on Tyer's arrangement was that "Nothing can be more satisfactory than this".

In 1859 Tyer was working as electrical engineer for the London District Telegraph Company, promoted by the same individuals that launched the Signals company.

By 1862 he had established *Tyer & Company* to make and market "Tyer's train signalling telegraph", a much more basic manually-worked apparatus which used a single, two-position pointer for each line, derived in appearance from the familiar single-needle apparatus, but differing in stopping to the right or left until moved back when the situation changed.

The instrument in the hands of the signalman managing two lines of railway, 'Up' and 'Down', had a rectangular dial with four pointers upon it; two for incoming trains, coloured red, and for out-going trains, coloured black, on the 'Up' rails, with two similar on the 'Down' rails, so controlling four blocks in all. There were also instruments with two pointers, one red and one black, for single lines of rail. These pointers were worked either left for 'Clear' or right for 'Blocked' by four push-pull stops, called by Tyer "pistons", at the base of the dial. It sounded a Gong for up trains and a Bell for down trains worked by the stops for train code and attention signalling; with beats 1 - acknowledge, 2 - passenger train, 3 - goods train, 4 - express or light engine, 5 - obstruction, 6 - testing the gong or bell.

Edward Tyer's system was continuously developed and altered over the rest of the century to become, apart from variations of the old single needle telegraph, the most popular railway signal system.

d.] **C V Walker's Miniature Semaphore Signal Telegraph**

Charles Vincent Walker had introduced a bell telegraph between signal boxes in January 1852 and that acoustic mechanism saw wide use on the South Eastern Railway. It was the first generally adopted system of electrical train control in Britain. In 1863 he had 330 bells in operation, in pairs and with intermediate bells, each worked by a so-called ringing key, commonly termed a "pecker". Eighty-four of these had automatic indexes to count the strikes, as up to twelve beats were required for some signals! The bells, of traditional shape, were four or five inches "across the mouth". Each bell set cost on average £4 6s 6d. The whole signal system had cost £3,650 in all, for bells, ringing-keys, indexes, wires and batteries. They were worked by station masters and ordinary signalmen.

Walker's bells worked two codes of beats, one for train safety, one for simple station to station messages. In the *General Code*, for train safety, one beat signalled 'Up Train Out', two beats 'Down Train Out', three beats 'Train In', five beats 'Line Blocked' and six beats 'Unblock Line'. It was an absolute rule that every bell signal had to be repeated back to the sender.

By the mid-1850s Walker had added a visual component. This used an instrument with symbolic miniature railway semaphores on its dial face for each line of rails in each signal station operated by rotating keys. Each had two arms, one red and one white, worked up and down by electro-magnets. The Red arm indicated the state of the inward line, from a distant station; the White arm, the line for the outward line, from the home station. There was also a Bell. When the semaphore was up the line was 'Blocked' or occupied. When the semaphore arm was down the line was 'Clear'. The Bell attracted the signalman's attention and gave messages by a code of simple acoustic beats. It required just one wire without a constant current to function.

The miniature semaphore was used so that those in charge of the out-door signals and points were warned by the same signals in the telegraph instrument signals with which every railway station-master, pointsman or porter was familiar.

e.] **W H Preece's Miniature Semaphore Signal Telegraph**
Designed by William Henry Preece, this telegraph also used a miniature railway semaphore, but required two instruments and a separate electric bell for each line of rail. It actually took the form of wooden model semaphore signals on twelve inch tall posts operated by small vertical lever-switches. This system was complex, necessitating four instruments for two lines of rail each with three circuits using a constant current, the latter justified by the additional fail-safe factor in multiple wires. It was used by the London & South-Western Railway from 1863.

Edward Tyer was to point out that this was essentially a copy, and an unnecessary mechanical elaboration, of C V Walker's Electric Semaphore signal dating from 1854, exhibited at the Paris Exhibition of 1855.

Preece's reputation was further damaged by an accident on the South-Western railway at Egham on June 7, 1864 which killed seven people. It occurred on the line to the fashionable Ascot Races, and only narrowly missed involving the train carrying the Prince and Princess of Wales. The government's incident report said that the signalling system on the London & South-Western Railway was "most dangerous", as it relied entirely on a time interval between trains rather than the telegraph block.

It must be said that much of this chapter is based on W H Preece's presentation to the Institution of Civil Engineers on his system in comparison with that of others in 1863, and the vitriolic responses he received from the railway signal engineers there present.

f.] **Charles Spagnoletti's Disc Signal Telegraph**
To make signalling as clear as possible this apparatus used a red and white coloured rotating disc on a green faced dial, with a red key and a white key. Two instruments were needed; one for 'Up' and one for 'Down' rails. Pressing the red key caused the red-half of the disc to appear on both the home and distant stations, the key could be locked down by a cross-pin. This indicated line 'Blocked'. Pressing the white key caused the white-half of the disc to rotate into view, showing line 'Clear'. Like all other railway signal telegraphs this had a Bell to attract attention and sound a code for the type of traffic; it was either a separate instrument with its own key, or built into the disc instrument and worked by either of the colour keys. This was introduced in 1863 on the intensely-worked Metropolitan Railway, the first wholly-underground urban line, and was eventually adopted by the Great Western Railway, for whom Spagnoletti worked, and its associated companies in the west of England, slowly from 1864.

g.] **E G Bartholomew's Railway Signal Telegraph**
In addition Eugene George Bartholomew introduced his own railway signalling system on to the London, Brighton & South-Coast Railway in 1855, where he was superintendent of telegraphs. This adapted the single-needle telegraph to give a permanent indication by weighting the index so that it remained on either the line 'Clear' or 'Closed' side of the dial. It also had a bell alarm to attract attention, the 'down' line bell having one tone, the 'up' line another, and to signal simple messages.

Bartholomew was to leave the Brighton to become station manager for the Atlantic Telegraph Company, and latterly engineer to networks of private telegraphs.

f.] **Francis Rudall's Railway Bell**
The newly-appointed Telegraph Superintendant of the London, Chatham & Dover Railway, Francis Rudall, introduced electric blocking on the entire system in 1863. This was initiated by a fatal accident at the Chatham tunnel on July 9, 1862. Rudall improved the common single needle telegraph by having the signalman insert a pin either side of the needle to retain it in the 'Line Blocked' or 'Line Clear' side until the appropriate train had passed.

In addition Rudall improved upon C V Walker's railway bells by producing a unitary version, with the electro-magnetic striker and a tapper above a hemispherical bell contained in the base casing. It was able to work from between three miles up to twelve on a few cells with ease. The Rudall bell signal code was more elaborate than Walker's: one beat, stop all out trains up; two beats, stop all out trains down; three beats, allow all trains in (station clear); four beats, special train; five beats, danger, stop all; six beats, all clear; seven beats, message on telegraph; and eight beats, testing circuit. All beats had to be repeated back.

Francis or Frank Rudall was the son of a celebrated flute maker and had risen in the service of the Electric Telegraph Company to become District Superintendant for north-west England in Liverpool before joining the Chatham railway in 1862.

Railway Telegraphs
As well as signal telegraphy, the railway companies in Britain and Ireland worked their own internal telegraphs for messaging as well as for train control. Circuits were set aside for railway use with single-needle apparatus, whether Cooke & Wheatstone's or Highton's, in the telegraph companies' public wires alongside the rails, between passengers stations, goods offices and workshops, as well as those in signal-boxes. These were leased of the telegraph company as part of the wayleave agreement; who undertook the maintenance of line and equipment. Messages, which reached

around 300,000 a year for each of the largest companies such as the London & North-Western, the South Eastern and the Lancashire & Yorkshire by 1867, were entirely related to railway business, reporting incidents and weather, organising rolling stock and traffic flows, and so forth; there was no intercommunication.

The guards on trains of some railway companies were provided with portable single-needle instruments and batteries to allow them to access these message circuits in emergencies.

There was, and remains, remarkable ignorance about the extent and importance of the railway companies' internal messaging circuits. The railway telegraphs were effectively parallel private networks to those used by the public and of equal line length and traffic. However, no collective figures relating to line or wire mileage worked by the railway companies were published. On the appropriation by the Post Office in 1870 these circuits were simply handed over to the railways as part of the price for not opposing the state take-over. The railways then had to create their own Telegraph Departments to take over the construction, maintenance and operating functions previously undertaken by the telegraph companies. A large number of telegraph company managers and clerks chose to join their existing co-workers on railways rather than be absorbed into the Post Office regime.

The vast independent railway telegraph networks survived into the late 20th century.

14.] **TELEGRAPH AT WAR 1854-68**
The Crimea

The war with Russia, when Britain and France landed a huge military expedition on the Crimea, a substantial peninsular in the Black Sea, in September 1854, was unusual. Far from being a war of movement it soon settled into being a long-term siege of the city and naval base of Sebastopol.

As far as Britain was concerned it was very much a "self-help" conflict with a remarkable series of voluntary initiatives. The railway contractor Morton Peto and his partner Thomas Brassey created a Railway Construction Corps from his own army of labourers and built a full-scale line of rails from the base port at Balaklava to the front line at cost. The mining industry in Leeds contributed two robust locomotives to work it. Joseph Paxton, architect of the Crystal Palace, organised an Army Works Corps to erect a township of wooden huts to protect the troops in the bitter winter. I K Brunel, the railway engineer, designed and had built a huge hospital from prefabricated components. William Fairbairn, the ironmaster and shipbuilder, constructed a pair of floating workshops to undertake all manner of repair and maintenance tasks for the besieging army.

The telegraph companies and their suppliers joined in with this war euphoria. In late 1854, the government in London created a military Telegraph Detachment for the Army commanded by an officer of the Royal Engineers. It was to comprise twenty-five men from the Royal Corps of Sappers & Miners (the army's artisan corps), a cadre of which were trained by the Electric Telegraph Company to construct and work the first *Field Electric Telegraph*, as it was called in 1854

The Telegraph Detachment was equipped with two telegraph wagons. Each was fitted with telegraph apparatus, instruments, batteries, a mole plough, a folding boat, all necessary tools, and drawn by six horses. The man-hauled plough was to lay a light underground cable. All this equipment was designed by the engineer Latimer Clark and made by his employers, the Electric Telegraph Company, at their workshops for the Army. The sappers brought with them twenty-four miles of copper wire insulated with gutta-percha resin for underground and underwater use.

Even before the War Frederick Cadogan, a barrister and a director of the Submarine Telegraph Company, had patented a lightweight army telegraph carriage on October 14, 1853. This had a closed wooden body mounted on a four-wheeled chassis, light enough to be hauled by a single horse in shafts. It contained everything to create and work an electric telegraph.

The body of Cadogan's army telegraph carriage was formed in two compartments. The fore part being a store containing shelves for batteries and apparatus and a long drum the width of the vehicle, on which insulated wire was wound, and from which it was run off to create the line. The roller was propelled by a geared hand-crank and limited by a brake lever. Roller guides were fixed on the roof and within the body to carry the insulated line away. The rear part contained two side seats, with spare cable drums beneath, and a central table for the telegraph apparatus, lit from a windowed door in the back. This part also had a side-hinged roof, lined with reflecting material to give extra light to the interior when opened.

In the field the line wire could be laid by either having the carriage move away from a place with a fixed telegraph paying out the wire, or the insulated wire could be run out and carried by hand. It could be wound back with the crank mechanism. A Manby's mortar, a small cannon, was provided to throw the wire across rivers or similar obstacles.

As well as forming a field electric telegraph it could be used for "firing trains", electrically detonating distant mines and other explosive charges.

As T W J Connolly in the 1855 edition of the 'History of the Corps of Royal Sappers & Miners', recorded:

"Two sappers in charge of the Field Electric Telegraph for service in the Crimea, arrived at Balaklava on the 7th December (1854), and repaired to the camp on the 17th, taking with them the instruments, batteries, insulated wire, and appliances, packed in two waggons. Twelve coils of wire, each a mile long, were packed in them, as also a subsoil plough, appropriate tools, and boats. The apparatus is only available for short distances and can be worked by six or eight men. To establish a communication between any two points, the wire, which uncoils from a drum revolving horizontally in a carriage drawn in advance, is laid in a shallow trough made by the plough, which serves the double purpose of cutting the furrow and depositing the line. The trough is just deep enough to protect the wire from ordinary accidents. Equally effective is the apparatus for communication with vessels at sea; and on any sudden removal of the army from one position to another, the wire can be so easily taken up that the men in charge of the telegraph are not likely to be embarrassed in any movements that may be determined upon. The two sappers were specially instructed in the electric telegraph establishment at Lothbury in the mode of working the instruments, laying the wire, and in the ingenious manipulation required to give effect to the process. Such, however, has been the state of the weather from snow, that no opportunity has yet occurred of employing the telegraph; but regarded as an important appendage to the army, Sergeant James Anderson and two privates have since been educated in the art, so that when the time arrives for using it, there will be an adequate staff of operators to attend to its scientific details."

The detachment was commanded from November 1854 by Lieutenant George Montagu Stopford, then from April 1855 by Captain Edmund Frederick du Cane, and finally, on his illness, from September 1855 by Lieutenant A C Fisher. The greatest burden fell on Lt Stopford who supervised the entire construction of the first electric field telegraph, making preparations during the bitter winter months and entrenching the wires in the spring of 1855 between the base at Balaklava and Sebastopol. S J G Calthorpe, a staff officer, was to write in his diary for March 29, 1855, "I have never mentioned to you that a field telegraph, which was sent out here near two months ago, is now in use. Lines have been laid down from Headquarters to Balaklava, to each of our Attacks, as well as to a station between the 3rd and 4th Division camps, and another between those of the 2nd and light Divisions. Lord Raglan (the commander-in-chief) can therefore now communicate in a few minutes with any of his generals at any time, day or night. It is also a great advantage to have it in the trenches, as in the event of any sortie by the enemy, reinforcements can be sent for and instructions asked by the commanding officers in either Attack."

Not everyone was welcoming to the innovation, a journalist reported from the Crimea, "The electric telegraphic apparatus passed up to camp yesterday (December 18, 1854) on two wagons, with thirty miles length of wire covered with gutta percha tubing, accompanied by the necessary implements for placing it *sub terra*. The first wire will be laid down from Lord Raglan's residence to Balaklava, to communicate with the various departments there. Two india-rubber boats followed the wires, the framework sides folding in, with paddles and sculls slung alongside. No one can imagine how these boats are to be employed, unless it may be for the heads of departments to visit his lordship, should the country be flooded, although from its hilly nature that would be almost impossible, except the deluge may return in Balaklava."

The Telegraph Detachment eventually possessed eight Field Electric Telegraph stations, 24 miles of line around Sebastopol, connecting the Headquarters, Kazach, the Monastery, the Engineer Park, the Right Attack, the Light Division, Kadikoi and Balaklava. It was a rough posting, the Engineer and Light Division stations were billeted in bell tents, the Monastery in a ruined inn, four others in wooden huts and one, the most forward, in a cave.

Each field station had two sappers to work a single-needle instrument, alarm and batteries, with a supply of battery plates and acids. They were assisted by two orderlies from infantry regiments to carry messages. The sappers worked the telegraph by turn, day and night. Sergeant Anderson, the senior non-commissioned officer, was stationed at the Monastery, on the Black Sea coast, receiving the messages from England by way of the submarine line from Varna and relaying them to Headquarters. The Monastery station later also handled the telegraph messages for the Sardinian Army.

At Headquarters, where Corporal Peter Fraser was the chief telegrapher, there were three corporals and three buglers, with three infantrymen acting as message orderlies. The messages to the Commander-in-chief were sent and received in numeric cipher; all other despatches were sent in plain English. Traffic at Headquarters reached a pitch in August 1855 with 402 messages sent and 464 received; that is, respectively, 15 and 13 despatches a day.

The operators, sappers and buglers, were drawn from the ordinary field companies of the Sappers & Miners in the Crimea and taught in the field by Corporal Peter Fraser, who had himself been taught to use the single needle instrument by the Electric Telegraph Company in London. Two of his charges were soon able to read code at a very effective 16½ words a minute. Sappers and buglers each received 1s 0d a day extra allowance for their proficiency and extra duties; and the two sergeants, Anderson and Montgomery, 5s 0d a day.

Pay for sappers working the Field Electric Telegraph was regularised in December 1856: non-commissioned officers in overall charge received 5s 0d per day as an allowance, sappers in charge of stations, 2s 6d, fully-qualified telegraphists 1s 6d, men responsible for batteries and lines 1s 6d and other telegraphists 1s 0d per day extra.

With regard to the practicalities of construction: the plough intended to lay the field cable often failed in heavy, water-logged earth before the city of Sebastopol and the eighteen inch deep trenches then had to be dug and filled by hand. Come Spring the telegraph was opened from Headquarters to Kadikoi, three miles distant, on March 7, 1855 and speedily extended to the siege lines. The gutta-percha insulated line was frequently broken; by troops digging for roots, by traffic, by burials, by shot and shell, by soldiers looking to use the gutta-percha to create tobacco pipe mouthpieces and, in one instance, by a family of mice.

In August 1855 Sidney Alfred Varley, on loan from the Electric Telegraph Company and younger brother of the company's senior electrician, C F Varley, was appointed civil superintendent of the field telegraph and, with ten civil clerks, sent out to work the equipment under Captain du Cane. It was intended to have one sapper and one civilian clerk to each field telegraph station. This proved unnecessary as the sappers worked the line perfectly well, without complaint, and the remaining civilians were soon posted to work the new submarine circuit on the other side of the Black Sea between Varna and Constantinople.

An Electric Telegraph School was opened at the Royal Engineer's depot at Chatham in Kent to train sappers and to maintain the Army's electrical equipment. The course lasted five months.

The British outfitted the Turkish Contingent Force, a mercenary corps, in 1856 with another telegraph detachment. Unlike its own unit this was provided with galvanised wire and lightweight porcelain insulators for attaching to trees and fencing, with only a few miles of gutta-percha insulated underground cable.

Attached was a single Electric Telegraph Wagon. It was intended to connect the several divisional headquarters of the Contingent when it was in a near permanent location with ten miles of wire and instruments for two terminal and two intermediate stations. The wagon was part of the First Company of Engineers, in the headquarters' reserve. In addition to communication duties its sappers operated the "Voltaic Apparatus" used to electrically detonate explosive charges.

The Electric Telegraph Wagon was a simple, tarpaulin covered military carriage with four 4¼ foot diameter wheels on india-rubber springs, to be drawn by one or two horses, made by A & E Crosskill in Beverley, Yorkshire, and once again outfitted by the Electric Telegraph Company in London. It contained four cases of equipment: one with tools and spare parts, the second with ten miles of No 16 gauge iron wire, eight sulphate cells, or sand batteries, in gutta-percha containers and the necessary chemicals, the third four single-needle telegraph instruments and four nitric acid batteries in oak containers for detonating charges, the fourth had two miles of gutta-percha covered copper wire on drums and a ladder. Iron wire for the long field circuits was to be used as it was cheaper, was more durable than resin insulated wire, it occupied less space and was easier to re-use. The Contingent's telegraph outfit cost £175, with another £32 for the nitric acid batteries.

The neighbouring French Army initially relied on a version of the Chappe *télégraphe aérien* or semaphore for its field signalling between the Sebastopol front and its base at Kameisch, but later also laid electric circuits, using the American telegraph.

Sebastopol fell to the French, British, Sardinian and Turkish forces on September 9, 1855. The war formally ended in 1856.

The Crimea Cable

The Telegraph Detachment initially also managed the Crimean shore-end of a temporary 310 mile long submarine cable laid from the Monastery signal station near to British headquarters in Balaklava to Varna in Turkish Bulgaria. This connected to the European circuits via a French Army-built land line to existing Austrian circuits at Bucharest, hence to London and Paris in autumn 1855. Politicians were thus enabled to interfere with all manner of military tasks.

The Black Sea cable was constructed by R S Newall & Co., who had laid the first successful submarine telegraph across the English Channel. Newall made his unsolicited proposal to lay a cable at cost to the War Department in London on December 9, 1854. It was accepted on December 12. By January 16, 1855 four hundred miles of cable had been insulated by the Gutta-Percha Company in London and shipped to Newall's Gateshead works for finishing, a construction gang of sixty men assembled and a new transport ship chartered! But things then went wrong; the new ship proved unseaworthy and the winter weather was terrible. The cable and equipment had to be transferred to a stronger vessel and only left England on February 25.

Newall's steamer, *Argus*, carrying his business partner Charles Liddell, his engineer Henry Woodhouse and the Army's Captain E F du Cane, as well as the cable, arrived at Varna on March 30, to be joined shortly by its navy escorts, HMS *Spitfire* and HMS *Terrible*.

It was decided to lay the cable from Cape Kaliakria, thirty miles north of Varna to Monastery Bay at Crimea. The little fleet set out on April 1 and completed laying the first war cable on April 13, 1855. The connection at the mainland end was meant to be by a line of overhead wire from Kaliakria to Varna but there was enough cable left for a submarine circuit instead. The Crimean cable made its first message from Balaklava to London on April 28, 1855.

Eventually a *Submarine Electric Telegraph Department* of the Army was created at the Monastery and Varna. This was drawn from the officers and men of the Royal Artillery rather than the Sappers & Miners. Their training was provided by the Sappers and the work was shared with civil clerks posted from England.

Some years later Samuel Alfred Varley was to write, "The cable consisted, throughout the greater portion of its length, simply of one No. 16 copper wire, served with gutta-percha a little less thick than the core of the 1858 Atlantic cable, and wholly unprotected. The shore ends had an iron sheathing, extending to a distance of 10 miles from the Varna shore, and of 6 miles from the Crimean coast. Its insulation was very perfect; and it remained in that condition for nearly twelve months, during the period of the Russian war, notwithstanding the many violent storms to which it was exposed in the Black Sea, until during a storm of more than usual severity, it was broken on the 5th December, 1855."

R S Newall also laid a cable for the British government from Varna direct to Constantinople, the Turkish capital, where another land circuit existed to Vienna and the European capitals. The cables were all worked with the American telegraph to enable compatibility with the continental circuits.

As with Morton Peto and the Crimean Railway, the speedy prosecution and success of the Crimean Cable was to be the pinnacle of R S Newall's career.

After the Crimea

Britain 1856-1862

The Corps of Sappers & Miners, that had effectively worked the electric telegraph in the Crimea in addition to its main function of creating the siege works about Sebastopol, was re-titled the "Royal Engineers" in October 1856, merging with the officer-only corps of that name.

The Army adopted the electric telegraph for internal communication in its fortresses; firstly at Malta and then at Gibraltar, eventually at those at Portsmouth, Gosport, Chatham and Plymouth in the late 1850s.

The military telegraph came of age in the 1860s. After its successful introduction the Crimea War of 1854-6 the field telegraph was utilised by the British Army in India, in China, in New Zealand, in Afghanistan and in Abyssinia; by the French Army in Italy in its campaigns at Gaeta and in Lombardy; by the Spanish Army in Morocco; and by the Prussian and Austrian Armies in Schleswig-Holstein and in Bohemia.

The field telegraph in China followed the headquarters of the advancing expedition many miles inland from the port of Canton. It was erected under the command of Major A C Fisher RE, who had had similar duties in the Crimea and had been the first head of the Army's Electric Telegraph School in Chatham. Its first line was from the harbour and the Navy detachment in Canton to Army headquarters with one intermediate station, a distance of 3,500 yards, laid on April 26, 1858. It was estimated that 25 sappers and 200 soldiers could lay one mile of single-core, gutta-percha insulated cable to a depth of twelve inches in one eight-hour day. The Canton force anticipated using Henley's magneto-dial telegraph but found that single-needle instruments had been sent. These required the local production of sulphate batteries, which had not been included in the equipment.

W T Henley manufactured a simple portable military telegraph that was adopted for field service by the British Army during the 1860s. It was a miniature single-needle galvanic telegraph instrument in a box-like mahogany case. The needle was calibrated so that it could also be used as a galvanometer; and it had two button keys let into the base. It was easily put into circuit with small butterfly nuts on either side of the case, and was carried by a brass ring on its flat top.

This very neat instrument, unlike Henley's magneto-telegraphs widely used in public circuits in Britain, required portable batteries; it could be worked with just two sulphate cells, and used either light iron wire or a resin-insulated field cable for its operation.

France 1855-1860

Probably first used in the Crimea, where regular use of the "mirror telegraph" by the Russians was reported in 'The Times' newspaper, during 1855 the French Army in the sun-baked deserts of Algeria was operating several patterns of *télégraphe solaire* or *héliographe*. These had been developed by Jules Emile Leseurre (1828-1864), one of the government's *inspecteurs des lignes télégraphiques*, to enable communication over long distances by reflecting the sun's rays. There were three models, the first was in a wooden box 50 cm by 30 cm by 40 cm, mounted on three short feet, out of which folded an elaborate two-mirror solar telegraph with a set of sights, a quadrant and a compass. There was also a very simple, lightweight single mirror version with a telescope sight on a tall tripod, with the reflector supported on a ball-mount at the end of the sighting tube, weighing in all 2.6 kg. They transmitted the European Alphabet or dot-dash code. By the 1860s the two-mirror apparatus had also been made lighter, adding the telescope sight, and set on a tripod. In October 1855 it was reported as working over 20 leagues (each 4.45 km). On one "line" between Boghar and Laghouat in southern Algeria, a distance of 240 km, three Leseurre solar telegraph posts replaced 23 messenger stations.

It was to be over ten years before other armies discovered that the heliograph was an inexpensive, portable alternative to the field electric telegraph.

However, in addition to adopting the heliograph, the French Empire had learned from observing their allies in the British Army during the Crimea war. For their brief and bloody campaign in northern Italy against Austria between May 31 and July 6, 1859 they organised a "*service télégraphiques*". This was formed of civilian staff engaged to follow the army in two "*brigades*" of ten waggons. It successfully laid 400 kilometres of line and created thirty-five telegraph stations along the advance, using light 2mm gauge wire on 6 meter poles, to keep the army in touch with metropolitan France. Each station was equipped with a portable American telegraph and Marie-Davy sulphate batteries.

In addition there was a clandestine "flying telegraph", a field telegraph worked by the military rather than civilians by which the Emperor Napoleon III's mobile headquarters was put in circuit with field stations at each corps and division of the army across the twelve mile front. This was accomplished by horsemen unrolling a lightweight gutta-percha insulated cable as they rode between the units, their operation "planned in Paris, and a supply of gutta-percha-covered metal thread forwarded with secrecy and dispatch". The cable was manufactured by the Gutta-Percha Company in London and the instruments used were Wheatstone's recently patented Universal magneto-electric dial telegraph that transmitted the roman alphabet.

It was claimed that at the decisive battle of Solferino on June 24, 1859 "the movement of the whole army was known and regulated like clock-work" by telegraph.

Spain 1859-1860
Between October 1859 and April 1860 Spain was at war with Morocco, with an army under General Leopoldo O'Donnell, extending its interests into Africa from its ancient enclave of Ceuta. The Royal government in Madrid commissioned a war telegraph of W T Henley in London. The largest element was a 25 mile lightweight underwater cable, with a single No 14 gauge copper core, linking the mainland at Tarifa, near Algeciras, across the Mediterranean Sea to Ceuta on the Moroccan coast. It was laid by the steamer *Tweedside,* which had brought the cable from London, during the midday hours of December 21, 1859; on which same day Ceuta was connected electrically with Madrid and the rest of Europe.

To accompany the troops of the Spanish expedition W T Henley also provided a complete field telegraph; including transport waggons, his magneto-telegraph instruments and a specially-designed field cable made with a copper core, gutta-percha insulation and lightweight iron wire armouring. The telegraph train followed General O'Donnell's staff out from Ceuta.

Britain 1863-1866
The British Army created a *Telegraph and Photograph School* with the Royal Engineer Establishment at Chatham Depot in 1858. Until 1864 the Chief Instructor in both of these arts was Captain Henry Schaw RE (1829-1902), a Crimea veteran, who went on to become Inspector-General of Fortifications. He was succeeded, between 1866 and 1871, in the same combined role by Captain Richard Hugh Stotherd RE (1828-1895), who was responsible for "the development and organisation of the equipments for military field telegraphy and signalling, and in working out a system of defence by torpedoes" in that position; the telegraph element of the school being also responsible for training for flag and light signalling, and for submarine mining. Stotherd was to command the Survey of Ireland and eventually became Director General of the Ordnance Survey.

On October 23, 1862 a detachment of the Royal Engineers from the Chatham depot forming a surveying party was to embark for New Zealand. All of its members were to be trained in the use of the electric telegraph, and "a complete telegraphic apparatus was to accompany them."

In 1863 the British Army had standardised its field telegraph equipment. It was still using a portable twelve-cell Wollaston battery, weighing 24 pounds, devised in 1813, although more modern Daniell sulphate cells were also available. For long military lines it used lightweight seven-strand No 22 BWG iron wire tied to earthenware insulators with No 18 gauge iron wire, stapled on to larch poles, 25 to 30 feet in length. For field service it had underground cable of No 16 BWG copper wire insulated with two coats of gutta-percha up to No 2 gauge thickness, coated with an anti-rot compound and a cotton serving steeped in tar. The wire and cable was wound on to portable wooden spindles on hand-barrows for easy unreeling.

This light and portable equipment was developed from the Army's experience in using the telegraph in field operations in the Crimean campaign in 1854-6. A dedicated telegraph construction and operating unit was only established in the 1870s – telegraphy was, until then, handled by the sappers of the Royal Engineers as part of their general duties.

During the 1860s there was a continuing dispute between the Royal Engineers and the Quartermaster-General as to which department should operate the field and fortress telegraphs for the Army.

During 1863 Captain Frank Bolton, an infantry officer, introduced his Portable Field Telegraph. This was based in principle on the American sounder or acoustic telegraph, but "carried by one man, in the form of a set of accoutrements, the indicator on the shoulder, close to the left ear, the battery in his pouch, and the finger-key, or contact maker, attached conveniently to the waist belt. With a proper supply of covered wire, each man would represent a complete telegraphic station in himself, being able either to send or receive." It was, being so compact and mobile, a wired 'walkie-talkie'.

The British Army had tested Henley's magneto-electric dial telegraph, developed in 1861, but found that although less complicated than competitive dial instruments Henley's was more "liable to error from unskilful manipulation".

At the same time several sets of Wheatstone's Universal telegraph, also a magneto-electric dial device not requiring any batteries, were purchased by the Army and tested in Ireland. This device was fitted in a small portable case. The Universal telegraph was that first tried on the battlefield by the Imperial French Army in 1859 during their invasion of Italy.

Prussia 1866
Of note was the use of the electric telegraph by the Prussian Army in 1866 against the Austrians. Four independent Telegraph Detachments were organised, each carrying 27 ½ English miles of wire with American printing telegraphs and batteries. The Detachments were able to lay wire at the speed of a marching column of infantry. One Detachment was deployed by each of two Army Groups in Bohemia, one was attached to the King of Prussia's personal military staff and one was held in reserve. At least two problems arose with their field telegraph: the wires were insulated in gutta-percha; this was found (yet again), however well protected, to oxidise and break in air, to be unsuitable for repeated rolling out and re-rolling, and to be vulnerable to severing by waggon-wheels. Latterly the wires were suspended from lightweight poles. Also the field telegraphers rode on horses, this was found to exhaust them over long distances, special horse-drawn carriages were then provided. The Prussian Army did not, at this time, use any optical flag or light signals.

Britain 1867-1870
Captain Stotherd, Chief Instructor at the Royal Engineers' Telegraph School in Chatham, prepared a plan for a standard Field Telegraph in 1867, based on the

most recent British and continental battle experience. Each Field Telegraph was to consist of three travelling telegraph offices and twelve wire and store waggons, carrying 36 miles of insulated wire and tools, three general service waggons, three artificers' waggons and a field forge. There would 245 officers and men in each Field Telegraph, including two Royal Engineer officers, a surgeon, a veterinarian, 90 sappers and 95 drivers and signallers; with 145 horses. There were twenty-five fully-qualified telegraphers in its ranks, including both of the officers.

They were intended for three purposes: to connect an army headquarters with the civil telegraph system; to follow an advancing army forming a line of communication to the rear, and to inter-connect fighting units near to the front.

The *travelling telegraph office* was described by Stotherd in 1870 as being like "a small omnibus" on four wheels with good springs, being drawn by a pair of horses. It carried two American register telegraphs on a small table, with two modified Daniell sulphate batteries beneath the table. It also possessed four other electric telegraphs in reserve; two more registers as spares and two American sounders for forward field use, along with two more batteries. It also had a set of Columb's signal flags and lights. Completing its load were copper earth plates, a roll of tools for repairing instruments, a tent, cooking utensils and picket ropes for the draught horses. It was crewed by three telegraphers, a driver and a spare man as cook and labourer. The travelling telegraph office weighed when loaded 22 hundredweight or 2,464 pounds, a large load for two horses.

The accompanying *wire and stores waggon* was also mounted on four wheels with springs, drawn by four horses, carrying six wooden drums each with three miles of insulated wire, along with tools and eighteen lightweight iron poles and a light ladder. The wire was intended to be laid upon the ground, the iron poles were to carry it over road crossings where it otherwise might be damaged by traffic. There was a portable ladder that could extend to 18 feet or fold to form a step-ladder. Underneath was slung a wheelbarrow on which one of the drums could be fitted and use to pay out wire. The wire was otherwise paid out from the waggon itself as it moved along the road. It weighed 32 hundredweight, or 3,584 pounds, and was protected with a waterproof canvas cover. There was one non-commissioned officer and six men to each stores waggon. The waggons worked in pairs, one laying wire and one erecting poles. The wire could be laid at the rate of 2½ to 3 miles per hour.

There was also a process to dismantle the line and rewind the wire onto the drums.

Stotherd standardised the electrical equipment of the Field Telegraph to two types of instrument; the American register and the American "sounder", both made especially durable, coming from one supplier, Siemens Brothers of Charlton, Kent. The sounder and its key, strongly made for field work, were to be used near to the front line. This simplification was based on experience in the field and as the system was generally adopted on the continent of Europe. For the same reasons no delicate instruments were carried, no galvanometers or relays, that might be subject to damage. Stotherd also proposed field use of "Bolton's Cipher Wheel" for both written and telegraphic messages. Two cipher wheels were later provided to each field unit.

The wire used was three-strands of No 20 gauge copper insulated with india-rubber to 2/10 ths of an inch diameter, covered with two thicknesses of tarred cloth tape. It had been severely tested by being over-run with all manner and weight of waggons. The wire was manufactured by Hooper's Telegraph Works Company of Millwall, and by the India-Rubber, Gutta-Percha and Telegraph Works Company of Silvertown. The ends were fitted with a weather-proof connector devised by Sergeant-Instructor Mathieson of the Royal Engineers that allowed their instant joining together.

The light iron poles were in two parts, fitting one inside the other for travelling. The lower part was 10 feet long by 1 inch diameter with a pointed shoe to be driven into the ground; the upper part was 9 feet long by 7/8 inches diameter. They were joined together by a bayonet fitting. A separate wooden "catch" was added to the tip to carry the wire and two supporting guy-ropes that were attached to iron ground pickets.

In 1870 Stotherd added a portable boat to the equipment of each Field Telegraph for use in laying the insulated wire across rivers.

It must be said that most of this system, including the portable boat, had been devised by Latimer Clark, engineer to the Electric Telegraph Company, eighteen years previously, and used by the Army in the Crimea.

Sir Francis Head, Bt, visited the Telegraph and Photograph School at Chatham in 1868 and left this description of Stotherd's Field Telegraph:

"The travelling telegraph office, in which as a dealer in lightning wholesale and retail, I sat by myself for several minutes, ruminating whether I most resembled *Jupiter Tonans*, or a common itinerant wizard - is really a curiosity. The sides and doors of this small chamber (4 feet 3 inches in breadth, and 5 feet 6 inches both in length and in height) are composed of cedar; its window being shaded by sliding green curtains.

"The furniture consists of a desk covered with fine green cloth, on which stood before me two of Morse's recording instruments, each about the size of an ordinary drawing-room chimney-piece clock. Beneath the desk, neatly arranged, and living together in happy communion, I discovered two electric batteries and two spare instruments. My seat, a cushion resting on two light white wicker baskets, contained a set of day and night visual signalling apparatus, a light patrol tent, and a set of cooking utensils.

"These wicker baskets, packed as above, and adapted to travel on a pack-saddle, enable the establishment, wherever the wire-waggon is unable to proceed, of a branch station for visual signalling.

"On the left of the operator or magician, when seated on this cushion is a cupboard opening by two light thin sliding doors, containing coils of recording paper, with a signalling apparatus to enable him to communicate with the men he has detached with the baskets on pack-saddles; lastly, it contains their kits, accoutrements, and, when on the march, their provisions.

"At the back of the seat are racks for the sappers' rifle carbines and sword bayonets; over the operator's head are fixed their tent-poles.

"Outside, on the roof of this conjuror's den, high above the two horses that draw it, is a seat and cushion for three non-commissioned officers, with a large boot beneath to carry the horses' gear and driver's kit; and underneath this boot a compartment, extending the whole breadth of the carriage, containing a water-barrel, field-stove for soldering, &c, hammers, a spade, and a few other heavier tools. The whole on springs with a drag-chain.

"To this little travelling office - which, weighing when fully loaded only about 20 cwt, is of course easily drawn by two horses- are attached three non-commissioned officers, each competent to act as a telegraph clerk, and a driver.

"The wire-waggon, drawn by four capital short-legged, active horses, conducted by two drivers girded with swords, and protected by its armed guard of non-commissioned officers and sappers, is composed of the platform and wheels of an ordinary general service waggon, on which, as a superstructure, is an elevated driving - seat capable of carrying three men, having beneath their feet a deal box of the whole breadth of the waggon, about 2 feet deep and 3 feet broad, containing besides picks and shovels, the kits of the drivers and their provisions.

"On the platform behind are fixed two sets, four in each, of revolving drums, around each of which is coiled half a mile of insulated telegraph wire (making altogether four miles). Reposing between the two sets of drums lie twenty-four iron tubular poles 10 feet long, of 1½ inches diameter, each of them containing within itself another smaller one 9 feet long, which on being drawn out, can, by a common bayonet-socket arrangement, be firmly fixed to the larger tube, thus forming a pole of elevation 18 feet high, which is fixed or inserted in a hole made in the ground by a common crowbar, or "jumper," driven by a sledge hammer, and then like the pole of a tent maintained in its place by three wire-rope guys secured to pegs, similar to those of a tent, excepting that they are of iron instead of wood, to prevent hungry men burning them for cooking when short of wood. These poles, which are pointed at the end, are simply used for road-crossings, to prevent the wire from being injured by the traffic.

"A common spike, driven into a tree or wall, may also be used where such supports are available.

"In two instances I saw a sapper, after running up the bars of a very light scaling ladder in two joints, belonging to the waggon, fix it by merely winding it once round a tree. Indeed, as it advances, it can easily be attached to almost any object in its path, and although, as I have described, it is usually elevated on passing a road, yet so efficiently is the wire protected by its thin insulating elastic covering, that waggons, and even a whole battery of guns, have been driven over it on a hard road without injuring it.

"The process of laying the wire down, as I witnessed it, is as follows: -

"Before commencing, three non-commissioned officers and twelve sappers suspended their rifles to loops on the sides and rear of the waggon's driving-box. At the word of command, just as an actor on the stage suddenly changes his costume, these useful men threw off their coats, their stocks, and then set to work, which consisted in actively paying out and fixing in the different ways I have described, the wire as the waggon proceeded.

"As soon as one of the eight half-mile coils was expended, I saw it rapidly connected with the wire of another by a simple and scientific joint... so thoroughly waterproof, that it is now used as a joint for connecting the electric cables of torpedoes under water.

"When the wire-waggon with its extraordinary conversational apparatus, from the absence of roads, or from the presence of bad ones, or of boggy ground, is unable any longer to proceed, one or more of the eight half-mile coils are carried forward by sappers on a hand-truck, (it occurred to me that one of these coils might easily be affixed to a horse's pack-saddle), and uncoiled by other sappers as they proceed, the electric communication being maintained by a portable sounding, hand instrument already described, ingeniously adapted by Captain Stotherd to be worked by one battery in the waggon, by which arrangement the electrical pulsations are communicated through the vein or wire from the arterial line, of which the waggon is the extremity."

The sappers of the Royal Engineers before 1868 were trained on a range of instruments: the single needle and two needle telegraphs, the American recorder and the American sounder and the Universal telegraph. On these instruments they sent and received the "European Alphabet", except with the two-needle device which had its own code, and the Universal telegraph which worked the common roman alphabet.

In July 1868 the 'Quarterly Review' described the Field Electric Telegraph Train that the Royal Engineers maintained at their depot in Chatham, Kent. This consisted of a number of field wagons carrying coils with four miles of insulated copper wire, iron poles, pickaxes and shovels, and several travelling office wagons containing the instruments and batteries, a desk and writing materials. The insulated wire of the Field Electric Telegraph was laid on the surface of the ground, using the light iron poles to carry it over road crossings.

British India & Abyssinia 1867-1868

Far away from Chatham the campaign to depose King Theodor of Abyssinia in north-east Africa and to rescue several diplomatists and missionaries from his regime was mounted by the Government of British India at Bombay during the late summer of 1867 and carried out in the spring of 1868. It was to be a massive expedition of European and Indian forces, 13,000 soldiers, 26,000 bearers and 40,000 animals, intending to land on the Abyssinian coast at Zula and proceed inland to Theodor's fortress-capital at Magdala.

The British Indian Army called upon Major John Champain of the Indian Engineers, much experienced in organising the telegraph lines in Persia, to prepare a plan for a Field Telegraph Train to support the expeditionary force. His plan was submitted in September 1867, proposing two services – an "aerial line" to connect the headquarters with the coast, and a "flying line" to connect the headquarters with its outposts. Champain, in Bombay, was only distantly aware of Army developments in England and, to some extent, 'reinvented the wheel'.

The "aerial line" was to allow for 350 miles of line, consisting of bare copper wire to No 16 gauge, weighing 60 pounds to the mile, suspended on 10,000 bamboo poles, eighteen feet tall, without insulators. To traverse forests, by attaching them to trees, and to allow for rare wet or marshy ground, 4,000 light insulators were to be provided. The copper wire would cost £1,000, the insulators, £500. To work this eight of Siemens & Halske's latest American telegraph instruments, used in India, with portable tables were needed, at £50 each, in total £400, with four tents to house them. One hundred Native Pioneers were to undertake the construction under four European Engineers, and twelve European Signallers were to work the line.

For the "flying lines" between the expedition's field units 50 miles of stranded copper wire insulated with Hooper's india rubber were allowed for, each drum of this to weigh 140 pounds so that two could be carried on a mule. The wire would cost £2,250. To work these mobile circuits twelve Siemens & Halske "sounders" or acoustic telegraphs were to be acquired at a cost of £25 each, £300 in all, requiring the recruitment of twenty European Signallers for their operation.

Lt St John of the Indian Engineers was appointed to command the Field Telegraph Train in Abyssinia and Lt Morgan was to assist him in commanding the European Signallers on the instruments.

In addition to the electric telegraph the Train was equipped with Commander Philip Howard Columb's Flashing Signals, an optical telegraph, as well as flags and heliostats. Two sets of Columb's apparatus were provided by William Nunn, maker of ships' signals and other lamps, of 67 St George Street, London Docks.

The Abyssinian Campaign, with its massive army and elaborate supporting train, which included a light railway and a portable pier or landing stage at Zula, was successful, Theodor being deposed, the hostages rescued and order restored, at a huge material cost. Only 29 British Indian troops were killed, and around 500 Abyssinians. The lightweight or "flying telegraph" was a failure and quickly abandoned, however the long "aerial line" following the Army sent and received 7,848 messages over the five month campaign.

British Outposts 1863-1870

The Army's depots and fortresses at Aldershot, Portsmouth, Malta, St Helena and Bermuda were all provided with electric telegraph circuits for internal communication. In July 1868 the Army was also working telegraphs in Persia.

The longest circuit that the Royal Engineers operated was on the islands of the Bermudas in the mid-Atlantic Ocean, connecting the strategic forts and the navy yard. During 1863 No 5 Company, Royal Engineers, had constructed a single overhead, roadside iron wire from the Central Signal Station at Fort George above St George's, the mercantile port and principal military garrison in the eastern part of the colony, eleven miles west to the Governor's Residence at Mount Langton. By 1866 the line had been extended two miles westwards to Spanish Point and the Admiral's House opposite the Royal Navy yard and fort on Ireland Island. It was completed in 1868 by a 2¼ mile submarine cable to the yard. In 1864 the civil government contributed for its extension with a branch from Mount Langton to the Post Office in the capital of Hamilton. There were eleven military telegraph offices on the Bermudas in 1868, reduced subsequently to nine, most of which were also open for public use.

This system gradually replaced the flag signals that had worked across the islands since the 1820s, which by 1847 had four hill-top posts - at Fort George, with the Central Signal Station for shipping and for meteorological reporting, Mount Langton, Gibbs' Hill, with the colony's lighthouse, and Ireland Island. The flags indicated the arrival and passing-by of shipping and other events, including a midday time signal; the numerical flag code was easily read by the civil residents, who were also allowed to send private messages.

15.] TECHNICAL DETAIL

Context

The electric telegraph was not invented by Cooke or Wheatstone, or by an American.

Carl Friedrich Gauss and Wilhelm Eduard Weber constructed the world's first electro-magnetic telegraph in Göttingen, Hanover in 1833. It consisted of induction-coil transmitter, not a galvanic source, and a galvanoscope as the receiver. The one kilometre long over-house circuit of two iron wires was built between March and April 1833 to coordinate the use of astronomic clocks at three locations at the University of Göttingen, and later had several "speaking" codes devised for it. The world's first electro-magnetic telegraph was in use until December 1839.

A small curiosity is that Hanover was a vice-royalty of the British crown, governed the Duke of Cambridge, until Victoria became queen in June 1837.

In 1835 Paul Schilling von Cannstadt, a Baltic-German living in St Petersburg, Russia, displayed to an academic audience his five-needle galvanic telegraph, the first using simple galvanometers to indicate messages. He was commissioned to make a line from St Petersburg to the Imperial village of Tsarskoe Selo in 1837 but died before commencing the works.

Carl August von Steinheil constructed a six kilometre long, two-wire circuit between his campus at the Academy of Science and the Royal Observatory in Munich, Bavaria, in 1836. This was worked by Steinheil's galvanic printing telegraph which had two nibs controlled by electro-magnets writing dots on a moving roll of paper. This was the first printing telegraph.

Steinheil's subsequent telegraphic inventions included the single wire and ground return circuit, the needle telegraph worked by current reversal, the acoustic telegraph using two bells with different notes, as well as the printing telegraph using "dots", groups of which made to emulate the forms of printed roman letters (only vaguely, it should be said).

As will be seen the subsequent decade saw the true innovations of Gauss and Weber, Schilling and Steinheil re-invented in several guises.

Railways or Roads?

As has been noted the Electric Telegraph Company and the British Telegraph Company negotiated wayleaves or rights to make their circuits paralleling the new railways. The obvious alternative to telegraphs alongside of railways was alongside of public highways. The roads of England and Scotland were carefully made up and solid, and, despite the introduction of the railways, were still well-maintained.

The Special Acts of the telegraph companies gave them general powers to open up and pass wires through any public road without compensation, provided notice was given to the local surveyor of roads and that the surface was reinstated. This provision was used by all of the companies for underground street circuits in cities and towns. Only with the advent of the new companies after 1851 were roadside lines adopted for long lines; virtually all of these roadside circuits were made underground as resin-insulated cables protected and concealed in wooden troughs or iron pipes.

There was, from the earliest days, strong opposition to the placing of poles and overhead wires alongside of public highways and turnpikes. Parliament generally resisted giving such powers to the telegraph companies, only the British Electric Telegraph Company's Act of 1850 gave specific authority to erect roadside poles and over-house wires. Poles were for many years confined to railways.

Only the British Telegraph Company used its general powers to attempt short roadside overhead wires in the 1850s where it could not gain a railway wayleave. Its pole circuits along roads led to public objections, from their intrusive nature and from the damage caused to the trees that lined most of the coach roads. The overhead wire circuits on open roads were also particularly vulnerable to vandalism.

At the end of the decade the Magnetic Telegraph Company was compelled to adopt roadside overhead wires when its many long underground gutta-percha cables began to decay in 1858; extending them even into city centres, high over the tops of houses. It was only able to do this by licensing the powers of the British company, which it absorbed in 1857. The Magnetic's protégé, the London District Telegraph Company, also "borrowed" the British company's Act to enable its over-house wires in the capital.

In the 1860s the United Kingdom Electric Telegraph Company was the first to generally adopt overhead or pole circuits alongside of the city to city coach roads. It met with immense public opposition, particularly from landlords with country estates and other property bordering the highway being "poled". This hostility was encouraged by the competitive companies.

The United Kingdom company was compelled to seek another Act permitting it to use overhead roadside circuits in 1863 after failing to agree terms with the individual who then owned its original 1851 rights. It was compelled to place poles along canal banks until then.

The Universal Private Telegraph Company's Act of 1861 granted it the right to use roadside overhead wires. Eventually the Telegraph Act 1863 gave general powers to all companies.

A significant technical detail was that at this time the British domestic telegraphic circuits were not in continuous charge; unlike in the United States where the line was always 'live'. The electrical source was only applied when messages were to be sent, that required was moderate by comparison.

Construction of domestic lines of telegraph in Britain was undertaken, with minor exceptions, by the companies themselves. They engineered the lines; employed and managed the necessary labour gangs directly, without the use of contractors. Iron wire, insulators, underground cable and iron conduits were purchased from manufacturers for both construction and for maintenance, by-and-large, to the companies' patents and design specifications. It is clear from their annual reports that large quantities of telegraphic stores were maintained by the companies for maintenance, renewals and new lines.

There was a difference with regard to underwater cables: the Electric company laid its own, the Magnetic and Submarine relied on contractors.

Apparatus

In 1845 the Electric set up workshops to manufacture instruments, and all of the companies bought instruments and components from patentees and manufacturers. Manufacturing and maintenance continued at the Electric and Magnetic companies' own workshops.

Distant Writing

In general between 1840 and 1870 public telegraphs in Britain used *needle instruments* for sending and receiving messages, connected from the earliest days by pole-suspended, *overhead wires* retained on insulators made of earthenware pottery, worked with galvanic batteries.

The needle instruments, almost unique to Britain, indicated the telegraphic message on a large dial by means of one or two index hands ('needles') moving either left or right to indicate the elements of a code or cipher. Each needle was worked electrically from behind the dial face by a small galvanometer.

The sending mechanism could be one or two small cylindrical commutators or switches worked by handles; or by keys (the latter known then in Britain as 'tappers' or 'pedals'), both connected to batteries; or by small magneto-electric devices (what might be termed pulse-generators) without batteries.

The First Telegraph

The initial permanent apparatus used by Cooke & Wheatstone was the five-needle telegraph requiring a five-wire circuit patented in 1837 to the design of Charles Wheatstone. It had five pairs of keys to work the five needles, left or right, on a diamond-shaped dial. This indicated twenty letters from the roman alphabet and ten numbers. A single needle was used to indicate a number (1 to 5 left, 6 – 0 right), two needles together indicated a letter. After a few minutes practice anyone who could read and write could work this device; for publicity purposes deaf children were allowed to operate it, and did so with ease. However user-friendly it might have been the need for five or six wires, that is five plus a common return, in a circuit made the five-needle telegraph uneconomic. These were only used on the brief circuit between Euston Square and Camden Town from September 6 to October 30, 1837.

Two groups of "diamond dial" five-needle apparatus were made; two 48 inch by 30 inch wall-mounted public display dials for Cooke & Wheatstone in 1837; and two miniature or desk-top instruments for the Electric Telegraph Company in 1849 as part of their law suit against George Little, a patent infringer. The latter pair were subsequently displayed in the Company's board room in Telegraph Street, along with a section of the original five-wire wooden batten that formed their first circuit in 1837 and which had been dug up in works at Euston Square railway station in 1863.

Table 36

Classified List of Electric Telegraph Patents

Compiled by Charles Coles Adey for the Institution of Civil Engineers, March 2, 1852

Date	**For Telegraphs, &c**
1837	Cooke and Wheatstone
1838	Davy
1838	Cooke
1840	Wheatstone and Cooke
1841	Wheatstone
1841	Bain
1842	Cooke*
1843	Bain
1844	Highton
1845	Wheatstone and Cooke*
1845	Bain
1845	Brett
1846	Highton
1846	Mapple*
1846	Poole*
1846	Bain
1846	Gamble and Nott
1847	Brett and Little
1847	Mapple, Brown & Mapple
1847	Ward
1847	Dujardin
1847	Reid*
1847	Petrie
1847	Hatcher
1848	Highton*†
1848	Brett
1848	Barlow and Forster*
1848	Henley and Foster*
1848	Bakewell
1848	Ricardo‡
1849	Pulvermacher†
1849	Hatcher
1850	Highton*†
1850	Brown and Williams
1850	Bright
1850	Siemens
1851	Clark‡
1851	Dering
1851	McNair‡
1851	Chatterton‡

*For Telegraphs *and* Insulation or Suspension of Wires.
†For Telegraphs *and* Batteries.
‡For Insulation or Suspension of Wires *only*

The original copper wires used on the earliest circuits were insulated by a covering of cotton or silk laid spirally over the wire; the cotton was steeped in india-rubber to protect it from the damp and then immersed in pitch and laid in wooden battens or small-bore iron pipes. The battens were buried in the earth. The pipes were mainly carried on short posts, but were also laid in the dampest conditions underground, even under-water. As an example, ten wires were laid in a two-inch diameter iron gas-pipe alongside of the London & Blackwall Railway in 1841. Cooke was to introduce a weight-driven air-compressor to keep the iron pipe pressurised and so free of water. The pipe joints were never air- or water-tight and the caoutchouc resin eventually cracked in heat.

The short-lived circuit on the Great Western Railway between Paddington and West Drayton worked from September 1839 until about February 1840 utilised W F Cooke's four-needle instruments with his "butterfly" keys, and five wires (with another spare).

Other early instruments introduced by Cooke & Wheatstone were the single-needle telegraph, needing just one wire, used on the London & Blackwall Railway in 1841 and the two-needle telegraph with two wires, first tried on the Edinburgh & Glasgow Railway in 1842.

The American Telegraph

The system patented by S F B Morse in 1846 was commonly called the 'American Telegraph' by government, by the telegraph companies and by the press in Britain during this period.

Before that, Morse had attempted to introduce in June 1838 a "homespun" version. The first receiver was contained in a wooden case; with a simple wooden clockwork drive for a paper strip and a needle on a metal rod moved by an electro-magnet. The transmitter used a wooden comb with separate, moveable teeth representing code elements to dip the tip of a pivoted arm into cups of mercury to make or break the circuit. It also had a similar repeater or relay using a pivoted arm and mercury cups on a wooden frame, copied entirely from Cooke and Wheatstone's patent of 1836.

These elements were eventually included in Morse's initial American patent of June 20, 1840. None of them were ever used in practice.

The "perfected" version of 1846 consisted of a 'key' to make and break an electrical circuit, a 'register' or 'embosser' that had an electro-magnetically-controlled point scratch a mark on a mechanically-driven roll of paper, and a 'relay' that took the weak line signal and amplified it in a separate local circuit to work the register. The 'register' was a substantial piece of equipment, now entirely constructed of brass and iron, requiring a strong current and a clockwork source. It had to be kept wound-up and to be turned on when a message was signalled. In Europe, by 1856 the scratching mechanism was replaced by a sensitive inking device, the "inker", that printed dots and dashes on the tape, and which required far less pressure and electrical current, rendering the local relay unnecessary. This improvement was devised by Thomas John, an official of the Austrian *kaiserlich-königlich Staatstelegraph*, in 1854. The 'key-and-writer', rather than the 'key-and-register', was the working mode of the American telegraph in European service from the mid 1850s.

Unlike its parent, the American telegraph in Europe developed in sophistication throughout the 1850s and 1860s. The original version, the "embosser", used by the Electric Telegraph Company from 1853 and made by Siemens & Halske, was replaced in the Company's service by Meinrad Theiler's "disc" inker in 1857, this had a thin wheel revolving in a reservoir of ink on the end of the lever instead of the original iron embossing pin. Siemens in Berlin soon produced their own version of the "disc" inker in 1862; this quickly dominated the north European market for telegraph receivers. In 1860 Digney *frères* in Paris developed the "bottle" inker, in which a siphon replaced the disc as the marking mechanism. The famous instrument maker, Breguet, also produced his own version of the Theiler disc inker, making the tape immediately readable by the receiving clerk. The Siemens and Digney inkers were used by the Electric, United Kingdom and Submarine Telegraph companies in Britain. Apart from the increased clarity in marking the message tape, the sensitivity of the inker over the embosser allowed for the abandonment of the local circuit and relay with its separate battery in all but the very longest circuits.

The American telegraph was replaced in Britain from 1868 by Wheatstone's automatic telegraph.

The reading of the scratch marks on the tape of the original register was in any case difficult and in America operators learned to interpret the movements of the device by its sound. By 1859, much against the wishes of S F B Morse, the "sounder" or acoustic telegraph was in common use on American circuits. This was a simple, small electro-magnetic device that clicked in time with the distant key, replacing the old register of 1846.

The first use of the sounder is revealed in a court case in Kentucky brought by the Morse Syndicate against one of its licensees, Henry O'Rielly, in mid-1851, to prevent him using their patented recording telegraph on any of his lines there. O'Rielly's clerks then disconnected the registering element and "Messages were sent... by listening to and interpreting the click made by the armature against the magnet." Although receiving by sound was not part of the Morse patent, the Syndicate used its influence to ensure that "for this acoustic offence the operator was arraigned for a contempt of court." The line between Buffalo and Milwaukie was being worked on the same acoustic principle in the same year.

The sounder was a great *economic* improvement over the old register. In 1861 William O'Shaughnessy said that the Indian government telegraph monopoly was saving £3,000 per annum after replacing its American registers with sounders. The Magnetic Telegraph Company in Britain also claimed in 1864 that its Bell apparatus, another acoustic receiver, saved it "several thousands" in a year over American 'writers'. It was subject to other criticisms, particularly in regard to its accuracy and security.

It needs to be emphasised that all the telegraphic terminal instruments described required constant attendance. There was in this period no apparatus that received a message entirely automatically. The needle and dial telegraphs needed a clerk at either end to send and receive. The American registers and writers and the type-printing telegraphs all had to be manually switched into the circuit on receiving an alarm from a distant station and the clockwork mechanisms needed to be often spanned to assure uninterrupted traffic.

A significant early change in technical operation was the move away from instruments requiring a two-wire circuit with earth returns to the much more economical single-wire circuit with earth return. This applied particularly to the two-needle telegraphs of the Electric and Magnetic companies; most contemporary and all subsequent devices used a single-wire circuit.

Auxiliary Instruments
Connections between electrical circuits within telegraph offices were made with a series of *turnplates*, small rotating brass switches of many designs. At larger offices the turnplates occupied much space and time in their switching functions.

Most telegraph offices in Britain were equipped with at least one desk-top *galvanometer* or a portable *detector* to measure the current in its lines and the state of the batteries. In appearance these were small single-needle instruments in fine wood cases, calibrated in degrees to record greater or lesser current.

Each early signalling telegraph worked in concert with an *alarum*, now spelled alarm. This drew the attention of the clerk to activity on the circuit. Those of Cooke & Wheatstone used an electro-magnet to release a clock-work-driven rotating hammer to continuously strike a bell until stopped manually. The alarums gradually went out of use in urban telegraph offices but were retained in remote stations where the clerk might be absent. The principle was adapted to remotely sound very large warning bells at the mouths of tunnels and similar points of danger.

The other common device in all offices was the *lightning protector* or *paratonnerre* which diffused the effects of extreme static electricity that otherwise might damage instruments and injure clerks. There were all manner of contrivances for this purpose, affixed to walls or on working desks in circuit between the instruments and the line of wire, with their own lead to earth.

Underground Cables
Whilst needle instruments remained universal in Britain, for a period between 1852 and 1859 *underground wires* insulated in a resin, commonly gutta-percha, and protected by lidded-troughs or in iron pipes were laid instead of pole telegraphs. Underground wires were apparently impervious to weather, vandalism and similar dramatic interrupters of traffic. All the extant companies constructed subterranean circuits for their trunk lines during that short era, virtually abandoning overhead wires to railway signal telegraphy. Although more secure these circuits required a much greater current; six twelve cell batteries could work 200 miles on a well-insulated iron-wire pole line but only 100 miles with a gutta-percha insulated copper-wire cable.

Then, in 1859, there were catastrophic electrical failures on a great many underground circuits as the gutta-percha insulation oxidised in air and disintegrated after several years' exposure. In 1849 the extensive subterranean Prussian and Danish telegraph systems built by the Siemens firm on a much cruder technical base, using "sulphuretted gutta-percha", laid under 24 inches of soil in a lead sleeve, had similarly collapsed after just a few months' service. Sulphur had been added to strengthen and improve the insulative qualities of the resin; but in addition it caused the copper to dissolve and in some instances the small current created a chemical reaction that ignited the gutta-percha. This latter effect was used to create the simple "Statham's Fuze" for detonating explosives by electricity.

Fortunately, the sale of the copper cores of the underground resin-insulated wires met a substantial part of the costs of replacing them with overhead pole lines.

With regard to underground (and to underwater) circuits it was found during experiments between 1859 and 1861 that the composition of the materials used was critical; there were large differences in the purity of copper metal, and gutta-percha was found to be delicate in its composition with air-bubbles, contaminating fibres and unexpected internal weaknesses, as well as sensitive to temperature. A major cause of electrical failure was in the jointing of the copper wires where lapping and soldering together made the core brittle.

There was argument over the merits of india-rubber over gutta-percha as an insulator. India-rubber was found to be the better electrical insulator, easier to join and more consistent in manufacture than gutta-percha, although its properties were such that it could not be drawn through dies for continuous covering.

For a short period in the early 1860s india-rubber was the more popular medium used to insulate underground cables, internal circuits and for insulators on overhead wires on poles. Caoutchouc or india-rubber had been advocated and used as an insulator for wire since 1838 by Charles West. He had unsuccessfully promoted a cable to France in competition with the Brett family, and had laid the earliest successful submarine telegraphic cable one mile across Portsmouth harbour for the Admiralty in 1845; it was still in use in 1860. West was engineer to several unsuccessful cable companies, including the Irish Sub-Marine company, and later became associated with S W Silver & Company, long-established manufacturers of caoutchouc goods. He developed with them a machine for spirally-winding thin india-rubber around copper wires to create cable cores. Silver & Co patented and manufactured underground and underwater caoutchouc-insulated cables and hard-rubber insulators for poles. However india-rubber was found on investigation and experience to be far less durable, being especially vulnerable to oxidisation in sunlight and general decomposition though weathering and age.

All of the issues raised were addressed with new processes. The sourcing of fine copper and its refining was immediately improved. So-called "pure gutta-percha" was introduced in 1861 that eliminated the contaminants and faults, and it regained its precedence in underground and underwater cable insulation until synthetics were introduced almost a century later.

There was, however, a general re-adoption of pole telegraphs in the 1860s for long distance lines and a flurry of patent applications for new insulators for overhead wires. Unlike in America the *insulators* used in Britain on these poles were not glass but glazed earthenware. In the period between 1838 and 1868 there were patents covering improvements in these so-called porcelain insulators, as well as a number later in the period using natural resin (*ebonite*, a form of vulcanised india-rubber) and resin-impregnated wood.

The principal technical differences between the companies in Britain were:

a.] **The Electric Telegraph Company**
The Electric Telegraph Company worked the master patent of Messrs Cooke and Wheatstone between 1845 and 1852 at first utilising *two-needle telegraphs* operated initially by 'S'-shaped rotating handles, then, and more commonly, by drop handles. It used two-wire circuits, with earth returns. In appearance they were substantial, in upright wooden cases of several descriptions, the original ones made by William Reid were quite plain, latterly they were much more ornamental. They all had a large square glazed dial above the two commutators or switches. The alarm bell, where fitted, was usually in a separate case, often placed above the dial. The instrument was put in and out of circuit by a rotating switch on the left side. Line and battery connections were at the back. The two-needle apparatus was considerably faster in working than the later single-needle device but this was counter-balanced by the cost of instruments and wires. In case of breakages in one or other of the wires the clerks were taught an abbreviated code using one of the two needles on the dial. Its use continued into the late 1870s.

In addition to these large desk-top instruments for public office use by 1850 the Company had utilitarian *portable two-needle telegraphs* for external use. These were in small rectangular oak bodies, carried in a leather case; the glazed front being protected by a slide-out wooden panel. Uniquely they had four finger keys on the back panel, two at either side, so that it could be hand-held for working. Connection to the line wires was made by a row of four brass screws also on the back, along the top. The glass front was hinged at the side, with a button on its face to move the side pins of the two needles back so as to turn it into a galvanometer.

The *single-needle telegraph* worked by a drop handle, with a single-wire circuit, introduced in 1848, was the Company's commonest apparatus in its public circuits from the mid-1850s until 1868.

The single-needle telegraph of Cooke & Wheatstone had the unusual nickname of *toujours prêt*, always ready, as unlike the clockwork-driven American and Bain instruments it required no preparation to be put in service. The name is said to have been introduced by the telegraph contractor, William Reid.

Described in the 1840s, "each needle was suspended in a light hollow frame of wood or metal, round which were wound two sets of fine copper wire, coated or insulated with silk or cotton. About 200 yards of fine-gauge wire is used. To prevent oscillation the lower point of the needle was slightly weighted. Below the needle was a handle, so formed as to turn on or break off the connection with the battery with the conducting wires, so to transmit motion to the needle, deflecting it either right or left."

Table 37

Electric Telegraph Company
Instruments 1860
Two Needle – Single Needle - Printer

	TN	SN	PR
Liverpool	4	2	15
Manchester	14	2	12
Glasgow	2	0	6
Edinburgh	7	1	5
Birmingham	6	2	6
Hull	3	0	6
Leeds	7	1	3
Aberdeen	4	1	1
Bristol	4	2	6
Nottingham	1	0	0
Stock Exchange	0	0	6
Southampton	5	0	5
Central Station	10	9	43

The Cooke & Wheatstone's original coil for the needle telegraph of 1846 was 6 inches tall, Nathaniel Holmes improved the winding and introduced shorter, fatter astatic needle pairs that reduced the size to 1 inch in 1848. Latimer Clark designed further improvements, and Samuel Alfred Varley devised "undemagnetizable" soft-iron cores for the needle coils in 1866.

The advantages Cook & Wheatstone's two-needle instrument possessed over Bain's and the American telegraph were stated in 1854; that it did not demand the same skilled hands to wind and adjust the machine and prepare the paper; it was always ready at hand, and only needed attention at long intervals; its disadvantages were, that it did not trace the message, and consequently left no telegraphic record for reference, and it required two wires, while the Bain writer and the American telegraph employed one; the current required to work it was the same as the former, and rather less than the latter.

As well as on the Electric, Cooke & Wheatstone's two-needle telegraph was used between 1852 and 1854 on the circuits of the Submarine Telegraph Company between London, Dover, Calais, Brussels and Paris.

The original two-needle code of 1843 had an alphabet of just twenty letters and ten numbers on a single square dial. By 1852 this had been replaced by a twenty-five letter alphabet with no numbers; the numbers were then spelled out as words. At the same time "twin-dials" were introduced, being two single-needle dials set in a single face allowing for economy in manufacture, worked by drop-handled commutators. These dials replaced the original six-inch coils of wire working behind the needles with compact one-inch coils.

The master and subsequent patents it acquired of Cooke and Wheatstone effectively locked-out all competition until 1852. The Company regarded others, especially Morse, as intruders.

As well as two-needle and single-needle instruments W F Cooke had patented the fault-finding *detector*, the principles of pole suspension, the principles of conduit wire-laying, lead-sheathing for subterranean wires and a variety of earthenware insulators for pole telegraphs.

The Company also offered Wheatstone's *magnet-and-bell* device to railways and others, such as factories and mines. This consisted of a large finger-pedal or key that worked a horseshoe-shaped magneto; pressing the key produced a single pulse of electricity. The distant receiving instrument was an electro-magnet that attracted the spring-loaded striker of a brass bell. Each stroke of the key had the bell sound once. It was the first commonly used magneto-telegraph, which is one without galvanic batteries, and the first acoustic telegraph. The magnet-and-bell was manufactured until the 1870s for signalling in mines.

The principal technical problem faced by the Company in its early years was an understanding of insulation of the circuits. The original circuits of wires in pipes were of such a nature that transmitting messages up to just twenty miles was difficult. The introduction by W F Cooke of overhead wires on poles insulated from the earth by glazed earthenware discs in 1842 allowed distances of more than one hundred miles to be worked successfully. It was the perfection over time of the insulation along the line and within stations that made the geographical progress of telegraphy possible.

In 1849 the 'Mechanics' Magazine' reported that rain and fog rendered the insulation of the overhead lines defective, and that in October of that year frost was breaking the iron wires on the long-line alongside of the London & North-Western Railway. The problem was such that in the dampest weather "contact" was created between adjacent wires at the poles and the clerks were compelled to hunt for a single "dry" two-wire circuit from among the eight or so wires on the hundred miles between London and Birmingham, delaying and disrupting all but through traffic. In fact it was impossible for periods to have a direct circuit beyond Birmingham; messages had to be collected there and re-sent on a new circuit to stations north.

The ceramic insulators were originally attached directly to the sides of the pole; cross-bars on the pole were not introduced to the Electric's circuits until the mid-1850s. As noted Cooke's original insulator was a flat ceramic disc. The Company's first insulator was Cooke's earthenware barrel, No 1, the next was Edwin Clark's metallic-bell-topped earthenware model of 1850, No 2, perfected in 1851 as a wholly-earthenware bell, No 3; an interim double bell model to Latimer Clark's design was used from 1856; the last insulator adopted was Varley's double-bell earthenware model of 1861, No 4; each introducing improvements intended to reduce current escape through atmospheric moisture.

Regarding progress in the insulation used on its overhead open wires, in 1868 the Company recorded that the new insulator of 1852 doubled the distance of line that messages could be sent direct. That introduced in 1853 rendered the circuits more weather-resistant. In 1857, a further improvement again doubled the distance of direct transmission, where three transmissions were used, only one was then needed. Finally with the new insulator of 1862 it became possible to telegraph from London to Edinburgh and Glasgow directly in all weathers, these direct all-weather circuits soon also included Aberdeen, Cork and Dublin.

Table 38

Cooke's Telegraph Costs
1838 and 1843

In 1843 W F Cooke published in the railway press his detailed costings for the two forms of telegraph that he had erected on the Great Western Railway:

Iron Tube & Post of 1838
(Used also, he said, on the London & Blackwall, Leeds & Manchester and Edinburgh & Glasgow Railways)

- Prepared ¾ inch tube, varnished within and without, 5¼ d per foot - £115 10s 0d
- Six copper wires, covered and varnished at £6 15s per mile - £40 10s 0d
- Labour and carriage, per mile - £27 0s 0d
- Iron fittings, boxes, &c - £12 6s 0d
- Tar, pitch, paint, rosin and sundries £15 0s 0d
- Posts and rails, at 3½ d per foot, including fixing - £77 0s 0d

Total cost per mile - £287 6s 0d

"To which a percentage for casualties, profit to the contractors, and the price of instruments remains to be added."

New Overhead System of 1843
- Drawing posts, with winding apparatus, per mile - £40 0s 0d
- Cast-iron standards with insulators (22 in a mile), per mile - £52 0s 0d
- Labour in fixing and painting, per mile - £12 6s 0d
- Anti-corrosion paint and tar, per mile - £11 0s 0d
- Carriage, tools and sundries, per mile - £13 0s 0d
- Contingencies, per mile - £13 0s 0d

Total cost per mile - £149 6s 0d

W F Cooke's earliest *overhead* or *pole lines* of 1842 on the Great Western Railway were formed of 9 foot cast-iron posts, much like the standards of street gaslights, with a 4 foot tall ash-wood headpiece to which short, separately-insulated vertical battens were attached on either side. The improved hollow, barrel-shaped insulators for the circuit wires were stapled horizontally to the battens; the wire was threaded though the core.

The overhead iron wires suspended in the circuits of 1845 to 1848 were of No 8 Birmingham Wire Gauge, which is about 1/6 of an inch in diameter, and weighing about 480 pounds to the mile. It was welded into lengths of one-quarter mile at manufacture. The standards or poles were then set 45 to 50 yards apart. The only exception to this was the wire on the very first long line, that between Nine Elms and Southampton, which was to No 7 gauge.

These early lines had intermediate winding posts with a small drum and ratchet mechanism instead of a simple insulator for each wire by which tension could be adjusted every quarter-mile. The wire merely passed though the centre of all the other pole insulators, disc or barrel, on the line without being secured.

The winder was soon regarded as an unnecessary complication and the wires were then tensioned between every pole and secured firmly to each barrel insulator.

The manufacture of ceramic insulators was not a speciality business in the 1850s and 1860s. Many potters in England added telegraphic "porcelain" and stonewares to their trade lists. One of the earliest and largest suppliers was Joseph Bourne & Son, of the Denby Pottery, Derbyshire, who were stone bottle and jar manufacturers. They had the advantage of patent kilns for making the inexpensive strong earthenware called 'stoneware'. The earliest insulators by W F Cooke were made at Denby, and they continued in that line for a century. By 1854 the Electric Telegraph Company was also purchasing stoneware from John Rose & Company of Coalport in Shropshire, far better known for their superior porcelain, and from Mayer Brothers & Elliot at the Dale Hall Works in Burslem, Staffordshire, which existed only between 1843 and 1861. These potters, and many others, undertook the moulding, glazing and firing from patterns supplied by patentees or by the Company.

During the late 1840s the poles were of squared Memel fir, treated to preserve the timber, fifteen to twenty feet long, six to twelve inches square at the base and four to six inches square at the top, painted white above the ground, charred and tarred below ground to prevent rotting. The poles were set between 50 and 70 yards apart. The Company's No 1 earthenware barrel insulators were attached by u-shaped iron staples directly, four wires to either side, to the post. A small wooden "roof" was set on the head of each pole to divert rain.

Round larch-wood replaced squared Baltic fir for all telegraph poles from 1850. The poles cost from 3s 6d to 4s 0d each in 1853.

Several patent processes existed for preserving timber. The first used for poles was *Kyanizing*, impregnating the wood with mercuric chloride, dated from 1832 and was used in the earliest lines of overhead telegraph in 1843; however the preservative rapidly corroded ironwork. *Burnettizing*, impregnating the wood with zinc chloride, was tried between 1844 and 1845. Eventually the simpler, cheaper *Bethelizing* process, dating from 1838, was adopted from 1848, which forced creosote into the wood of the pole under vacuum and did not necessarily require over-painting.

The *Timber Preserving Company* was formed by Act of Parliament in December 1849 to absorb the firms that worked Bethell's, Margery's and Payne's processes for preventing rot in wood. It had offices at Whitehall Wharf, Cannon Row, Westminster, and undertook its operations at Durand's Wharf, Trinity Street, Rotherhithe on the River Thames. They offered to prepare railway sleepers and poles for telegraphs for 5d each.

The Company adopted Alexander Mitchell's patent screw-piles and screw-pile shoes, to secure its posts and their bracing wires. This, for telegraph poles, was an iron cylinder with a two-stage auger on its base for quick and very secure insertion into the ground. A miniature elongated version was used to embed the iron bracing wires.

Poole's portable wire-stretcher was used for drawing the ends of iron wire together using two clamps connected by a system of levers so that they might be permanently joined. Moses Poole was a patent agent, so the real originator is not known.

Only from 1852 did cross-bars secured by an iron staple appear on the Electric's poles as the need for more and more parallel circuits appeared. The Clark No 2 and No 3 insulators then being suspended from beneath the cross-bar; in 1861 the latest Varley No 4 insulators were screwed into the top of the cross-bar.

The wire for overhead lines continued to be solid-drawn No 8 BWG (Birmingham Wire Gauge) diameter galvanized iron, but now weighing 387 pounds a mile.

On the South Eastern Railway, which used Cooke & Wheatstone's system, a great snow storm over April 19, 1849 brought down its No 8 gauge wires and *sixty* lineside poles through the weight of ice.

In April 1859 C F Varley said that he was using much heavier No 3 BWG iron wires on the important long overhead lines at the side of the London & North-Western, Great Western and London & South-Western railways. He would "never again" use No 8 gauge iron wire on lines more than 200 miles in length as the thicker wire had far less electrical resistance.

However, overhead iron wires on poles were not suitable for tunnels, under bridges and through the streets of urban areas. W F Cooke had patented the first underground cable in 1840. This consisted of up to nine varnished No 16 gauge copper cores each protected by tar-coated cloth, drawn in clusters of three or four through solid–drawn lead pipe, covered overall with a tarred rope outer. It was first laid under the footpaths to connect the Company's existing London offices in 1845 and then through tunnels along the London & Birmingham Railway in 1847. These very limited circuits, expensive and complicated to lay with their lead outer-sheath, lasted for twenty years.

The Company eventually had a small network of *underground circuits* in most cities. They were laid to a common model in 3 inch diameter socket-ended cast-iron pipe sections, each 9 feet long, weighing 100 lbs, located under the footpaths of streets, divided into sections by proving- or test-boxes on 3ft high iron posts every 440 yards. The upright posts were later replaced by flush test-boxes set into the pathways; iron cases 28 inches long by 10 inches wide by 12 inches deep with flagstone covers, inset every 50 or 100 yards.

As the iron pipes of the conduits were being laid a single iron 'leading-in' wire was threaded through. The subterranean cable of a copper core insulated with gutta-percha resin and protected by a serving of cotton or rope was prepared in 400 yard lengths on wooden bobbins. An iron frame fitted with two wooden rollers was positioned over a flush box on the piping; the cable was run between the rollers to avoid chaffing to be attached to the 'leading-in' wire in the pipe. The wire was then pulled through along with the cable by man- or horse-power. The Company's *jointers* numbered each circuit cable with metal tallies and then permanently connected the circuits as laying the line proceeded.

These early subterranean wires were manufactured by J & T Forster, india-rubber and gutta-percha manufacturers, of Streatham Common, Surrey. They had developed and patented a process for covering copper wire between thin fillets of gutta-percha resin in concert with C V Walker of the South Eastern Railway, during 1847. Its invention came after W H Hatcher, the Electric company's secretary and engineer, had suggested that the newly-discovered resin might be used for insulation in 1846. The actual processing machine was devised by William Henry Barlow, a civil engineer. The Electric company snapped up Forster's patent, but it was soon superseded by a better process.

Originally, on its introduction in July 1849, there were three No 16 BWG copper wires in each underground core insulated with resin up to one-half-inch diameter. This was soon abandoned as one failure disrupted three circuits, to be replaced with a single No 16 BWG copper wire covered in gutta-percha to No 3 or 4 BWG thickness. In 1850 double-coating of resin was introduced as a further insulative measure and became general. The insulated cores were protected by tarred cotton tape and sanded, and weighed 85 pounds per mile.

In keeping with the short-lived technical fashion of the 1850s the Electric company introduced long-distance subterranean lines insulated with gutta-percha. Edwin Clark adapted its existing underground city system in 1853 to lay eight separately-insulated copper cores bound together as a cable with sanded, tarred tape and jointed in quarter-mile lengths, within cast-iron or earthenware pipes for its so-called 'Express Lines' alongside of the London & North-Western railway between London and Manchester and Liverpool in the north of Britain, its busiest circuits.

Insulation of electrical wiring had become a monopoly of the Gutta-Percha Company of Wharf Road, London. This used the *Gutta-Percha Covering Machine*, patented by Charles Hancock in July 1848 and assigned to the Gutta-Percha Company; the machine hot-rolled up to seven copper wires with the resin through a die in a continuous process.

On May 13, 1854 the Police Court heard that thieves entered the depot of the Eastern Counties Railway in Wheeler Street, Spitalfields, London, on the previous Sunday and stole 440 yards of copper wire insulated with gutta-percha "tube", weighing about 90 pounds, the property of the Electric company. The cable had been discovered at the house of the "fence" handling the stolen property cut into foot long lengths. The railway's inspector of telegraphs, Charles Fish, identified the material, and Edward Ship, a foreman with the telegraph company, informed the court that it was valued at 2s 6d a yard.

By 1860 the Electric company, after the failure of gutta-percha underground, had reverted to overhead circuits on poles for all of its long lines; with a new system devised by C F Varley, using heavy gauge iron wire and new, more efficient insulators.

Contrarily, to insulate its internal station circuits the Electric adopted india-rubber. Two miles were initially installed in 1852 at its Charing Cross office in the Strand from the battery room and between the instruments. This was some of the earliest manufactured by S W Silver to Charles West's process. During the 1860s the Company used Hooper's patent india-rubber insulation for most of its indoor circuits.

Regarding other instruments, the Electric Telegraph Company acquired the rights to Alexander Bain's *chemical telegraph* or writer which indicated a broken line on electrically-sensitive paper strip, which it used between 1848 and 1862 on its busiest circuits. In his patent he used a "finger pedal" or key to transmit electrical pulses to a wire touching the surface of a strip of chemically-dampened paper. The paper strip was slowly drawn by clockwork from a roll between the wire and a small brass cylinder that formed the return circuit. Pressure on the "finger pedal" caused the wire to make a mark on the paper, either a short dot or a long dash. It was particularly sensitive in operation, requiring less current than other telegraphs, so much so that it was planned to experiment with it on the Atlantic cable of 1857. To counter-balance this sensitivity, the circuits of the Bain writer were particularly vulnerable to interruption by "atmospheric electricity".

Alexander Bain patented his *fast telegraph* in 1848 - a variant of the chemical telegraph in which the "finger pedal" was replaced by a miniature hole-punch worked by a small mallet and fed with strips of paper. Messages could be prepared by several 'punchers' and the paper strips fed into a rotary sender between a wire and a hand-turned metal roller so that the punched holes made and broke the circuit. This enabled the rapid transmission of messages irrespective of the 'hand' of an operator. However the rotary sender and the receiving writer had to be carefully governed to work synchronously. The patent for the fast telegraph was immediately acquired by the Electric company.

In July 1847 the Company was reported to be developing its own improvement of Bain's chemical telegraph. Its rotary sending and receiving mechanisms were to be powered by steam rather than clockwork, and be capable of sending and receiving 1,000 to 2,000 letters per minute. It, too, used punched tape, but their punch was also to be worked by steam. Even if using rods and belts for transmission of the steam power, it was fanciful. Only in 1868 was pneumatic power to be adapted to punch holes in telegraph message tapes.

Latimer Clark, the Company's engineer, modified Bain's fast telegraph by introducing a much improved, speedier punch for the paper tape in the 1850s. According to G P Bidder, a director of the Company, by March 1852, using his punch the Bain printer regularly achieved 300 words a minute from tape.

By this improvement, according to James Graves, in 1853, the Bain "printing telegraph had to be learned by punching with a three-lever machine which perforated the paper slip - one lever punched a dot or small square perforation in the paper, another punched a dash of three times the length of the dot, and the third made blank spaces where required, either between the letter, or between the words."

About 1850 the Company experimentally adapted a Bain chemical printer to work with a long stick or rule of moveable metallic elements rather than with the finger pedal or punched tape. By this, short messages in code could be sent by drawing it under an electric feeler and printed on tape at an exceptionally fast speed, anticipating Bonelli's telegraph.

It featured Bain's electric clock in all of its offices, having several in the Central Station at Founders' Court. This was a long-case time-piece in an oak body 4ft 6ins tall by 1ft 4ins wide. The normal clock face at the head read hours, minutes and seconds. The simple clockwork mechanism required no springs or weights but was regulated by a long pendulum at the base of which was an electrical coil in place of the usual bob. This was governed to move alternately between permanent magnets at either side of the body. A single pendulum might control several clock mechanisms. Bain advocated *earth cells*, zinc and copper plates or zinc and carbon in the form of coke buried in damp earth, to provide current; the Company used ordinary sulphate galvanic batteries for its electric clocks.

It acquired too, Edward Davy's *relay* or *repeater* for extending its domestic circuits, an improvement on that patented by Cooke & Wheatstone, although pre-dating it, and Henry Highton's 'gold-leaf' telegraph in 1846.

W H Hatcher, the Company's first secretary and engineer, patented several telegraph instruments in 1847. His *double-index* machine, with two separately moving hands, was used on the South Devon Railway's circuits in the early 1850s to manage the air pumps that propelled its trains, before the line was put in circuit with the rest of the country. The indices revolved in opposite directions; for train management "they could indicate at all the stations on a single line the progressive movement of two trains running in opposite directions". It was worked by a current-reversing induction machine and small batteries of cells. Hatcher's apparatus was also used experimentally for "working with the code of signals in use by the Admiralty".

The Company eventually bought Nott & Gamble's and Brett & Little's improvements in telegraphs in 1849-50 after fighting to convince the Courts that they were infringements of their patents.

Table 39

Codes of the Electric Telegraph Company

The Single-Needle and Bain codes used in its domestic circuits until 1854

(. Left and – Right)

	Single Needle	*Bain*
A	.	.
B	. .	. – .
C	. . .	– . .
D	. . . .	. . . –
E	. –	. .
F	. – –	– –
G	. – – –	. – . .
H	. . –	– – –
I	. . – –	. . .
J	. . – – –	. . – . .
K	. . . –	. – – .
L	. . . – –	. –
M	. . . . –	. – . –
N	–	. – –
O	– –	. . . .
P	– – –	. . – .
Q	– – – –	– . – .
R	– .	–
S	– – .	– .
T	– – – .	. . –
U	– . .	. . . . .
V	– – . .	– – .
W	– – – . .	– – . .
X	– . . –	– . . –
Y	– – . . .	– . –
Z	– . . .	– . . .

In replacement of the Bain chemical writer on its long-distant domestic circuits in the late 1850s the Electric introduced the American *register*, manufactured by Siemens, initially with an "embosser", then with an ink siphon to indicate signals on a clockwork-driven paper tape, worked with a sending key. Although less sensitive, requiring more galvanic cells in its operation, than the Bain printer the American telegraph also used a single-wire circuit so was a straightforward substitution of equipment.

The Company's hostility to S F B Morse and his claims was such that it retained Bain code until it opened its circuits to the Continent in June 1853. It then adopted what it termed the "European Alphabet", the Continental dot-and-dash code with its diacritical marks, for all of its printers, both Bain's and the American telegraph, and for the single-needle instrument. For the latter a left movement of the needle equalled a dot, a right movement a dash.

The first use of the *American telegraph* in public service in England was in 1853 when it replaced the two-needle instrument on the International Telegraph Company's circuit between London and Amsterdam so as to conform to continental practice.

Frederick Bakewell's copying telegraph, developed between 1848 and 1851 and tested by the Company, had manuscript writing or a drawing in varnish on tinfoil applied to a rotating cylinder six inches in diameter and twelve inches long propelled by carefully-governed clockwork rotating at 30 revolutions a minute. A moving electric feeler on a long parallel screw "scanned" the foil differentiating between the metallic and varnished portions. The receiver was identical but the drum had a dampened sheet of sensitised paper on it and the metallic feeler passed the current through it, marking it in facsimile of the varnish writing.

A facsimile of a foil manuscript with 400 characters was distantly copied in two minutes over fifty miles by the Company in April 1851 from the Electric's Central Station at Founders' Court, London to the York Hotel in Brighton. Several facsimiles were sent back and forth, messages were written in full, with capitals and punctuation. It was noted that abbreviations and shorthand could also be used. Bakewell's copying telegraph also successfully transmitted autograph copies of writing a distance of 600 miles there and back between Paris and Nantes, in France, in February 1857.

The Electric experimented in 1854 with the system devised by the Rev Robert Walker, professor of physics at Oxford University, to transmit signals in both directions simultaneously on one wire. The world had to wait until the 1870s for Joseph Stearns in America to successfully introduce similar *duplex telegraphy*.

In 1854 Cromwell Varley patented his *double current system*, which comprised a double-current key and polarised relays. This overcame the significant time-delay in signals using the single-current or American system in underwater and underground telegraphy. It could send twenty-five words with 300 current reversals in a minute, receiving on the American telegraph. The system was first introduced into the Company's long-lines from London to Manchester and Edinburgh in 1854 and to the Holland cables in 1855. Another advantage was in the reduced need for current; only four Daniell cells were required for the Manchester line. It was soon adopted on all of its inland lines using the American telegraph, saving on costs and increasing efficiency.

Double-current or current reversal working of the American telegraph was almost unique to the Electric Telegraph Company's domestic circuits, although widely adopted for submarine cables. It was an example of the minor efficiencies and economies that the Company adopted, scarcely recognised or even understood in the rest of the telegraphic world. It had the disadvantage of having to be converted to single-current working to access European circuits. Varley addressed this issue in the following year.

Varley's 'translator' of 1855, an automatic system of batteries and relays or repeaters was introduced for point-to-point working with the American telegraph, the key-and-inker, between London and Amsterdam, and then between London and Berlin and eventually to St Petersburg in Russia. This permitted through working without transcription. The longest direct line from London to Odessa, by way of Amsterdam, Hanover, Berlin, Königsberg, Riga, St Petersburg and Moscow, was worked from 1858 with thirteen Varley translators at five to six words a minute by 1858. This line was often used by the Company to publicise its reach.

The Varley apparatus used in the International Telegraph Company's circuits from London to The Hague in 1855 comprised an American 'register' or embosser, two relays, a spacing instrument, two switches, a galvanometer and a key. This could be used at either end as a terminal or as a pair as an intermediate translating device. It was so designed to be used with the Company's double current circuits and with European single current circuits interchangeably. The terminal clerks in the longest point-to-point direct circuits had no involvement or even awareness of the introduction of Varley's equipment in their working.

The original American relay used in long continental circuits required continual adjustment due to the "natural" variations in current as batteries changed and conditions affected the state of insulation. Varley's relays on the American telegraph were adjusted just once each day as they were brought into circuit.

As already mentioned, commencing in 1853 the Electric had begun purchasing American telegraphs from Siemens & Halske. By the mid-1850s these were sensitive inkers worked with local circuits and relays rather than the crude 'registers' used in the United States. During 1857 the Company encouraged two Swiss telegraph engineers, Franz and Meinrad Wendel Theiler of Einseideln, in devising an even more sensitive receiver that so reduced friction in the mechanism that the local circuit and relay of the American telegraph were made redundant. M W Theiler patented the *direct printing telegraph* in Britain in September 1857; the Electric company acquired the rights for £500 and immediately bought eight instruments for use on its long lines. Subsequently Breguet purchased the rights for France in 1858. M W Theiler settled in England and, with his sons, began manufacturing his receiver and other telegraph equipment for the Company.

In the twelve years subsequent to the formation of the Electric company Charles Wheatstone had been seriously occupied at King's College; so much so that he was able simultaneously to introduce, on June 2, 1858, the second generation technology of public electric telegraphy, the *automatic telegraph*, and the revolutionary means to pass the benefits of telegraphy on to the individual, the *Universal telegraph*.

The Electric company acquired the licence for Wheatstone's *automatic telegraph* and introduced it on its long-line between London and Newcastle in July 1867, where it was in constant action transmitting from sixty to a hundred words a minute. Henceforth the Company used it on its busiest long-distance circuits. No other company could handle bulk traffic so effectively. This instrument maximised the usage of single circuits by allowing a constant feed of messages on punched-tape into the sender; at the other end the receiver recorded the code on another paper tape, in almost a continuous process. It had three components: the perforator, of which there were several, to enable fast message entry on paper tape; an automatic transmitter through which the punched tape was run at speed to transmit the code; and an automatic receiver, that inked the code onto plain paper tape.

Long strips of paper were fed through a perforating instrument with three keys (dot, dash and space) constructed so that the holes controlled the reversal of the current in the manner of a card on a Jacquard loom to generate letters of the alphabet and other signs. The paper strip was placed in the transmitting instrument which on being set in motion moved it along and caused it to act on two pins in such a manner that when one of them was elevated the current was transmitted in one direction and when the other was elevated it was transmitted in the opposite direction. The elevations and depressions of the pins were governed by the holes and intervening paper. The receiving instrument or printing apparatus had two pens or inkers worked by electro-magnets so arranged that when the current flowed in one direction one pen was depressed onto a moving strip of paper and when in the opposite direction the other pen was depressed. The pins of the transmitter and the pens of the receiver could lift back with springs, permanent magnets or electro-magnets. The transmitter and receiver were driven synchronously by carefully-governed clock work. The patent also allowed the transmitter and its perforated tape to work a single-needle or double-needle telegraph.

The fourth instrument was an independent so-called 'translator' that allowed an operator to quickly imprint up to 30 different letters, numerals or symbols on to a moving paper tape by using permutations of just eight keys and a space button. This was not a telegraphic device but a simple typewriter; it was not worked in public service.

In 1860 Wheatstone amended the automatic telegraph to send and receive messages without using current reversal so as to work with the Electric's newly-introduced Siemens inker-writers rather than his own more complex receivers. About ten per cent of the Company's instruments were inkers by 1868.

The original Wheatstone automatic telegraph of 1858 gave an increase in message transmission performance of a factor of five over the single needle and key-and-writer apparatus.

R S Culley, the Company's engineer, accelerated the perforating process and eliminated mechanical resistance by introducing a pneumatic three-key punch with piston valves during 1867. This allowed women clerks to perforate tapes for the automatic telegraph with ease. The air came from the reservoirs that worked the Company's inter-office pneumatic message tubes.

The overwhelming bulk of its apparatus continued to be Cooke & Wheatstone's *single-needle telegraph* worked by a drop-handle, slightly modified latterly to place a small angled wooden shelf just below the dial for the clerk to place and read message forms for transmission. It is hinted in several sources that clerks using the single-needle device received messages acoustically as they were able to differentiate the tones of 'right' and 'left' signals as the needle struck its stop pins. C W Siemens observed that the instrument clerks worked their telegraphs with the left hand and wrote down messages with the right hand.

During the mid-1850s the Company introduced the desk-top *Umschalter*, the first switchboard, in replacement for the mass of turnplates for switching. This device, also called at the time the Swiss commutator or current director, was used in major towns to connect local with trunk lines and with other local lines. It consisted of an elaborate peg-board of crossed copper strips, insulated from each other and connected as required by a copper spring-peg through holes at their overlaps. It could rapidly change and connect message circuits and manage internal battery circuits. Although often termed the Swiss commutator the "Umschalter" was devised by F W Nottebohm, technical director of the *königlich preussischen Telegraphen-Direktion* in Berlin.

The "Umschalter" was reportedly adopted by the Electric Telegraph Company in 1854. It was used to connect local lines at principal stations and to connect local lines to long lines at the transmission stations of London, Leeds, Manchester and York. Rotary switches continued to be used to connect long lines. The use of the "Umschalter" or switchboard for public telegraph circuits was abandoned immediately the Post Office took over, not to be reintroduced until 1904.

One of the largest "Umschalter" switches was installed at the transmission station in York in 1860. "It consisted of a vertical board, having secured to it twelve parallel horizontal bars and twelve vertical ones. By metal plugs any vertical bar can be placed in contact with any horizontal bar". Twelve single-wire circuits could thus be selectively connected.

Previously a *Turnplate* or rotary switch had been used to connect multiple circuits. That at Normanton transmission station in 1857 was able to select from four two-wire circuits. By rotating a milled knob the clerk was able to make connections by quarter turns. A smaller version switched between two two-wire circuits by half-turns.

Samuel Alfred Varley's *chronopher* apparatus was controlled by a clockwork-driven conical pendulum and was used from 1852 by the Electric Telegraph Company and the railway companies to send time signals from Greenwich Observatory to some 1,000 towns and railway stations. The time current was received at 1 pm each day, when ordinary message traffic paused, on the single-needle telegraph. The great clock at the Houses of Parliament and its bell, *Big Ben*, was also controlled by the chronopher.

The Electric company devised a special "arrangement" in 1852 by which a weighted ring, released by a single electric trip, dropped to close ten time circuits simultaneously. It was entirely enclosed in a glass dome.

S Alfred Varley, brother of Cromwell, had previously improved the insulation of the Company's overhead lines by introducing soldering of wire joints in 1852, in place of mechanical or wound joints in the iron wire. He was employed by the Company from 1852 to 1861.

Cromwell Varley and his son devised a *Fault-finder* in 1859. This was an extremely sensitive needle galvanometer between the astatic-pair of which were jaws in which an insulated wire was placed. Previously faults were discovered by pricking the insulation with a pin to obtain a contact for the detector!

The Electric company continually reviewed its technology: in 1858 it tested David Hughes' type-printing telegraph. This was in its earliest stage of development and was, unfortunately, rejected as unreliable. The later version was far superior but the opportunity had been lost. It experimented with G Caselli's "pantographic telegraph" or *pantélégraphe*, a copying device, and P A J Dujardin's type-printing telegraph, a competitor to the Hughes apparatus, in the mid-1860s. The five-foot tall, cast-iron-framed *pantélégraphe* was tried between London and Liverpool in January 1864 and the Dujardin printer was used for a short period between London and Edinburgh in 1865. The Company found both instruments unsatisfactory for public use, the Caselli facsimile telegraph was slow and difficult to synchronise, and there proved no public demand for it. In its final years it also tried the simple American *key-and-sounder* working the "European Alphabet" acoustically.

Wireless in 1862

On March 27, 1862, John Haworth, a forty-two year old Yorkshireman living in Notting Hill in London, patented "An improved method of conveying electric signals without the intervention of any continuous artificial conductor." He made remarkable claims; apparently transmitting messages *wirelessly* for a distance of ten miles from Notting Hill to Croydon; for about fifty miles to Brighton; and to Bangor, in Wales. The Directors of the Electric Telegraph Company instructed Cromwell Varley, their chief electrician, to experiment with apparatus constructed according to the instructions of Mr Haworth.

In the 'Electrician' magazine of February 27, 1863, Varley wrote: "Mr Haworth paid me [a] visit a short time ago, when I asked him if he had any objection to his invention being tested by actual experiment: he said he had not, and pointed out to me how to arrange the various parts of the apparatus. I have preserved the pencil sketch made at the time, as indicated and approved by him. This was strictly followed in the experiments."

"The apparatus used was constructed especially for this purpose. The primary coils were thoroughly insulated with gutta-percha, the secondary coils by means of a resinous compound and india-rubber. The plates of copper and zinc at each station were but an inch and a half from each other; they were each six inches square. The two stations were only eight yards apart."

"The apparatus at each station consisted of a plate of copper and a plate of zinc, connected to a flat secondary coil containing nearly a mile of No 35 copper wire. The secondary coil was placed immediately behind the plates, and behind this was placed a flat primary coil."

"At the sending station the primary coil was connected with six cells of Grove's battery, and contact intermitted. At the receiving station the primary coil was connected with one of Thomson's reflecting galvanometers, of small resistance, no more than that of an ordinary telegraph instrument".

"With this disposition of apparatus no current could be obtained."

"To account for Mr Haworth's assertions that he has worked from Ireland to London, and between other distant places, I can only suppose that he has mistaken some irregularity in the currents generated by his copper and zinc plates for signals."

"If he can telegraph without wires, why does he not connect England with America, when he can earn £1,000 per diem forthwith, and confer upon the world a great blessing?"

However in a subsequent issue of the 'Electrician', dated March 6, 1863, J M Holt responded to Varley: "I have seen Mr Haworth's apparatus at work repeatedly, and have myself read off from the indicator the messages which have arrived; and these 'irregular currents mistaken for signals' have consisted of words and sentences transmitted as correctly as by the electric telegraph. My house has been one station, and Brighton, or Kingstown in Ireland, the other."

On October 30, 1863 Haworth patented an improved model of his wireless telegraph.

J J Fahie, from whose book 'A History of Wireless Telegraphy, 1838-1899' these extracts are drawn, added "After this we hear nothing more of Mr Haworth."

Water & Air

The Company's pioneer underwater cable across the estuary of the Tay river in Scotland consisted of three relatively light single-cored cables bound together as one; its companion across the Firth of Forth similarly consisted of four single-cored cables laid as one. The Isle of Wight circuit was a four-cored cable; that to the Isle of Man was a single-cored cable. The Firth of Forth cable from Granton to Burntisland was marked by five green buoys to prevent damage by ships' anchors.

The Company's four initial marine cables from Orfordness to Scheveningen on the Continent, actually owned by the International Telegraph Company, of 1853 were laid with single circuits in relatively light armour, the single core being covered with double coats of gutta-percha and cotton tape and yarn, armoured with No 8 BWG galvanized iron wire, weighing two tons a mile. The four cables were joined together as one at the marine league, three miles off the English and Dutch coasts for protection against ship anchors. The Gutta-Percha Company and R S Newall, makers of the very first underwater circuits, manufactured the cables. The Company laid them using its own vessel, equipment and crew, as it did with its all of its domestic and later foreign underwater cables.

Initially the first Holland cables worked well but were to suffer repeated damage by ships' anchors, additionally the iron wire corroded more quickly than anticipated and required constant repair.

The Company's original cables were replaced in 1858 by a single cable, comprising four copper cores of No 13 gauge covered with gutta-percha up to No 0 gauge and armoured with No 00 gauge iron wire, between Orfordness and Zandvoort for Haarlem. This was a very heavy and strong cable weighing over nine tons to the mile manufactured by the Gutta-Percha Company and armoured by Glass, Elliot & Co. Four years later an identically armoured four-core cable was laid by the Company between Lowestoft and Zandvoort.

The Holyhead to Howth cables failed in 1859 and were replaced in 1861. This was to be a single-cored lightweight circuit of two tons to the mile, running seventy-six miles from Howth to Rhosneigr on the "mainland" of Anglesey, avoiding the shipping traffic to Holyhead. It was done on the cheap, the cable was that salvaged from its original Dutch circuits. Being lightly armoured it failed several times in subsequent years, finally expiring in 1865. The Company then gave up on the Dublin route and laid a heavyweight cable, larger even than those on its Holland route, from near Port Patrick in Scotland to Whitehead in Ulster in July 1866; it had six cores, weighing ten tons to the mile. To secure its traffic to Ireland and to access the posited Atlantic telegraph the Company also sponsored a new cable to Waterford in southern Ireland during 1862.

The Electric Telegraph Company worked *pneumatic tubes,* as patented by its engineer Latimer Clark, in London, Liverpool, Birmingham and Manchester. In their final form they had a 1½ inch bore air-tight lead core within a 2 inch iron pipe passing from the instrument gallery of the main telegraph station to a branch station, under the streets. Power came from a small, one-horsepower high-pressure-steam beam engine in the main office basement evacuating air from an eight foot long by four foot diameter iron vacuum chamber, a two inch pipe led from this to the instrument gallery.

Latimer Clark's patent of January 28, 1854 gave a description of his "Apparatus for Conveying Letters or Parcels between Places by the Pressure of Air and Vacuum". These are edited highlights:

The apparatus has a tube extending from one station to another, having branches communicating with *vacuous receivers*; the branches are provided with stop-cocks. The receivers have pipes communicating with the tube which connects the receivers together, and also with the *vacuous reservoir* which has a pipe in connexion with an exhaust apparatus. The vacuous reservoir is very similar to an ordinary gas holder, and is in like manner provided with counterbalance weights, pulleys, and chains.

The mode of working was as follows:

The letters to be forwarded from one place to another are placed in a capsule or holder filling the tube, which is then deposited within the open end of the tube. An electric signal is then made to the distant receiving station, and the attendant having closed the tube by a slide or valve opens communication between the tube and the *vacuous receiver* by means of a stop-cock, having by the same operation closed the stop-cock to the *vacuous reservoir* in consequence of their both being connected by cranks and levers, so that by the opening of the receiver stop-cock the reservoir stop-cock is closed, and vice versa, the capsule containing the letters will be propelled by the pressure of the atmosphere to the receiving station, where it may be removed. The capsule or carrier, which may be made of leather or other suitable material, is surrounded by an expanding valve, so as to exclude the passage of air.

The capsule may be removed from the pipe by opening the upper half of that part of the pipe, which is hinged and fitted air-tight for that purpose, and contains a perforated diaphragm, which may be raised or lowered at pleasure, its rod, passing through a stuffing-box. The perforated diaphragm is only closed at that station at which the capsule and its contents are desired to be retained, and is at all other times raised. The capsule being thereby stopped, the valve is again closed, and the capsule removed, by opening the moveable portion of the pipe as described.

It is obvious that by this arrangement the capsule may be caused to travel in either direction by closing either one or other of the stops.

In actuality the operation seems somewhat different.

The cylindrical message-carriers were of gutta-percha resin covered in felt, 5 inches long by 1½ inches diameter, small bundles of up to eight message forms were pushed into the hollow core at the branch office. The carrier was placed in the open mouth of the tube and an electric bell rung at the main station, the pipe connected by a simple valve to the vacuum chamber and atmospheric pressure propelled the carrier to a vertical tube-station in the gallery where a spring buffer immediately cut off the vacuum and the carrier dropped out through a trap-door onto a counter. The carriers were calculated to travel at 40 miles per hour.

There were five pneumatic tubes at Telegraph Street; four external "circuits" for messages to and from the stations at Founders' Court, Cornhill, Stock Exchange and Mincing Lane; and one inter-departmental "circuit" used for messages and documents in 1864. The total reached seven external and five in-house tubes during 1868, with a larger 2¼ inch pipe being introduced, transmitting twenty messages in one carrier. The new "air circuits" led to the offices of the Atlantic and Indian cable companies. A larger 40 hp steam engine was also installed.

In Latimer Clark's system only vacuum was used to propel the carriers. It was thought that the use of compressed air would fail as it expanded and became less effective towards the end of the tube.

In 1858 it was proposed to connect the new Central office with the Strand and several other busy stations with large-bore, 2¼ inch diameter carrier tubes. Latimer Clark advised the laying of a parallel second 1½ inch tube to provide vacuum at the distant station allowing to-and-fro traffic in the large one. The secondary tube was first applied parallel to the large bore tube between Founders' Court and Mincing Lane during 1858 but its capacity was discovered to be inadequate for the traffic. A vacuum chamber of 1,680 cubic feet was then constructed in a basement adjacent to the Mincing Lane telegraph office, continuously evacuated by the 1½ inch pipe, to act on the 2¼ inch tube. The experiment came to an end when one of the carriers stuck in the large tube and the continuous vacuum rose to such a level that the chamber collapsed, drawing into its void the owner of the house, his kitchen furniture and the glass of most of the windows of the neighbourhood.

When Cromwell Varley became engineer as well as electrician to the Company in 1860 he took up the scheme to connect the Central station with Mincing Lane, Cornhill, the Royal Exchange and Founders' Court with two-way air circuits. To achieve this he introduced compressed air in addition to the vacuum in each tube controlled by an ingenious set of self-acting valves. In Latimer Clark's original system the operator at Founder's Court had to manually open and close two valves or cocks to receive a carrier on receiving an electric bell signal from the farther end. This meant that he could only manage two air circuits at one time. Varley caused the vacuum and the compressed air to work the series of valves and cocks merely by pressure on three spring-loaded mechanical buttons or miniature valves.

The "receive" button opened the vacuum to two small cylinders; one closed the door of the tube, the other opened the main valve between the vacuum reservoir and the tube, which stayed open on a detent. As the carrier arrived it struck a rubber buffer that worked a third cylinder that released the detent to cut off the vacuum in the main tube, allowed the end door to open and the carrier to fall out by gravity.

The valve attached to the "send" button, once the message carrier had been placed in the tube, opened the compressed air reservoir to close and lock the end door of the tube, and then at the end of its travel opened a second valve allowing compressed air into the main tube.

Once the carrier had arrived at the far end the electric bell was rung and the "Cut-off" button was pressed which used the compressed air to close the main valve to the tube and to unlock the end door ready for the next carrier.

The sophisticated and ingenious mechanism of the air valves was manufactured for Varley by F G Underhay, a sanitary engineer and brass founder, of Clerkenwell.

Before two-way working was introduced the message-carriers were returned by hand in bags.

In 1871, to the Institution of Civil Engineers, Varley stated "It was found that the saving in expense, by the number of clerks' salaries dispensed with, was considerably more than the total expenditure of working the engines and the interest upon the capital expended in putting down the pipes." A wire could carry just one message at a time whilst the 2¼ inch tube carried fifteen messages in a single carrier. Over the distance of 1,340 yards between Telegraph Street and Mincing Lane the tube was therefore equal to fifteen wires; each wire would require one sending and one or two receiving clerks. On this "line" the carriers took 60 to 70 seconds by vacuum and 50 or 55 seconds by compression to complete their journey.

The outer iron pipes originally had screw-joints which proved leaky and allowed water to be drawn in by the vacuum. The screw-ends were eventually cut out and the joints all soldered. Problems also occurred with the carriers, although the lead-line tubes caused little wear. Thin metallic tubes were tried but were too easily crushed before gutta-percha resin covered with felt was settled upon. Even so, if the felt did wear friction could cause the gutta-percha to melt and stick to the tube. The end cap also blew off from internal air pressure when entering the vacuum, eventually a rubber band replaced the cap.

A long 2¼ inch two-way air circuit was planned between Telegraph Street and the Strand, with an intermediate station at Fleet Street, but as there were already two or three telegraph companies working over the route the Electric decided not to proceed with the work.

The air also powered the perforator or tape-punching apparatus of the Wheatstone automatic telegraph, speeding up the keying of messages immeasurably. The mechanism for this was introduced by R S Culley, the Company's engineer, in 1868.

The use of pneumatic and atmospheric transmission of power dates well before the advent of the electric telegraph. In 1827 John Hague of Wellclose Square, London, had patented atmospherically-worked cranes, hammers and engines. The connection between Samuda & Clegg, the patentees in 1838 of the most-used system of atmospheric propulsion on railways, and the telegraph in the 1840s is very well-known. However, the compendious patent for atmospherically-driven machinery acquired by Thomas Clarke, engineer, of Hackney, and John Varley, engineer, of Poplar, of February 1846, which included a railway, a ploughing machine, a pile-driving machine, excavating machines, a stone-cutting machine, a stamping mill and a wharf crane, is relatively unknown. The huge coincidence of the family names of Clarke and Varley in this and the subsequent development of pneumatic and atmospheric tubes by Latimer Clark and Cromwell Fleetwood Varley for the Electric Telegraph Company seems to be just that - a coincidence.

The steam engine for the air pump in the basement at Telegraph Street additionally drove a "lathe" for mechanically cutting paper strips to form the paper tapes used in the printers of the Company's American and Automatic telegraphs.

In 1870 the Post Office immediately abandoned the Electric Telegraph Company's automatic pneumatic tube system and adopted the simpler pattern of Siemens & Halske, developed in 1863 in Berlin. The decision was made by the Post Office administrators without consulting their engineer-in-chief. Although sold as a single, continuous, circular compressed air circuit with a constant flow of carriers Siemens could not make it work as such in London and it required to be split into two pipes for each route. To compound this miss-selling, Siemens new pipes were shoddily made, leaking air and accumulating water, leading to jams and freezing, as well as quickly wearing out the resin carriers. Worse, the heavy, manually-worked Siemens valves, with a "guillotine" action, frequently cut the carriers, and their cargo of messages, in two.

b.] **The British Electric Telegraph Company**

The British Electric Telegraph Company adopted Edward Highton's telegraphic system in its Act of 1851. The principal element of Highton's arrangements was a *single-needle* instrument worked by a pair of so-called *tappers,* similar in appearance to piano keys, instead of rotary switches or commutators and drop handles; and with a light horseshoe magnet inside the galvanometer coils and a squat diamond-shaped pointer on a dial instead of magnetized needles in both the coils and on the dial. It was said to be the cheapest of all telegraph instruments. Through this instrument the single-wire ground-return circuit was introduced generally into British telegraphy. The apparatus in the service of the British Telegraph Company used Highton's own single-needle code.

The Electric Telegraph entry in the 'Encyclopædia Britannica' of 1860 written by the great physicist and telegraphic innovator, William Thomson, described the apparatus thus: "Highton's instrument is adapted to signal..., through one telegraph wire. It is simply a 'single needle,' with some modifications of form and dimension, which render it capable of working at a higher speed. Instead of the straight needle of the original [Cooke & Wheatstone] instrument, it has a small, light horse-shoe magnet, turning round a horizontal axis in a line through the centre of its bend, and midway between its poles, on a shaft which bears a thin rhombus of ivory for index, attached to it by an acute angle, and hanging down in front of a black dial. The sending apparatus consists of a galvanic battery, and a key presenting two flat levers of ebony or ivory, working up and down on spring-joints when pressed and released by the operator, who generally applies one hand to one of them, and the other to the other. When one of these levers is pressed down, the positive pole of the battery is thrown to the line, and the negative to the earth; and when the other is pressed, the same connections are made with the poles reversed. When neither is touched, the line is kept to earth simply, and both poles of the battery are left insulated. It is found practicable to operate at a considerably higher speed with this instrument than with the original single-needle instrument; so that by means of it, with the alphabet arranged for it by Highton, nearly as much work can be done through one wire as through two by the common [Cooke & Wheatstone] double-needle system. It is to be observed, however, that much of this gain in speed is due to the excellence of Highton's alphabet."

Table 40

Highton's Single-Needle Code 1851

Highton's alphabet or code was remarkably efficient: being "made up in the following manner: twice to the right, or 33, signifies A; twice to the left, once to the right, and once to the left, or 1131 = B; 311 = C; 133 = D; a single signal to the left, or 1 = E; thus acting on the correct principle of representing the letters of most frequent occurrence by the most rapidly executed signals; F 313, G 1133, H 113,1 31, J 3133, K 1331, L 331, M 1113, N 13,0 11, P 1111, Q 1313, R 333, S 111, T 3, U 131, V 1311, W 1333, X 3113, Y 3111, Z 3131. A motion to the left signifies 'Do understand,' and one to the right 'Not understand.' 'Repeat' is expressed by 3331, and 'Wait' by 3333." This was said to be a great improvement on that devised by W F Cooke in which left and right movements of the needle corresponded "in some arbitrary way with their order in the alphabet".

The Highton single-needle telegraph was also used successfully on the underground circuits of the European & American Telegraph Company when it merged with the British concern in 1854.

Unlike other systems Highton's evolved over a period of several years. The horseshoe magnets were patented in 1848, when they were worked with two wires by rotating commutators. It was in his patent of 1850 that Edward Highton introduced current reversal and single wire working, and the tappers were patented in 1852.

The Company's iron wires were suspended from poles using Highton's patent gutta-percha insulator; in this a silk ribbon was wrapped about the wire for about sixteen inches and covered by hot gutta-percha in a horizontal cone shape. When this remarkably elaborate arrangement cooled to a solid it was screwed onto the pole or cross-bar and varnished. Another variant had cylindrical fillets of gutta-percha inserted through the poles. It also used Highton's rather more effective patent "bead" insulator, a pierced glass sphere inserted directly into the body of or stapled on to the shaft of the pole or pinned to a supporting arm. Highton patented the cross-bar or horizontal supporting arm for carrying insulators on pole telegraphs in 1848 and X-arms in 1852.

The British Telegraph Company laid its underwater cable from Port Patrick, Scotland, to Donaghadee, Ireland, on June 9, 1854.

The six-core cable was manufactured by the Gutta Percha Company of London and armoured and laid by R S Newall & Company of Gateshead to the same pattern as that used by the Magnetic company in their Irish cable of 1853. The steamer *Monarch*, chartered from the International Telegraph Company by R S Newall, accompanied by the tugs *Wizard* and *Conqueror,* successfully laid the twenty-seven mile cable from Port Patrick to Whitehead, near to Donaghadee.

To connect with its domestic network the British Telegraph Company laid an underground circuit from Whitehead to Carrickfergus for Belfast, and another to Stranraer and Ayr for Glasgow in 1855. The connection to Dumfries for London was not completed until March 1855. It used Highton's single needle telegraph in its circuits.

Edward Highton was a director of the Company until its merger. His tappers were in use in public telegraphy for over seventy-five years.

c.] **The English & Irish Magnetic Telegraph Company**

The English & Irish Magnetic Telegraph Company worked William Thomas Henley's system; he was a founding director of the Company. This was based about a *magneto-electric telegraph* instrument that did not require batteries of electric cells, but used a key or short lever to generate sufficient electrical force to affect a needle galvanometer. Henley's telegraph had a large square dial set in a mahogany case at a slight angle up from the horizontal, with two needles. At either side was a short thumb lever that when depressed generated a pulse of electricity. Each lever worked one needle in one direction, so the instrument required a two-wire circuit. These instruments used what ought to be termed "Henley's Code".

Table 41

Henley's Two-Needle Code 1853

The magneto needles only worked in one direction

Understand R		Not Understand L	
Yes	R	No	L
Letters	V	Figures	V
1 A	R	D 4	L
2 B	RR	E 5	LL
3 C	RRR	F 6	LLL
7 G	V	J 9	V
8 H	VR	K 0	LV
L	VL	N	VR
M	VLL	O	VRR
P	VLLL	Q	VRRR
R	LV	T	RV
S	LLV	U	RRV
V	LLLV	W	RRRV
X	VVL	Y	VVR
Z	VVV	&	VV

L = Left, R = Right, V = Together

There were two sizes of magneto telegraph: the commonest could send messages on overhead wires up to 200 miles or to 100 miles on underground circuits and cost £15. A very much larger magneto was used on the underground and underwater line between Liverpool, Belfast and Dublin, over 530 miles, and cost £38.

As described by William Thomson in 1860: Henley's telegraph "consists of a double or single magneto-electric machine, sending through two line wires, or only one, to a double-needle or single-needle receiving apparatus, which consists of electro-magnets, with steel needles movable through small angles across the lines of force between their poles. There is no commutator and no breaking of the circuit in the sending machine; but a single motion of a key, when pressed down by the operator, produces an electro-motive impulse, which sends a current through the line; and the return motion of the key, rising by a spring, produces subsequently a reverse impulse and a reverse current. Under influence of the first, or direct current, as we may call it, the receiving-needle moves from a stop, on which it rests during cessations of action, and strikes another placed to limit its motion. On this second stop it rests until the reverse current brings it smartly back to its normal position. The resting of the needle firmly on either stop is secured by the magnetic force exerted between itself and the soft iron of the electro-magnet."

"In the double-needle system of the magnetic telegraph, a single motion and return of either needle constitutes a simple signal; and the alphabet is composed out of two simple signals, ... positive and negative. In the single-needle magnetic system, the operator works precisely as with a ... key, and he thus produces short and long deflections, since the needle rests deflected against its limiting stop until the reverse current brings it back; and the alphabet is composed... out of two simple signals, the short or dot, and the long or dash."

The Company's clerks, according to Bright, received messages on the magneto-electric telegraph acoustically as the left and right needles struck pins with slightly differing tones.

The principal disadvantage of the magneto-electric telegraph was the need for a two-wire circuit.

The Magnetic company's main circuits were insulated with resin and buried underground in Henley's patent protective troughs. It had tried unprotected gutta-percha insulated wire on its first circuit between Manchester and Liverpool in 1851 but this failed almost immediately and was replaced by a resin-insulated line in troughs.

Charles Tilston Bright, who had worked for both the Electric and British Telegraph companies, replaced W T Henley as engineer to the Magnetic company in 1852 and made substantial modifications and additions to Henley's system. He had a comprehensive patent in 1852 covering improvements to Henley's magneto telegraph replacing his short-acting levers with more robust rotating handles, a new very efficient overhead insulator and several varieties of troughs for protecting underground circuits. Bright was then age 20.

Its underground circuits of 1852-3 in England and Ireland were created to Henley's plans. For its main city-to-city circuits ten insulated wires were laid in troughs of grooved boarding, covered either with wooden or iron lids. Each copper wire was of No 16 BWG insulated with gutta-percha to No 3 BWG thickness by the Gutta-Percha Company, served over with two thicknesses of jute and Stockholm tar, and laid in the troughs in two rows to a depth of two feet. There were testing boxes every three miles.

Under busy streets of towns from 1852 the Company used cast-iron split-pipes of Henley's patent design each of six feet length with a two-inch bore, the metal 3/8 inch thick. The top and halves were secured together by two pairs of lugs and small nuts and bolts. Similar split-pipes to Henley's patent, whether round or square in section, were to be adopted by all the other companies except the Electric.

The cost of laying six wires in troughs or pipes along the mail roads was from £180 to £200 a mile; for ten wires the cost went up to £230 a mile.

The overhead lines that it built, mainly in Ireland, were on round larch poles with insulation for the No 8 gauge iron wires originally formed, after Henley's plan, from small cylinders of gutta-percha, called by the inventor "thimbles". The resin tubes were speedily replaced in 1852 by large earthenware insulators designed by C T Bright. The Magnetic allowed only eight wires to be attached to each pole.

On October 9, 1852 the English & Irish Magnetic Telegraph Company attempted to lay its cable from Port Patrick, Scotland, to Donaghadee, Ireland (21 miles). The six-core cable was manufactured by the Gutta Percha Company of London, armoured and laid by R S Newall & Company of Gateshead. Twenty-five miles of completed cable were loaded aboard the contractor's steamer *Britannia*, of this length four miles were regarded as a contingency. It was to run from Mora Bay in Scotland to Donaghadee Harbour. After an abortive start late in September, laying commenced on October 9, 1852 in severe weather, after paying-out sixteen miles the contractor was forced to cut the cable as the seas threatened the safety of the steamer.

R S Newall returned to Port Patrick with the *Britannia* in June 1854 and, overcoming immense difficulties, recovered the sixteen miles of old cable over a period of four days. It was found on testing to be electrically sound.

The Magnetic company finally made its connection between Port Patrick, Scotland, and Donaghadee, Ireland, on its second attempt, during May 23, 1853.

The six-core cable was once again manufactured by the Gutta Percha Company and R S Newall. Newall also contracted to lay the cable. His steamer *William Hutt* was accompanied by the tugs *Conqueror* and *Wizard* acting as guard boats, and successfully laid down the twenty-four miles of cable from a point two miles south of Donaghadee to Mora Bay, a little to the north of Port Patrick. It cost £13,000 to complete.

The cable specification allowed for six copper conducting wires of No 16 gauge insulated with gutta-percha resin, supported by hemp cords, all surrounded by a serving of tarred hemp spirally twisted around the cores. This was protected or armoured by ten No 1 gauge iron wires galvanised with zinc to resist corrosion, spirally wound around the whole. It weighed seven tons to the mile. The cable was based on Thomas Crampton's design for the successful cable across the Channel in 1851. An identical specification was used in the British Telegraph Company's Irish cable of 1854.

The Magnetic company also was constructing an underground roadside six-core circuit from Carlisle to Dumfries and Port Patrick in May 1853, to connect the cable with the rest of England and Scotland.

d.] **The European & American Electric Type-printing Telegraph Company**

The European & American Electric Type-printing Telegraph Company was formed to work the telegraphic system of Jacob Brett. This is somewhat misleading as Royal Earl House in the United States had communicated the patent granted to Brett in Britain. The instruments intended to be used on its circuits were the Brett-House *type-printing telegraph*, a complicated device that produced alphabetic print on a paper strip; it required, however, only a single wire circuit with an earth return. Its wires were insulated in resin and buried underground in William Reid's patent wooden troughs. Jacob's brother, John Watkins Brett, was a director of this Company and was also managing director of the Submarine company.

The Submarine Telegraph Company, which also tried Brett's patents, made some extravagant claims for this sophisticated apparatus in January 1850, "The telegraph shall, by the aid of a single wire and two persons only (the one stationed in France and the other in England) be capable of printing, in clear roman type (on paper) one hundred messages of fifteen words each, including addresses and signatures, all ready for delivery in one hundred consecutive minutes".

In the event the Brett apparatus was unreliable and the Submarine and European companies both used Cooke & Wheatstone's two-needle telegraph to work their earliest circuits.

The original Brett-House telegraph consisted of two elements, the *compositor* (sender) and the *printer* (receiver). The compositor mechanism had a keyboard like a miniature piano with twenty-eight keys, beneath which was a rotating cylinder with a spiral of twenty-eight small pins along its length, on the end was a wheel or circular commutator or switch that opened and closed a circuit twenty-eight times in one rotation. The cylinder was kept revolving by a weight and pulley, with a speed governor, sending a series of electrical pulses. Pressing a key stopped the cylinder at one of the pins and broke the circuit.

The printer possessed a small type-wheel with twenty-eight characters engraved on its periphery, an abbreviated alphabet, a dot and a space, also revolved by a weight and pulley. Beneath it were two large vertical electro-magnets that created a to-and-fro motion, regulated by a so-called hydraulic governor. The opening and closing of the circuit by the compositor caused the electro-magnets in the printer to allow the type-wheel to rotate in precise sympathy with the cylinder beneath the keyboard. As a key was pressed, the cylinder stopped, the circuit was broken and the type-wheel stopped at the same moment, at a particular letter. The wheelwork rotating the type-wheel was then applied to eccentrics that moved a paper tape one space and pressed it firmly against the type-wheel, which was kept 'inked' by a hollow-roller filled with powdered plumbago (graphite). As the current was restored when the sending key was released and allowing the compositor cylinder to rotate, small springs lifted off the paper tape and the type-wheel continued to turn.

Both compositor and printer relied on clockwork-generated energy to turn their separate rotating elements; electricity merely regulated the rotation. An initial key press set off an alarm bell perched on the top of the apparatus after which the instruments at either end had to be put in synchronisation before the message might be sent.

In appearance the Brett-House telegraph had a tall pierced or skeleton brass framework containing the printer, with a bell mechanism at the head, fitted to a mahogany stand in which the compositor and its keyboard was set. There was also a large clock-like dial in the centre brass framework that indicated the letters of the alphabet by means of a rotating hand. It was, of course, a very complex and expensive apparatus compared with the needle telegraph; its chief advantage was its sending speed, printing alphabet on tape twice as fast as the needle competition could be read.

This was the original electro-magnetic version of the House telegraph devised in 1844 not the particularly elegant electro-pneumatic version widely used in the United States from 1850.

Royal House's successful electric type-printing telegraph preceded the mechanical office typewriter by thirty years.

The European company also experimented with G E Dering's single pendulum needle telegraph on its circuit between London and Dover for a short period.

The 'Builder' magazine in November 1852 described the European company's original circuits, "The line of telegraph of which we are speaking consists of six pure copper wires encased in gutta-percha. These wires are manufactured in half mile lengths, which (after being joined together) are protected along the high roads by wooden troughs, and in towns by iron tubes, which are respectively sunk to an average depth of two feet beneath the surface of the ground. The troughs are of simple construction, being formed by sawing a deal into three, thus obtaining a square of about 2¾ inches, with a groove cut out at the planing mills, to contain the wires. The ends as well as the tops (which latter are about three-quarters of an inch in thickness), are cut to a bevel, and so the covering is made complete and secure. In the method of joining the iron tubes, the Company have availed themselves of a patent taken out by Mr Brett; a circular dovetail on the casting of each alternate pipe is inserted into a corresponding aperture left for the purpose in the substance of the tube next adjoining it, and so on. The Company, foreseeing the possibility of injury to their wires, have provided at the end of each mile, a box, in which the continuous line of wire is coiled, for the length of some few yards; so that, should any mischance occur, the means of testing the soundness of the line, mile by mile, are at hand; for all that is requisite in such a contingency will be the severance of the coiled wire at the end of any given mile, and a trial of its efficacy up to that point by means of a portable battery."

The seven mile long urban section from the Cornhill telegraph station to New Cross Gate, across London Bridge, was laid under the pavements inside the 2 inch cast-iron pipes by William Reid, the first and largest telegraph contractor in Britain, by September 1852.

The rest of the Dover circuit, in wooden troughs, was speedily laid by the contractors, Frend & Hamill.

The European company's original gutta-percha insulated underground circuits from London to Dover were not well engineered and quickly started to fail. W T Henley engaged to take-up its whole length, replacing the bad parts and re-covering the remainder with a serving of tarred jute. He did this, without stopping the working of traffic, during 1855.

George Saward, the former secretary of the British Telegraph Company, of which the European company became a component, noted to a Parliamentary enquiry on January 12, 1860 that its long subterranean line between London and Liverpool completed in May 1854 was also of poor quality. Of the six gutta-percha insulated copper wires laid in the troughs one had never worked and the other five failed within nine months of use. He mentioned that the circuit was worked with the "little" Highton single-needle, double-tapper instrument at twenty words a minute. Thirty-six 24-cell Daniell batteries were initially used, but better performance was achieved by reducing this to twenty-four 24-cell batteries.

e.] **The Submarine Telegraph Company**

The Submarine Telegraph Company had a direct electric connection only between Calais and Dover from the completion of its line. On Monday, August 29, 1851 the Foy-Breguet telegraph instrument was used to send the first "official" message from France to England. On the following day, in addition to the Foy apparatus, Henley's magneto telegraph, Reid's double-needle instrument and Brett's printing apparatus were tried successively on the cable. The Company was to utilise Reid's version of Cooke & Wheatstone's two-needle instrument for two years when it established circuits between London, Brussels and Paris, before finally settling on the key-and-writer of the *American telegraph* which was generally used on the Continent of Europe for public telegraphy.

John Watkins Brett was the promoter and a director of this Company and of many other overseas cable companies, as well as of the European & American Telegraph Company. His brother, Jacob, was to provide electrical expertise to both companies, as well being patentee of the printing telegraph.

The "improved" and much modified Brett patent instrument displayed at the Great Exhibition in 1851 and used experimentally on the Channel cable between England and France in that year comprised two separate parts somewhat different in working from the original: there was the basic printing element controlled by either hydraulic or pneumatic regulators, with a signal bell, twelve inches wide by seven inches deep by twelve inches high; with the communicator or sending element opening and closing the circuit, sending pulses of electricity, by means of a rotating handle or hand pointing to a letter on an engraved circular index, in a case four inches by four inches by two inches deep.

Three alternatives were shown to the public: a more complex printing element with an additional dial having an index hand for paper-less receiving and bell signals; and a communicator with a piano keyboard, each key representing a letter of the alphabet.

There was also a *pocket communicator*, a miniature rotary device indicating the roman alphabet, for use by guards on railway trains, just three inches by three inches by two inches in size. The pocket apparatus required that a separate electric battery be carried on the locomotive tender; its circuit being made from a small reel of copper wire connected to the line-side overhead iron wire by a long pole, the return being by a connection to the rails.

In 1858 John Watkins Brett wrote that the patent instrument "incurred a sacrifice on my part of many thousand pounds, without any valuable result for general purposes."

William Andrews, the company's engineer, worked through the late 1850s to develop an effective current reversing and relay apparatus for underwater cables to defeat retardation, improving on those introduced by C F Varley and Siemens Brothers. In essence these worked as the sender or key in concert with the receiver or inker of the American telegraph. He was successful in 1860 and his "pneumatic relay", or "pump", as it was commonly termed, was introduced on the Submarine company's longest cables from England to Hanover and to Heligoland and Denmark. It had been developed with the Company's mechanician, James Banks, and the telegraph instrument makers, John Sandys, R B Jones and Reid Brothers. Its advantage, in addition to discharging or reversing the current in cables, was stated to be that the key had an instantaneous descending and a graduated ascending movement governed by a hydro-pneumatic device, enabling messages to be interrupted between a letter, word or sentence. It was first used at the Company's Cromer station in East Anglia to connect with Heligoland and Flensburg in December 1860, when eleven instruments were in service. The "pump", then made by S W Silver, was later adopted on the government's 1863 cables in the Persian Gulf.

The Submarine Telegraph Company worked the 'European Alphabet', developed in Germany, on its American telegraph instruments, the same as the Electric and United Kingdom companies.

The Submarine Telegraph Company's first cable of 1851 was of four copper conducting wires of No 16 BWG, each insulated with gutta-percha up to No 2 BWG thickness, "formed into a rope", covered with tarred hemp and protected or "armoured" with ten iron wires of No 1 gauge. It weighed six tons to the miles and lasted without substantial repair until 1859. The Ostend cable of 1853 was of similar construction but with six cores. Subsequently stranded copper wire was used instead of a solid single wire. The Hanover cable of 1858 had two stranded cores and weighed three tons a mile. The Boulogne cable of 1859 had six stranded cores protected by No 0 gauge iron wire armour and weighed an exceptional 9½ tons a mile. In the same year the Denmark cable was laid by way of the island of Heligoland with three strands and weighed four tons a mile. The Company placed all of its conducting circuits in one cable.

The two underwater cables of the Magnetic company to Ireland were similar to the Submarine's Ostend line with six separate copper cores. Unlike those of the Electric company, the cables of the Submarine and Magnetic concerns were laid by contractors from the contractor's steamers.

Between October 31 and November 2, 1858 the Company had Glass, Elliot & Company lay its longest cable. The circuit ran from Cromer to Weybourne in East Anglia and then 210 miles to the island of Borkum off the coast of Hanover in Germany, hence to the city of Emden. There were 280 miles of cable; there were two cores each of four No 22 BWG copper wires insulated with gutta-percha and Chatterton's preservative compound to No 3 BWG thickness by the Gutta-Percha Company and armoured with twelve wrought-iron wires each of No 6 ½ BWG by Glass Elliot. It had taken two months to manufacture; the laying was supervised by the Submarine's engineer, William Andrews, on board the screw steamer *William Cory*, which was accompanied by the paddle steamer *Reliance*.

From July 11 to July 14, 1859 a new three core circuit was laid in two lengths to Denmark; from Cromer to Heligoland by the *William Cory* steamer and from Heligoland to Tonning by the *Berwick*. This, of 328 miles total length, was also manufactured by the Gutta-Percha Company and Glass Elliot & Company.

The Submarine company saved money when it was compelled to lay a new cable from Beachy Head to Dieppe as part of the renewal of its French concession. It bought the remainder of the six core cable made for the Mediterranean Telegraph Company's unsuccessful line from Cagliari in Sardinia to Bone in Algeria and had W T Henley recondition and then lay it between England and France on June 27, 1861.

That was not the end of its parsimony (or economy); when the Hanover cable was abandoned in 1865 much of it was recovered and reconditioned by W T Henley, under sub-contract from the Telegraph Construction & Maintenance Company. Its two cores were combined with newly manufactured stock to make a 47 mile four-core cable that was laid from Dover to La Panne in Belgium during November 1867.

f.] **The British & Irish Magnetic Telegraph Company**
The British & Irish Magnetic Telegraph Company, an amalgamation of the British, English & Irish and European concerns, attempted to substitute C T Bright's *Bell telegraph*, a sounder having two bells worked with current reversal in a single wire circuit by two *tappers* and batteries of electric cells, for all previous galvanic and magneto instruments. The Bell telegraph required, on medium to long circuits, the use of a relay with a separate local battery. However the simple Highton single-needle instruments worked with tappers and Henley's magneto-telegraph continued in use in many circuits. The Bell apparatus' used its own variant of the dot-and-dash principle, the so-called 'Magnetic Code', differing from the common 'European Alphabet' used by its Highton instruments and its competitors.

William Thomson noted in 1860 that "the sound of two bells, struck by the needle or needles, when deflected by two currents (positive and negative) respectively, has been recently put into practice on a very extensive scale, by Sir Charles Bright, with the aid of a simple and effective relay,... which he has invented for the purpose, and which proves most successful. This relay, with a local battery supplying the mechanical power required to strike the bells, has been substituted at the principal stations of the British and Irish Magnetic Telegraph Company in England and Scotland, instead of Highton's single needle (which is still retained on their railway circuits, and some of their less important commercial circuits); and ..., that 'for ordinary circuits nothing can work better'; that 'more work can be got from one clerk and one wire by it than by any other receiving instrument;' and that it is gradually being extended to the utmost in the telegraphs of that company. The transmitting instrument used for sending is still Highton's key described above; and it is worked by the staff of operators and clerks trained under Highton's system. The receiving clerk sits between the two bells, and, with only the ear engaged in receiving the signals, writes down his interpretation of their meaning with a degree of ease and accuracy not attainable when one clerk has to watch the needle and dictate his interpretation to another who writes it down, as in receiving by the needle instruments or any other instrument indicating by transient visual signs."

Charles Bright's Bell telegraph was the first successful acoustic message telegraph (if one ignores the crude railway bell signals), preceding the American acoustic box-sounder by several years. It was also by far the "fastest" non-automatic telegraph instrument, regularly receiving cipher at over thirty words a minute on the longest circuits, as the operator's hands and eyes were free for message-taking.

Highton's single-needle telegraph was continually improved, initially being made smaller, and then, in the late 1850s, having separate needle dial and tappers so that the sending element could be identical with that used on the Bell telegraph.

By 1862 Henley's magneto-telegraph was in use only on the Magnetic's rural circuits in Ireland. There were none remaining in Britain.

William Thomson records in 1860 that "At many of the more important stations Sir C Bright has introduced his bell relay in connection with them [Henley's magneto-telegraph]; the double-needle instrument being made to direct the power of a local battery to strike one bell when a current comes through one of the line wires, and another bell when a current comes through the other wire; and the single-needle instrument being similarly arranged to produce on a single bell a mere blow giving a clear sound, or a blow and sustained pressure producing a muffled sound, according as the short signal (dot) or the long signal (dash) is sent."

Henley developed a magneto-dial telegraph in 1855, indicating the alphabet. In November 1861 he promoted this with a warranty of five years, "at half the price of any other dial telegraph", for use on private wires in the Magnetic company's Manchester circuits.

Although the Submarine company was one of the earliest adopters of the American telegraph in Britain the Magnetic seems not to have used *any* recording or writing instruments. Neither did it use the switchboard.

Regarding its land-lines; as well as continuing to lay resin-insulated wires in Henley's patent horizontally-split cast-iron pipes until the late 1850s the Magnetic also began, as its subterranean gutta-percha insulation failed, to use iron wires suspended from poles on its long-distance lines and adopted C T Bright's very large and very effective double-bell ceramic insulator of 1858, bolted to the top of cross-pieces.

Bright's insulators were made, it seems, by John Cliff & Company, Imperial Potteries, Princes Street, Lambeth, London, manufacturers of stoneware for the chemical industry and "white stoneware insulators, pole caps, battery-cases, &c." Cliff's works functioned from 1857 until 1869, when they removed to Runcorn in Cheshire.

The bulk of its resin-insulated subterranean wires were carried in slots machined in creosoted wooden sleepers, 3 inches by 3 inches in section, these were sealed with a $^1/_8$ inch thick galvanized iron lid secured by small iron spikes. They were buried in a trench 24 inches deep. The underground cable was laid in these troughs as they were placed in the trenches from a large diameter wooden drum.

These subterranean lines gradually failed, the Company's directors believed, "due to the misdirection of the iron nails used to secure the lids, to the perishing of the gutta-percha through dryness, to the entry of contaminated water and to attack by coal gas leaking from parallel underground pipes."

When the Magnetic and British companies merged in 1857 to form the British & Irish Magnetic Telegraph Company, the combined firm possessed two cables connecting Britain and Ireland, from Port Patrick to Donaghadee, with three magneto circuits and six galvanic circuits. This capacity gave the new company a virtual monopoly of traffic to Ireland for several years as the Electric competition then had only two circuits to the city of Dublin.

C T Bright was the Magnetic company's engineer until 1860 and a consultant until 1868, whilst his brother Edward was the Company's chief manager throughout.

g.] **The London District Telegraph Company**

The London District Telegraph Company initially used a unique *single-needle telegraph* devised by Edward Tyer, its electrical engineer, using his patent "piston" key, a push-pull knob. Latterly it also used the cheapest telegraphic apparatus, Edward Highton's single-needle instrument with two tappers, left and right, as adopted by its parent, the British & Irish Magnetic Telegraph Company. These were connected by a network of *over-house* suspended iron wires for its urban public single-wire circuits. In these public circuits it used the "European Alphabet".

In its subsidiary private-leased circuits the District used the Siemens Brothers' *magneto-electric dial telegraph* of 1859. It had tested W T Henley's, Polidor Lippens' and Charles Wheatstone's dial telegraphs before deciding on the Siemens instrument. This device, common on railway circuits in Germany and Russia, indicated the roman alphabet with a pointer on a small dial using an electrical escapement worked by a communicator handle resting on a second much larger metal dial face, rotating a magneto. The instrument was much larger than Wheatstone's Universal telegraph and was used only on the District's circuits.

The District's principal circuits were constructed in radial trunk lines outwards from a central hub in Cannon Street, with branch lines from each radial and some cross connections. All of its public messages, even those for the shortest distances, were routed, with a dedicated wire for each station, through the central hub. The office in Cannon Street was also in electrical connection with the Magnetic's chief station in Threadneedle Street. It was intended to have other hubs about London as its message business developed but this was never carried out.

In 1859 the District planned, and to a great extent implemented, multi-core subterranean cables beneath the pathways to connect its anticipated hubs. Each core was of No 18 BWG copper wire covered with gutta-percha up to No 7 BWG, a "rope" of these cores was contained in a further gutta-percha tube, covered with two coats of tarred yarn. Ten "ropes" or cables containing 160 miles of wire were commissioned of W T Henley's Telegraph Works. Three lines were commenced, from the City to the West End, to South London and north to Islington. By July 1861, when its main radial trunks were completed, one third of the lines and around two-thirds of its wires were in gutta-percha insulated subterranean cables. The cost of the underground cables proved prohibitive given the District's frail financial circumstances; other than those for the tunnels of the Metropolitan Railway, no more were made after an initial 30 miles of line.

Its other circuits until 1866 were so-called "over-house" open wire lines on poles. The roof-top supports were novel; being cylindrical, telescopic wrought-iron "poles", stepped on to the ridge tiles of house roofs and stayed with iron wire ropes. They were apparently painted to protect them against the elements; those in the East End of London were described as "elevated garish green and white poles". They were devised by its electrical engineer, Edward Tyer, in 1860.

The short poles, carrying from one to twenty galvanized-iron wires, were secured on house roof-tops at long 300 yard intervals and were said to deface the skyline. Its insulators on these poles were to C T Bright's large ceramic double-bell pattern, as used by the Magnetic company from 1858. These wires proved extremely vulnerable to high-winds, leading to the destruction of much of the network in January 1866. In cities the telegraph companies had threaded their wires through underground conduits beneath the streets, concealing their presence.

The District did not, apparently, use any up-to-date switching devices, like the Electric's *umschalter,* which would have speeded connections and accuracy in its complex circuits, of which eighty entered its principal office from the suburbs.

h.] **The Universal Private Telegraph Company**

The Universal Private Telegraph Company was formed to work Charles Wheatstone's compact *magneto-electric dial telegraph* of 1858 that did not use any batteries and which he dubbed the "Universal telegraph" for ordinary people.

William Thomson gave this effusive, and wholly independent, review of the Universal telegraph in 1860: "The details of this most pleasing and popular of telegraphic systems have been recently improved with admirable skill and ingenuity by its inventor. In his original [1840] instruments (to use his own words), 'much remained to be done to render them capable of extensive practical application. Increased speed, greater simplicity, and portability of form, and, above all, absolute certainty of action, were required, to give them, with the advantages they possessed, decided superiority over the needle and other signal apparatus in use.' By his improvements patented in 1858, he has 'rendered this telegraph all that is required for practical use, combining *certainty, speed, simplicity, durability*, and *portability*.' To avoid as far as possible more massiveness in moving parts than is required for strength, or for mechanical effects to be produced by inertia, an obvious enough principle, too often neglected by instrument-makers, has been the chief object aimed at, so far as the mechanism of these instruments is concerned. The works of a watch or chronometer are more durable and more certain in their action than those of almost any larger machine comparable with it as to complexity, and Mr Wheatstone seems to have been impressed with this idea in designing the beautiful receiving instrument..., along with [a] form of 'sender,' adapted to work it, which, being electro-magnetic, requires no battery...".

"For the uses for which these instruments are chiefly intended, that is to say, for short lines of telegraph, with no specially trained telegraph operators to work them, these instruments seem to be almost perfect. The facility they afford for communication between different offices, departments, or stations of government, of national defences and field operations of an army, of law-courts, and of general, commercial, and manufacturing business establishments, can scarcely be over-estimated. It is to be hoped that, at least in all matters affecting the security of the country, and the efficiency of our army, in any part of the world, they will immediately be taken advantage of to the utmost."

The Universal telegraph had two modes, alarm and telegraph. If alarm was selected turning a small crank at the front rotated a magneto-electric device to set off a bell at the receiving instrument to attract attention. In the telegraph mode it sent messages in roman alphabet by a pointer on a small "communicator" dial driven by the cranked magneto-electric device. The pointer was stopped by pressing one of thirty buttons around the dial at the appropriate place, halting until another button was pressed. It received signals with an identical pointer on another "indicator" dial.

The Universal telegraph was mainly used in pairs, connecting just two locations; but subscribers could connect by a separate circuit to a central office in the cities where the Company operated so that messages could be transcribed to and from the public telegraphs. For circuits with several Universal instruments the company used a switch or "current changer" that enabled the clerk to send up or down the line in either direction, without interrupting the communication of those stations situated in an opposite direction to that in which he wished to speak. It allowed several instruments to communicate with each other at the same time by dividing the circuit into independent sections. In such complex arrangements the use of the current changer required each Universal telegraph have its own call sign (as with public telegraph stations) and that it be switched as a through circuit when not in use.

The Universal telegraph indicated the full twenty-six letter roman alphabet, a full–point, a comma, a semi-colon and a cross- or reset-mark. The dial also contained a sub-set of the numbers 1 to 0 with a reset-mark, shown twice for speedier use. The crank was worked with the right hand, the communicator buttons with the left hand.

The alarms, used to attract the clerk's attention, were ingeniously designed to work only with the sending of two or three currents or rotations of the crank so as to avoid accidental use.

The earliest instruments of between 1859 and 1863 had separate communicator and indicator components; the original communicator dial was of quite large diameter with a belt-drive. The receiving indicator then had a swivelling dial on two small posts with the alarm in the base. It was occasionally called the "coconut" receiver by the press as the dial was contained in a small barrel-shaped wooden body. However the commonest Universal telegraph combined both in one compact polished-mahogany case, of a size 14 inches long by 8 inches wide by 10 inches high, a handsome adornment to any desk. There were also even neater, hand-portable one-piece Universal instruments for field use. These improvements to Wheatstone's original design were made by his employee, the engineer Augustus Stroh.

In 1862 Wheatstone demonstrated a new Universal type-printing receiver for private use to be used instead of the indicator dial. In this the rotating index hand was replaced by a brass daisy-wheel with letters and numerals on the petals which were 'printed' onto a re-useable tin-foil tape automatically, without the need for attendance. Contained within a discrete printing box; it was opened and the metallic message tape read as and when the recipient desired.

In 1867 its engineer, Colin Brodie, was experimenting with switchboards for use at its hub stations in London, Manchester, Newcastle and Glasgow by which the subscribers' Universal telegraphs could be put in circuit with each other, creating local networks.

There were three other competitive magneto-electric dial telegraph instruments available in Britain.

The most successful was that developed by Siemens & Halske in Berlin in 1858, where it was called the *magnetzeiger* (magneto indicator or dial), made available to private subscribers by the London District Telegraph Company. With a large and somewhat clumsy, though thoroughly effective, construction (it was so large, with a door at the front, that one wit in Europe dubbed it the "dog kennel"), it does not seem to have been used outside of the British capital, but over 700 were in use in Russia, Germany, Turkey and Sweden by 1864. In Siemens instrument the electro-magnet, wound with insulated wire and placed vertically inside a brass cylinder, was made to rotate on a vertical axis between the poles of permanent horse-shoe magnets by a large crank handle. Alternate currents of positive and negative electricity were generated and transmitted to the distant station, setting in motion an index-hand by an escapement. A serrated wheel beneath the handle enabled the operator to stop the handle at any particular letter with greater certainty. It was both reliable and accurate.

Of some importance was the much simpler dial telegraph devised by W T Henley in 1861. Similar in operation to but more compact than that of Siemens & Halske's, this appears to have had technical limitations which affected its acceptance, despite the support of the British & Irish Magnetic Telegraph Company.

The so-called Globe telegraph of Henry Wilde, of 1863, a clear imitation of Wheatstone's instrument, appeared too late to be successful in the private wire market.

At the 1862 International Exhibition in London the 'performance' of these instruments was compared: Wheatstone's Universal telegraph "worked perfectly" through a circuit of resistance equal to that of about 375 miles of No 8 gauge iron wire, and had previously been tested successfully up to 450 miles, working practically on 100 miles. Siemens magneto-dial worked through 468 miles of No 8 wire and was in regular use on a similar distance between St Petersburg and Moscow in Russia and over 25 miles in Bavaria. Henley's dial worked through 185 miles, and Wilde's Globe magneto could, in its most improved version, work through 140 miles of wire, but its normal small armature, producing the current, limited it to much lesser distances. Apart from that latter negative, Henley's magneto-dial was criticised in that "there is no notched wheel to enable the operator to stop suddenly, and no contrivance to prevent the handle from being moved back - it is consequently somewhat liable to fail in unskilful hands."

The Company used Wheatstone's patented *aerial cables* of 1860. A "telegraphic rope" containing from thirty to a hundred earth-return copper wires of a fine No 22 gauge each insulated with india-rubber overlaid with cotton tape was suspended from a single strong iron wire (or, if necessary on short spans, an iron rod) sustained by wire-stayed, roof-top metal poles or "straining posts" each one mile apart with some intermediate supports. The iron-wire stays were buffered with india-rubber cylinders to reduce wind noise and damaging movement. Each insulated copper wire was individually numbered and represented one client circuit, at every straining post was a complex connection box from which a circuit might be taken off to serve a client. The circuits in the cables were coloured red for one direction and black for the other. These aerial cables were laid along side-streets rather than busy thoroughfares to avoid public annoyance.

The copper wires were protected by the patent caoutchouc insulation made by S W Silver & Co.

Although the Company had problems with Silver's patent india-rubber insulation the aerial cables proved more robust and weather-resistant than conventional roof-top iron-wire circuits, as well as being cheaper than subterranean lines.

It planned to suspend its aerial cables in interconnecting triangular sections across London, each leg of one mile length. The properties at the points of triangulation were to be acquired by the Company and rented out after it had installed its masts and boxes on the roof.

Outside of London the wooden test boxes, containing the junctions from the many private circuits, were attached to the poles or to the sides of houses, rather than at roof level.

In London in 1863 it maintained its major route from Finsbury Square in the City, for Reuter's night office, south down Wilson Street, across Finsbury Circus, Draper's Gardens and Angel Court to the Stock Exchange, by Reuter's day office, down Birchin Lane and Clements Lane to Cannon Street. It then carried due west along Cannon Street, Ludgate Hill, Fleet Street, the Strand to Charing Cross, then south down Whitehall to the Houses of Parliament. It had a branch from Ludgate Hill to the Central Criminal Court, another from Charing Cross to Waterloo Place, for Reuter's West End office, and to St James's Street at Pall Mall.

Wheatstone was a director of the Universal Private Telegraph Company throughout its existence and was extremely active in its promotion.

i.] **The United Kingdom Electric Telegraph Company**

The United Kingdom Electric Telegraph Company was formed to use Thomas Allan's needle system in 1851; in this the magnets rather than the core were attached to and moved the needle. This idea proved abortive and it adopted the *American telegraph* using the key-and-inker for its single wire overhead or pole circuits in 1861 when it commenced operations. The American telegraph was, of course, free of all patent and other legal restraints in Britain. The United Kingdom company was to be the largest user of the American apparatus in the country.

Their American telegraphs and associated relays were supplied by Siemens, Halske & Company of London. It used the same 'European Alphabet' that was worked by the Electric Telegraph Company and all of the continental systems.

However in 1862 the Company acquired the rights to David Hughes' *type-printing telegraph* for use in its circuits and adopted the *ebonite* insulators of its own engineer, William Andrews, for its pole-suspended wires. The insulator consisted of an earthenware bell covering an ebonite or hard rubber cup inserted on an iron bolt. Where necessary, in urban areas, it used W T Henley's patent iron split-pipes to protect its subterranean resin-insulated circuits. Henley, a major telegraph contractor, had been a founder of the Magnetic company. It used S W Silver's patent india-rubber insulation for these short underground circuits, but this failed after four years and had to be replaced by protected gutta-percha.

One cost-saving novelty adopted by the United Kingdom company was the attachment of cast-iron brackets for its insulators to some of the many tall factory chimneys of the north of England, and suspending its wires between them at great height and over a great span. In at least one instance the bracket fell off and damaged the factory roof beneath.

The method of ascending the great factory chimneys to attach the brackets was that devised in 1845 by James Duncan Wright, a Scotsman living during the 1850s and 60s in Ramsbottom, Lancashire. A large square kite, in two pieces, of a size needing two men to work its two ropes, was flown over the chimney allowing a long cord to run across its mouth. Once in position the cord drew across a rope which connected with a length of chain. Once the chain was secure around the head of the chimney, a single block pulley and rope was raised to the top and used to haul up a wooden seat or platform from the ground from which to work. The kite and pulley was a far simpler and cheaper means of access than applying scaffolding to the whole shaft.

The kite apparatus was widely imitated in the north of England, being used for making repairs and, especially, for installing copper-rope lightning conductors, as well as for telegraph brackets and insulators, to factory chimneys up to 450 feet in height.

The Hughes type-printer, which produced messages printed in roman alphabet on a paper tape at a high speed, was only gradually introduced on circuits with the heaviest traffic, even some of the Company's long-lines relied on the American telegraph until business justified the change. Hughes' first success had been on the long line between Paris and Bordeaux in France, a distance of 575 kilometres, using the original version of his printer. The circuit was completed there in September 1860; Prof Hughes was on hand, as he was later in England, to instruct the French clerks in its operation. A version improved by Gustave Froment, his manufacturer in Paris, was introduced in the following year and that was adopted by the United Kingdom company.

The Hughes instrument proved important, it is therefore proper to describe its action: it had a keyboard similar to that on a piano, the separate keys being connected to vertical rods arranged in a circle. Pressing a key raised the tip of the associated rod above the normal level. Concentric with this circle of rods was a rotating vertical spindle that carried an arm called the 'chariot'. This swept around over the tips of the rods and was engaged by any one protruding. The engagement was thus transferred mechanically to an arm with contacts in the transmitting circuit so sending out a momentary signal current. The spindle rotating the 'chariot' was geared to a printing-wheel having raised characters on its outer periphery so that as the 'chariot' rotated one revolution so did the printing-wheel, which presented in turn the individual printing characters to a strip of paper. It was raised into contact by a further simple mechanism and released by the signal current. The sending and receiving instruments had to be synchronised but this was achieved by a simple technique of interchanging recognised signals.

David Hughes' patent was bought in shares and he became a director of the Company when it acquired his UK patent in 1862, remaining on the board until the firm was appropriated. The Company purchased all of its Hughes printers from his associate in France, the instrument maker, Gustave Froment, of rue Notre Dame des Champs 85, Paris.

Latterly the perfected Hughes apparatus was the most widely-used instrument for long overland and short submarine circuits in Europe, Asia and Latin America, enduring for nearly a century, until the 1950s in rural use, when it had long been superseded by the more effective and complex teletype and telex. It well outlived Cooke & Wheatstone's and even the American system in public telegraphy.

The American telegraph, with the key-and-writer or inker, was retained for many branch circuits throughout the United Kingdom company's existence and it was eventually used in its European connection working the 'European Alphabet' or dot-and-dash code.

j.] **Bonelli's Electric Telegraph Company**

The 'Electrician' magazine of July 6, 1862 gave an elaborate description of Gaetano Bonelli's new typo-telegraph, as displayed at the International Exhibition in London during that summer.

"We will endeavour briefly to describe the *modus operandi* of Signor Bonelli's system.

"Let the reader suppose himself to be the operator; before him he will find an oak table, 6½ feet in length 17 to 18 inches wide, along the centre of this table runs a miniature railway, terminated at either end by a spring buffer, and spanned midway by a kind of bridge 6 inches in height and 2½ or 3 inches wide. Upon this railway is placed a species of wagon, 1 yard long and 5 inches wide, 3½ in height, running upon four brass wheels: on the surface of this wagon are two long rectilinear openings - the one occupying the upper half and destined to carry the message which is to be sent, the other occupying the lower half, and intended for the message which may be to be received, upon the bridge are two small metal combs, each containing a number of insulated teeth, answering in number to, and connected with, the insulated conductors of which the line is formed. The combs differ from one another, the one which is to despatch the message being formed of so many teeth having a certain freedom of action is on the side of the bridge farthest from the operator; the other, or writing comb, is formed of a similar number of teeth fixed in a block of ivory, and forms a perfect line, which rests with a slight but regular pressure transversely on the paper, and occupies the nearer portion of the said bridge.

"We will suppose that the tables have been tested, and that a number of messages have been sent for dispatch; these messages are distributed to a given number of compositors, who set them up in ordinary type with great rapidity; the first that is finished is handed to the operator, whose wagon has already been pushed to the upper end of the rail and is held there by a simple catch, he places his dispatch in the opening destined for it, and in the second opening he places a plate of metal upon which has been laid four, five, or six strips of paper prepared with a solution of nitrate of manganese ; this done, he turns a small handle and watches if the operator at the other end has done his work; the wagon is at once freed from the catch, and is set in motion by a simple weight, the pace being regulated by a fan. The type of which we have spoken is thus brought under the action of the despatching comb, and runs lightly under its teeth from end to end; one half of the journey being made, the writing comb comes in contact with the prepared paper. If the operator at the other end has had a message to send it will have been printed in clear, legible characters, of a deep brown colour, answering with unerring fidelity to the forms over which the corresponding type comb has passed while the operator (the reader) learns that his message has as surely been received; the message is stripped off, the wagon remounted, the type-box changed, and the process of transmission and reception repeated. All this, which takes so long to describe, is so rapidly accomplished that from 450 to 500 messages may be dispatched per hour, the passage of the wagon occupying 10 to 12 seconds, during which time a message has been sent and received at each end of the line.

"It will be seen at once that it is morally impossible that any demand should arise that would over-tax the transmitting powers of this system, the whole question resolving itself into rapidity of supply. Now, ordinary compositors can set up a message of 30 words in one and a half minutes, this period is, of course, divisible by the number of compositors, ten giving ten messages each minute and a half, twenty giving twenty messages, and so on. By this happy application of electric science to the typographic art, it is believed that the price of dispatches will be reduced to a minimum, and the rapidity of distribution vastly increased, while the chances of mistake are almost annihilated, being reduced to the possibility of typographic error, in the first and only process in which error appears to be possible.

"It is scarcely needful to say that the dispatch received is actually sent out; as the wagon descends it is stripped from the plate, passed for a few seconds under a stream of water, blotted off, dried by hot rollers, and put into the envelope, which is, by this time, ready to receive it."

k.] **The Indo-European Telegraph Company**

The Indo-European Telegraph Company of 1868 demonstrated how far overland technology had come in twenty years. The Company, after examining the Hughes type-printer, selected Siemens adaptation of Wheatstone's automatic telegraph for its circuits. This had separate keying of messages on to paper tape, and receiving by inking on to tape at the terminal station. Siemens introduced on to the line a new rotary magneto sender that transmitted from the punched tape without batteries of cells. The Indo-European line relied upon Varley's translator or relay that enabled very-long-distance, uninterrupted transmission. Dependent on conditions either three or five translators were used in the line between London and Teheran.

The Company's line consisted of two 6mm gauge iron wires, much stronger than the common 4mm or 5mm gauge used in Europe. An extra domestic wire was added in places. They were suspended from Siemens patent iron-capped earthenware insulators on 70,000 posts with wood shafts in Poland and Russia and Siemens patent cast-iron shafts in the Caucasus and Persia.

The patent poles were manufactured by Siemens Brothers in Greenwich, London. These had a seven foot tall, four inch diameter, hollow cast-iron column with a twenty-one inch square base piece buried in the earth for stability. Into this was inserted a slightly conical twelve foot tall iron extension, with a twenty inch long lightning rod at its extremity. A small iron bracket near the tip carried the two insulators, one on either side. The patent insulators consisted of a cast-iron cup with a side flange to attach to the pole bracket. The iron cup had an inner earthenware insulator cemented within from which an iron hook protruded, to which the line wire was attached.

Siemens Brothers also made the armour for the short-lived Black Sea cable; Hooper's Telegraph Works Company provided the india-rubber insulation.

l.] **Technical Miscellany**

India

Based on his empirical knowledge William O'Shaughnessy formed his initial circuit of 1851 between Calcutta and Kedgeree of No 1 gauge iron-rods, 3/8 inch in diameter, welded into 200 foot lengths, weighing a half a ton to a mile, and suspended them in parallel pairs on tee-shaped head pieces each with two two-piece stoneware insulators on tall wood and bamboo poles. The rods were joined together using molten zinc poured into moulds at the union.

To work these he had made the simplest possible needle telegraphs, an open horizontal index with a vertical mirror to reflect the movements to receive, and rotating current reversers dipping pins in mercury to send messages. A simple turn-plate completed the apparatus, which cost about 30s 0d in total. There were no alarms; the telegraph had to be watched constantly for messages. At night an alarm clock with a magnetic trigger was in circuit. The small but powerful nitric acid batteries consisted of twelve cells of platinum and zinc.

These were replaced, after extensive comparative tests of English, American, French and German instruments, during 1854 by the American telegraph.

Exploders

One of the bye-products of telegraphy was the use of electricity to remotely detonate explosive charges. This required an electrical source, a durable insulated wire and the means of ignition, a fuze or detonator. Although several substantial efforts were made in the early 1840s, including a huge explosion set off by electric cells to clear a shore-side cliff in the way of the South Eastern Railway, it required to be successful the production of such a simple thing as resin insulated wire which did not occur until 1848.

The Gutta-Percha Company had made hundreds of miles of "sulphuretted gutta-percha" insulated wire for Siemens & Halske in Prussia in 1849. Unfortunately, at least for the purposes of telegraphy, it was found that a copper wire covered with sulphuretted gutta-percha allowed sulphide of copper to form on the interior of the resin. If the copper wire breaks or is cut the current passes through the sulphide, this becomes incandescent and then ignites the resin. This accidental discovery was utilised by Samuel Statham of the Gutta-Percha Company and marketed as *Statham's Fuze*. A short length of wire in a thick coat of gutta-percha with a high sulphur content was left for several months until the sulphide had formed. A small portion of the resin was then cut away to expose the wire and a gap of a quarter inch made in the copper. It was found by Michael Faraday in 1854 that gunpowder fired "with certainty" using this fuze at the end of eight miles of wire, and he tested it successfully over 100 miles! He also ignited six fuzes in succession.

Statham's Fuze, being so cheap and simple, was used for many years in demolition works, detonating gunpowder and gun cotton. Its disadvantage was that it required very powerful galvanic batteries or smaller batteries and induction coils to work reliably. To make it more sensitive Statham's Fuze was later charged with fulminate of mercury, six mines were thus simultaneously detonated at dock works in Cherbourg in France at a distance of 300 yards using a small induction coil and a single cell during 1860.

The British Army used a "galvanic fuze" in proof-firing artillery. This had a quill or tube with a wooden head, filled with fine gunpowder, containing two copper pins connected within by a superfine copper wire. Passing a current from a galvanic battery through the pins caused the wire to heat and ignite the surrounding powder. It was not widely used.

There was great inconvenience in using batteries of liquid-filled cells and induction coils in the field, particularly in military demolitions. Unsuccessful experiments were tried with W T Henley's lever-operated magneto-electric machines, similar to his telegraphs, and Statham's Fuze in the 1850s.

Charles Wheatstone and Frederick Abel, the government chemist, undertook a series of trials from 1855 which resulted in Wheatstone's *Magnetic Exploder* that was patented in 1860 and Abel's *Magnet Fuze*. The Magnetic Exploder, the first electric blasting machine, contained six small magnets rotating on a common axis and six fixed sets of coils that generated a sure, powerful current. It ignited from two to twenty-five Magnet Fuzes instantaneously through a single gutta-percha insulated copper wire. The Magnetic Exploder was widely used in colonial mining and by the British Army from 1861. The Confederate States acquired several to detonate submarine charges, known then as torpedoes, under abolitionists' ships in 1864.

The Magnet Fuze was the detonator used with the Magnetic Exploder, inserted in charges of black powder or the much more powerful new explosive, gun cotton. It has a box-wood head with a long copper primer filled with phosphide of copper and a tubular case of black powder. Frederick Abel went on to invent the high explosive, cordite.

Projectile Velocity

In March 1864 George Glanville Newman, the Electric Telegraph Company's District Superintendent in Liverpool, devised a method of measuring the velocity of projectiles of cannon. It consisted of a Bain chemical printer, recording the results on tape, a clock with a half-second pendulum, a battery of cells and gutta-percha insulated connecting wire. The muzzle of the cannon was crossed with 24 or 30 gauge copper wire and a frame with a further cross of wire erected 120 feet away. On firing the shot passed through the copper wire breaking two circuits marking the Bain tape with the timing.

It was tried in tests of James Mackay's experimental "windage" gun on Crosby Sands, near Liverpool, late in March 1864. The piece was 8 inches in calibre and weighed 9 tons, forged by the Mersey Steel & Iron Company, firing a 170 pound steel bolt. It was fired at a target armoured with 5½ inches of iron backed with 9 inches of teak, and pierced it at 200 yards range. The velocity of the gun was measured electrically by Newman's apparatus as 1,640 feet per second.

Fire & Burglar Alarms

The principles of electric telegraphy were introduced to the defence of property in the 1840s; and its very first application in Britain was contrived to cover virtually all such domestic dangers.

John Rutter, engineer to the Brighton Gas Company and a popular writer on gas and electricity, patented the first electro-magnetic fire and burglar alarm "system" in June 1847, the *Electric-Indicator*. This consisted of mercury thermometers with two platinum wires sealed in the tube in each room; mercury-filled switches attached to each door and window; a galvanometer; and a clockwork alarm bell with an electro-magnetic release, all connected by a copper wire circuit. In the case of fire once the temperature drove the mercury up to the platinum wires a circuit was completed and the alarm released; in case of "trespass" closing or opening a door or window brought a wire in contact with the mercury switch and set off the bell. The circuit worked in one direction for fire and the other for burglary so that the left or right movement of the needle of the galvanometer, located in "the master's sleeping room", signalled which danger was imminent.

Rutter's patent Electric-Indicator was demonstrated and marketed by Francis Whishaw at his Adelphi showrooms in 1848 and by Horne, Thornthwaite & Wood, instrument makers, 123 Newgate Street, City, in 1850. By 1851 it was being manufactured at the works of the telegraph engineer, W T Henley in Clerkenwell, in which year an improved version was introduced.

In 1850 Rutter's Electric-Indicator consisted of two neat mahogany boxes, one containing a battery of six Smee zinc-silver cells that would last "many months" with a small galvanometer inset, the other containing the clock work alarm, the trigger-weight and the electro-magnetic release for the trigger. There were two circuits, one with red-covered wire, the other with green-covered wire, and a white-covered return for both. The red circuit against thieves was attached to so-called 'circuit plates' on drawers, closets, boxes, windows and doors, the green circuit to electric thermometers in rooms and passages. The green circuit for protection against fire was *always* connected to the alarm; the red circuit was turned in and out of use by a single ivory knob on the alarm. A key was used to span the clockwork alarm. The original mercury trip switches were now replaced in the concealed 'circuit plates' by springs that closed the electric circuits once a door, window, lid or drawer was opened. As in the original specification the small galvanometer had the green circuit wound one way and the red another to give an indication of either fire or burglary when the alarm was released. To prevent unnecessary battery loss the circuit was automatically broken once the alarm bell was sounded.

Batteries

The earliest source of electricity used in telegraphy in Britain was the Cruikshank cell dating from September 1800, based on Volta's original discovery, using zinc and copper plates immersed in dilute sulphuric acid. It was known also as the "sand battery", as it used that material to prevent acid spillage. However the simple Cruikshank cell had a substantial defect; its output and effectiveness declined gradually over time.

These first cells, each of a pair of metallic plates, were arranged in teak or oak troughs – forming the *battery* of cells. In 1847 these batteries were 24 inches long by 6 inches wide; latterly, from 1850, the troughs were 30 inches by 5½ inches with twenty-four slate-partitioned cells. These, and their successors, were primary or, what are now called, fuel cells creating electricity, and not storage cells that could be recharged.

Battery power was measured on the galvanometer or detector in degrees of deflection of the needle, from 0° to 90°. In the line circuit this varied for many reasons; the number and condition of the cells, the state of the insulation and the ambient state of the weather, in particular atmospheric moisture.

The most significant cell in telegraphic service was that devised by John Frederick Daniell, a colleague of Charles Wheatstone at King's College, London. This was a copper-zinc device with *two* liquid elements contained in a glass jar, invented in 1836 and introduced into the industry in 1852. This had the considerable advantage of being constant in its output. It was known generically as the "sulphate battery". The Daniell cell was improved in 1853 by John Fuller, reducing its cost by one-third. In modern measurement each sulphate cell produced a constant 1 volt.

There were many minor improvements to the sulphate cell made by the companies' electricians and others over the years; the improvers each lending their name to these differences.

Sir William Robert Grove devised the zinc-platinum or nitric acid cell in 1839; this had twice the constant output (c. 2 volts) of a similar Daniell cell. Bunsen replaced the expensive platinum element with carbon in 1840. The powerful nitric acid battery was commonly used in telegraphy the United States from the outset of their lines. As it gave off toxic nitric acid fumes it had to be replaced by the sulphate cell in America during the 1860s.

The main stations of the companies possessed several hundred Daniell or other sulphate batteries to drive their many circuits; these were never used in total as they needed constant maintenance and repair by the battery-men. The Electric company alone had 96,000 sulphate cells in use by 1854.

In 1857 John Muirhead of the Electric Telegraph Company redesigned the Daniell cell so that its batteries were formed of "chambers" in their cases rather than of fragile glass jars, making them more robust and portable. The Muirhead sulphate battery was the commonest in service during the 1860s.

The Intercontinental Cables

The oceanic cables were entirely different from domestic land and submarine practice at this time, using Varley's or Siemens double keys to send and highly-sensitive Thomson mirror-galvanometers (and latterly Thomson's delicate siphon recorder) to receive messages. From patent law reports the Electric company's Cromwell Varley and Latimer Clark seem to have assisted William Thomson in perfecting the vitally important mirror-galvanometer. The long underwater cables were in constant charge and worked by current reversal.

It was noted that the already damaged first American cable of 1858 with its thin copper conductors was finally burnt out when the equivalent of 2,000 volts, from 312 Daniell cells with multiplying induction coils, was passed through it by S F B Morse's protégé, E O W Whitehouse.

As an experiment the engineer Latimer Clark had the 1865 and 1866 cables connected in Newfoundland and sent signals back-and-forth across the Atlantic from Valentia on their combined length of 3,500 miles using Thomson's mirror-galvanometer and a single cell "pygmy battery" made from a silver thimble! The Atlantic cable of 1866 could be driven by just twelve Daniell cells (c. 12 volts), but twenty or thirty were commonly used.

Technical Costs

For a comparison of the costs of telegraphic instruments available in 1852 we have W B O'Shaughnessy's "price list". He was despatched by the Governor-General of India to London in 1852 to investigate contemporary telegraph technology, over a short time he assembled a collection of instruments at the expense of the East India Company to judge their appropriateness for Indian conditions:

- American telegraphs, 'coarsely-made' in New York, at £11 each
- American telegraphs, 'well-made' in South Germany, at £10 10s to £14 each
- American telegraphs, which 'cannot be surpassed', by Siemens & Halske in Berlin, at £54 a pair
- Bain chemical printers, clockwork, made by William Reid, at £32 a pair
- Breguet dial telegraph, receiver and sender, at £12 the set, with an alarm at £9 12s
- Brett type-printing telegraphs, a single set, at £100 a pair, otherwise £50 a pair
- Cooke & Wheatstone two-needle telegraphs, "the best" by William Reid, at £12 each

- Cooke & Wheatstone single-needle telegraphs, by William Reid, at £6 each
- Dering pendulum single-needle telegraphs with simple current reversers, at £40 for six
- Dujardin magneto-electric printing telegraphs, at £31 10s a pair
- Foy-Breguet semaphore telegraphs, receiver and sender, at £25 4s the set
- Highton "commercial telegraphs", at £45 (*sic*) each
- House type-printing telegraphs by J B Richards of New York, at £108 each in America

From E B Bright's evidence of 1853 it is known that W T Henley's magneto-electric two-needle telegraphs cost £15 each.

In the Indian context, locally-made 'reversers' for sending cost 24s 0d each, 'telegraphs' or galvanometers for receiving 4s 0d and turnplates for switching 2s 0d.

The finest brown stoneware insulators by Bourne of Denby were available at 5d each in London; and Mitchell's patent iron screw-piles for poles, made by Ransom & Sims of Ipswich, at 6s each.

Joseph Whitworth, the engineer appointed by the government to report on the American telegraphs in 1852, observed that the simple Morse register cost £8 ($40) and House's complex type-printer, £50 ($250) there.

In technical context, marine chronometers, highly accurate clock mechanisms in brass and steel, cost between £21 and £25 in London during 1855.

Ten years or so later, sample buying-in costs for contemporary telegraphic apparatus and common supplies for telegraphy in the 1860s were:

• Hughes Type-Printing Instruments	£60
• Wheatstone Universal Instruments	£30
• American Printing Instruments	£10
• Breguet Dial Instruments	£10
• Double-Needle Instruments	£6
• Single-Needle Instruments	£3
• Bell and Tapper Instruments	£2
• Detectors (galvanometers)	£1
• Stoneware insulators (dozen)	6s 6d
• Iron wire No 8 gauge (100 yds)	10s 0d
• Iron wire No 12 gauge (100 yds)	5s 0d

In the late 1860s Theiler & Sons of Islington were selling their patent portable single-needle telegraphs for £4 10s, their patent American telegraphs with inkers for £12 0s, older pattern American telegraphs with embossers for £10 0s, American keys and relays for £6 0s, alarms for £2 0s and upright galvanometers for £2 0s.

Siemens magneto-electric dial telegraphs cost £19 each in the mid-1860s, whereas the best price for one of Wheatstone's competitive Universal instruments was £25. Henley's magneto dial was said to cost £16. These were far more complex in manufacture than the galvanic needle and American apparatus.

Instrument Performance

In the earliest days of the telegraph, between 1845 and 1848 the transmission rates with the two-needle telegraph were remarkably slow. A rate of six words a minute was the norm on the Electric Telegraph Company in that period. The Queen's Speech in 1846 was sent at seven words a minute from London to Southampton. It was this poor performance that required the introduction of translation into abbreviations for transmission. As performance improved, due to clerks' practice and better insulation of the lines, there was a move back to sending simple text.

However by 1850 sample sending speeds on the Electric company's two-needle instruments were recorded at between 23 and 26 words per minute; achieving 45 words in October 1849 and 52 words in July 1850 when transmitting mainly figures.

William Thomson pointed out in 1860 that much of the improved performance was achieved by "slimming down" the needle apparatus. The reduction in weight and travel of the heavy drop handle, its subsequent replacement by the hand pedal or key, and the reduction in size and weight of the needles, all contributed to the increase in speed of transmission in the 1850s.

Table 42

Sample Material Costs 1864

By R S Culley, Electric Telegraph Company

Timber	
30ft larch poles	10s 0d each
Charring pole bases	1s 0d each
Painting and tarring poles	2s 0d each
Earthenware pole caps	4d each
Oak arms, staggered widths	3d each
Wrought-iron bolts	12s 0d a gross
Insulators	
Single-shed insulators with wrought-iron pins and nuts	6d each
Double-shed insulators with wrought-iron pins and nuts	1s 0d each
Wire	
No 8 BWG galvanised iron wire	£19 10s a ton
No 16 BWG copper wire covered to No 8 BWG with gutta-percha	£24 a mile

From 'The Telegraphic Journal', January 16, 1864

C V Walker in 1850 estimated the average speed of a two-needle telegraph on the South Eastern Railway circuits as 16¼ words per minute. J S Fourdrinier, the Electric's secretary, said that in 1854 the same device was customarily sending at 21¼ words per minute, whilst E B Bright of the Magnetic stated that their two-needle Henley telegraphs were working at 27$^1/_3$ words per minute. The manually-worked Bain printer apparently achieved only an average of 19½ words a minute at that time; although it had been recorded as sending at 38 words a minute in October 1849. In comparison Henry O'Rielly in New York said that his American recorders worked at 20 to 23 words a minute.

Bright's Bell telegraph, an acoustic instrument, with Highton's twin tappers was, according to his brother, capable of working at from 30 to 40 words a minute. This was generally agreed to have the fastest transmission rate of any apparatus in common operation by ordinary clerk-operators in Britain.

Latterly, taking several contemporary sources regarding instrument performance it is recorded that the double-needle telegraph could be worked at 45 words per minute; the single-needle could achieve 35 words per minute in skilled hands, but averaged 27 words per minute. The American key-and-writer averaged about the same message rate as the single-needle device. The Universal telegraph could work at a maximum 20 words per minute (but more usually at 5 words per minute); whilst both the very sophisticated House and Hughes printers could send and print alphabet at up to 54 words per minute.

The Wheatstone automatic telegraph in common service from London achieved 120 words per minute to Manchester, 90 to Sunderland in the north-east of England, 60 to Aberdeen in the north of Scotland and 40 to Dublin by underwater cable.

The simple American 'sounder', an acoustic receiver, almost universal in the United States from the mid-1850s and familiar to current audiences for cowboy films, was introduced only at the end of this period by the Electric company but not at all used in continental Europe where the American (actually a Siemens or Digney) inker or writer predominated. The bureaucratic need for another level of permanent record prevailed over economy.

The circuits of the Atlantic and the other intercontinental cables were worked by current reversing keys and Thomson's mirror galvanometer. During 1867 the average speed of sending from Ireland to Newfoundland was eight words a minute.

Workshops

The Electric company maintained its own Factory for the manufacture and repair of instruments at Gloucester Road in Camden Town in London. The Factory was built in 1858 and covered a half-acre of ground adjacent to the London & North-Western Railway at Camden Town. It had two parts, around a large open yard. Next to the railway were mechanics' and carpenters' shops, instrument stores, insulator, battery and wire-fitting shops and a packing shed, all of two storeys. Next to the road was a single-storey building with a lacquering shop, a testing room, a tool store and the general offices.

The work of the Factory divided into two major functions: *electrical*, comprising the remanufacture and repairing of instruments, the manufacture of Varley's translators or relays, the winding of coils and the examination and testing of new instruments. The wire used was made from copper recovered from its old batteries. The other area was *mechanical*, the testing and fitting-together of insulators (supplied in pieces for better inspection), the preparation and binding of gutta-percha insulated copper wire for cables, the manufacture and refurbishment of Daniell batteries, and the manufacture of carriers for the pneumatic tubes.

The Magnetic company had similar shops in Bolton, Lancashire, near its headquarters in north-west England, for assembling insulators, manufacturing and maintaining batteries and general storekeeping.

In 1869 these two factories employed 175 people.

There were many small workshops in London and Birmingham, connected with the scientific instrument and clock-making trades, which made components and assembled instruments for the telegraph industry. None, except those of Reid, Wheatstone, Siemens and Henley, approached the Companies' shops in size.

Private Lines

Internal circuits in large factories, collieries and metal mines commonly used Louis Breguet's galvanic dial telegraph provided by small instrument makers. The Breguet device, sold in Britain without credit to the designer, cost £6 and was in two parts; a large diameter, engraved-metal sending dial with a rotating handle, and a separate receiving dial.

Two sets of Breguet dial instruments, with batteries, iron wire, insulators and everything except poles, ready for fixing for a one-mile private circuit cost £30 in 1868.

Technical Legacy

The companies handed over the following stores to the government in 1870: the Electric, 119 tons of iron wire, 457 miles of gutta-percha insulated wire, 6,102 poles, 138,656 insulators, 30 instruments and 30 Daniell batteries; the Magnetic 3½ tons of iron wire, 65 miles of gutta-percha insulated wire, 4,355 poles, 76,424 insulators, no instruments and 2 batteries; and the United Kingdom, ¼ ton of iron wire, no insulated wire, 1,706 poles, 18,862 insulators, no instruments and 75 batteries. The Electric company had on-going contracts with several suppliers for wire, poles, instruments and batteries that the government adopted.

In 1872 the Post Office Telegraphs were still using Cooke & Wheatstone's single-needle, Highton's single-needle, Bright's Bell, Henley's magneto, the American inker, the American sounder and Wheatstone's Universal telegraphs in its circuits. The Hughes apparatus was confined to foreign service.

The Electric Telegraph Company's great allies, the railway companies, defiantly retained Cooke & Wheatstone's and Highton's single-needle telegraphs in their own track-side circuits for another century. The last two-needle telegraph circuit was still in use in 1880; it was retained at Royal request on the Queen's private line to Buckingham Palace.

16.] **FINALE**

By 1860 the strength of the Electric Telegraph Company in the British domestic market was unassailable. All of the most profitable inland and offshore circuits were in its hands; it had grown organically, without dividend-diluting mergers; it had steadily introduced cost-saving technology and uniform equipment. It had kept control of all aspects of its business, abandoning those that were unprofitable; extending its reach deep into the Continent of Europe, introducing relatively minor ideas to consistently augment its services and its profits. It had attracted, from Wheatstone onwards, an immense body of scientific and technical talent that gave it incomparable authority in electrical theory and practice. Most of all it had been ruthlessly effective.

The principal competitor, the Magnetic company, had many problems, related to the expensive failure of its underground circuits and its external interests. Its personnel were entrepreneurs and minor technicians. As a result of serial mergers its management was fractured and its equipment lacked standardisation. Its only strength was its connection with the Submarine company's cables to Europe.

Both had floated domestic subsidiaries with radically new business models: the Electric with private telegraphy, and the Magnetic with district telegraphy. The first had been a runaway success; the latter had struggled from its beginning.

With regard to foreign connections the Electric's proprietors, although involved in the Atlantic cable, kept their distance from the eastern cables, choosing to concentrate on land lines through Europe to India, culminating in the success of the Indo-European company. In concert with this relentless expansion eastwards, the Electric had very nearly replicated its domestic model with its own network of public telegraphs along the railways in British India in 1863; only to be frustrated by government. The Magnetic's directors, in addition to the American cable, were distracted by their interest in expensive and apparently interminable submarine works in the Mediterranean and Red Sea. The Magnetic was in a weak position.

The two firms co-operated from 1855 in having a uniform message tariff and in 1860 merged their news functions. They also started to co-operate in managing the development of the Atlantic Telegraph.

The likelihood was that they would soon merge their interests into a single national provider of electric telegraphy. However the eruption of the United Kingdom company with its cheap tariff into the market in 1861 spoilt this natural evolution. Although the Electric and the Magnetic co-operated in opposition, it was perceived that any merger would only bolster the character of the new concern as the consumers' friend.

It was not until 1865 that the United Kingdom company admitted defeat over its pricing and agreed to co-operate with the Electric and the Magnetic. A formal merger was discussed but it was too late; the Post Office and the press had loudly campaigned for government control in the "public interest" and won the day.

After two years of parallel operation, laying circuit extensions to its own premises, the Post Office finally absorbed the business of the telegraph companies on Friday, February 4, 1870.

Only the Electric Telegraph Company was regarded by the markets as a sound investment. In the mature years of the business, during the 1860s before the government appropriation affected the market, its stock was always traded at a premium of 5% or more. In comparison, in the same period, the shares of the British & Irish Magnetic Telegraph Company, the London District Telegraph Company, the Submarine Telegraph Company and the United Kingdom Electric Telegraph Company, were always at a 40 or 50% discount, or worse in the case of the District and United Kingdom concerns.

However in developing their businesses the companies had struggled and then thrived over twenty years; at the end they were well-rewarded.

The purchase of the domestic public telegraph monopoly for the Post Office under the Telegraph Acts, 1868 and 1869, was finally authorised at £6,750,000. However, by 1876 the Post Office had managed to spend £10,071,536 with another £2,000,000 outstanding.

The paid-up capital of the domestic telegraph companies in 1868 was £2,496,744.

The incredible excess in expenditure had been used to buy-out the interests of the railway companies in the rights-of-way that they had granted the telegraph companies (an interest the government's officials in the Post Office failed to recognise) and for large-scale, unplanned extensions.

The amount the Post Office eventually paid the railway companies for telegraph wayleaves was *never* revealed to Parliament or, therefore, to the public. Quite possibly the total was never calculated.

Table 43

Telegraph Company Stock & Share Prices 1861 - 1868

From 'The Electrician'

For week-ending November 23, 1861

	Paid	Range
British & Irish Magnetic Telegraph Company		
Shares A	£50	£29 to £32
Shares B	£20	£18 to £20
Shares C	£20	£9 to £11
Electric Telegraph Company		
Stock	£100	£95 to £98
London District Telegraph Company		
Shares	Not quoted until May 1862	
Submarine Telegraph Company		
Shares	£1	7s 6d to 12s 6d
Shares	£10	£4 to £6
United Kingdom Electric Telegraph Company		
Shares	£2	£1 to 10s

For week-ending October 24, 1862

	Paid	Range
British & Irish Magnetic Telegraph Company		
Stock	£100	£54 to £57
Electric Telegraph Company		
Stock	£100	£100 to £108
London District Telegraph Company		

Shares	£4¾	15s to £1 15s
Submarine Telegraph Company		
Shares	£1	7s 6d to 12s 6d
Shares	£10	£4 to £6
United Kingdom Electric Telegraph Company		
Shares	£3	£2 10s to £3

For week-ending May 1, 1863

	Paid	*Range*
British & Irish Magnetic Telegraph Company		
Stock	£100	£65 to £69
Electric Telegraph Company		
Stock	£100	£100 to £102
London District Telegraph Company		
Shares	£5	£2 to £ £2 10s
Submarine Telegraph Company		
Shares	£1	7s 6d to 12s 6d
Shares	£10	£4 to £6
United Kingdom Electric Telegraph Company		
Shares	£3	£3 to £3 10s

From 'The Investors' Manual'

For month ending October 15, 1864

Capital	*Paid*	*High*	*Low*
British & Irish Magnetic Telegraph Company			
£534,780 stock	£100	£65	£57
Electric Telegraph Company			
£879,975 stock	£100	£106	£101
London District Telegraph Company			
12,000 shares	£5	£2	£1
Submarine Telegraph Company			
£280,000 stock	£100	£50	£45
75,000 shares	£1	12s 6d	7s 6d
United Kingdom Electric Telegraph Company			
30,000 shares	£3	£2½	£2

For month ending October 28, 1865

Capital	*Paid*	*High*	*Low*
British & Irish Magnetic Telegraph Company			
£515,170 stock	£100	£81	£80½
Electric Telegraph Company			
£899,875 stock	£100	£132	£125
London District Telegraph Company			
12,000 shares	£5	£2½	£2
Submarine Telegraph Company			
£265,000 stock	£100	£60	£57½
75,000 shares	£1	£1	15s
United Kingdom Electric Telegraph Company			
30,000 shares	£5	£3½	£3
Universal Private Telegraph Company			
7,600 shares	£25	-	-
	£3	-	-

From 'The Railway News'

For week-ending October 27, 1866

	Paid	*Range*
British & Irish Magnetic Telegraph Company		
Stock	£100	£87 to £89
Electric Telegraph Company		
Stock	£100	£133 to £138
London District Telegraph Company		
Shares	£5	15s to £1 5s
Submarine Telegraph Company		
Stock	£100	£50 to £60
Shares	£1	10s to 15s
United Kingdom Electric Telegraph Company		
Shares	£5	£1 to £2

From 'The Investors' Manual'

For month ending October 26, 1867

Capital	*Paid*	*High*	*Low*
British & Irish Magnetic Telegraph Company			
£515,170 stock	£100	£102	£96½
Electric Telegraph Company			
£899,875 stock	£100	£146	£140
London District Telegraph Company			
12,000 shares	£5	£1¼	£¾
Submarine Telegraph Company			
£265,000 stock	£100	£70	£63
75,000 shares	£1	15s	10s
United Kingdom Electric Telegraph Company			
30,000 shares	£5	£1¾	£1¼
20,000 10% shares	£5		

For month ending October 31, 1868

Capital	*Paid*	*High*	*Low*
British & Irish Magnetic Telegraph Company			
£515,170 stock	£100	£168	£165
Electric Telegraph Company			
£899,875 stock	£100	£232½	£220
15,000 shares	£8	£19	£16
London District Telegraph Company			
12,000 shares	£5	£3¾	£2¾
Submarine Telegraph Company			
£265,000 stock	£100	£98	£90
75,000 shares	£1	£1	15s
United Kingdom Electric Telegraph Company			
30,000 shares	£5	£5¾	£4¾
20,000 10% shares	£5	-	-
Universal Private Telegraph Company			
7,600 shares	£20	-	£20
	£18	-	£17

There was little or no trade in the Universal Private Telegraph Company's shares
Of note is the steep rise in prices in 1867 in anticipation of the government appropriation.

Given the flam-flam paraded by the Post Office at the parliamentary committee to investigate the terms of the appropriation, one of its members, George Leeman, MP and Lord Mayor of York, chairman of the North Eastern Railway Company, proposed on July 13, 1868 "that the imperfect information before the Committee on the subject of the ultimate cost involved in the purchase of the telegraph companies and other interests, as well as the uncertain amount of revenue to be derived from the working of the telegraphs by the Post Office, does not justify the further prosecution of the Bill, until the information shall have been laid before Parliament". In their eagerness to pursue a populist measure his wholly accurate analysis was rejected by the committee.

Opposition to the Bill also came, surprisingly, from Sir Rowland Hill, architect of the great Post Office reforms of the 1840s, who had introduced the Postage Stamp and the Penny Post. He inspired his younger brother, Arthur Hill, to write a detailed critique in the 'Edinburgh Review' of April 1869, effectively reiterating George Leeman's questions. Hill condemned the vague terms of the purchase, declaring outright that "the mode of compensation is as bad as can be conceived" and that "nothing is accurately defined".

The proposed revenue figures he thought dubious and unlikely to meet the financial cost of the purchase; "Even if the receipts from telegrams should be so great as after paying working expenses, to cover the annual charge occasioned by the original outlay, that would be no justification of its extravagance."

Hill condemned the bill in its detail, too; especially the "mischievous" franking privilege granted to all virtually all of the railway companies and the two largest canal companies, allowing them to send free messages throughout the entire system. He also expressed anxiety over the Post Office contriving to mix the expenses of the telegraph with those of the profitable letter service; doubting, as well, their ability to manage construction works economically and effectively.

A standard rate of 1s 0d (later reduced to 6d) for twenty words was immediately introduced by the government and it had virtually every rural Post Office put in circuit, giving a vast increase in traffic. The long-lines were intended to standardise on American ink-writers; the intermediate lines on single-needle instruments, using the 'European Alphabet' worked by the Electric, United Kingdom and Submarine companies, re-educating, with some difficulty, operators of the 'Magnetic Code' used on the Bell telegraph. The hundreds of new local circuits to small urban and rural post offices used the expensive Wheatstone Universal telegraph, which the Post Office carefully renamed the "ABC" apparatus; rewriting its purpose.

With hindsight the greatest loss of all was the abandonment of the Universal telegraph for domestic circuits when the Post Office acquired the patent. Wheatstone's intention to connect houses and business by 'electric mail' was lost for a hundred years. The Post Office saw telegraphy merely as an additional source of paper to be delivered by their letter-carriers.

Although R S Culley, the Electric Telegraph Company's chief engineer, continued in post for a few years the technical management of the Post Office Telegraphs soon fell into the hands of W H Preece, a "practical telegraphist", whose contempt for science and scientists became notorious. The ability that Wheatstone, Faraday, Thomson, Airy and the other great physicists had with the Companies to introduce innovative concepts and apparatus was lost; as was British domination of communications technology.

The weight of cheap-rate public traffic, compensatory free-message rights given to railway companies and an absurdly cheap press rate overwhelmed the system and the Post Office Telegraph Department, like those on the Continent on which it was modelled, quickly went into operating loss from which it *never* recovered. It became a permanent, growing, concealed burden on the public purse. That this state of affairs was tolerated can only be ascribed to the "incentives" provided to those interests able either to criticise (the press) or compete (the railway companies).

The purchase overspend was funded in great part by transferring money, £812,000 by 1873, without Parliamentary authority from customers' accounts at the Post Office Savings Bank to the Post Office Telegraph Department, secretly and illegally.

Who got rich from the telegraph?

The following extracts are from the published Estates of several of the principal personalities in the nineteenth century telegraph industry, showing who gained and who lost in the final accounting. This is a random selection:

- Charles Bright, telegraph engineer and cable promoter, £1,274
- Latimer Clark, telegraph engineer, £10,149
- Edwin Clark, engineer, £4,452
- William Fothergill Cooke, telegraph patentee, £16
- Robert Grimston, telegraph company chairman, £112,500
- John Pender, telegraph and cable company chairman, £337,180
- William Thomas Henley, telegraph contractor, £12,750
- William Henry Preece, Post Office telegraph engineer, £32,320
- John Lewis Ricardo, telegraph company chairman, "under £50,000"
- Cromwell Fleetwood Varley, telegraph electrician and engineer, £42,157
- Charles Vincent Walker, telegraph engineer, £2,467
- Charles Wheatstone, telegraph patentee, c £70,000

The only two Estates that require real notice are those of W F Cooke, at £16 (sic), who introduced the telegraph to Britain, and W H Preece, £32,320, a public servant. The modest amount left by the great cable speculator, Charles Bright, is also of interest.

The Post Office Telegraphs

There was a clear cultural change in the telegraph system in 1870. The companies had a critical balance between what were termed the commercial and engineering functions. The *commercial* side comprised the retail, operating and accounting functions, the *engineering,* the technical and maintenance functions; essentially 'earning' and 'spending', which possessed a carefully managed balance pre-1870.

The commercial staff, mainly recruited from the lower middle-class, having some formal education, with a flat hierarchy based, by and large, on performance, that recognised ambition and talent, immediately had a severely reduced status imposed on them.

Effectively the 'commercial' side vanished, subsumed into the historic Post Office culture, with all of its activities relocated within and controlled by the existing postal service, used to receiving, sorting and delivering letters by hand and horse. The Post Office by 1868 was a passive, almost inert, amazingly elaborate bureaucracy, with no sense of public service or fiscal responsibility. The tasks of the commercial component of the telegraph industry were almost entirely dislocated: marketing of the telegraph ceased, progress of staff became based on tenure rather than efficiency, a cumbersome hierarchy was imposed, working conditions were degraded, there was no effective leadership or strategy. Even the publication of profit and loss figures ceased. The company commercial staff, who had enjoyed a "modern" environment and great local autonomy of action, were demoralised by the archaic and bureaucratic management. They left in their hundreds.

To replace them, whatever the promises of economies of scale to Parliament, within eight months of the takeover the new telegraph department had to employ *twice* as many people as the companies had found necessary.

Reporting of performance to the public by way of Parliament became driven by political need rather than public responsibility, where previously the directors and shareholders had demanded accurate information. Emphasis was given only to ill-considered achievements and to justification of unproductive activity. Only increases in revenue were reported, no effort was made to calculate, let alone reveal, the costs related to this revenue, or to determine the benefits (if any) of the massive expenditure that took place post-1870. The companies' experienced accounting function was entirely eliminated, that responsibility passing to the existing Post Office bookkeepers who had *never* seen any need to publish profit and loss figures, or for that matter to publish any reconciliation of its books for public consumption. This negative bureaucratic regime was continued post-1870 in the Telegraph Department.

All that remained of the pre-1870 telegraph industry was the *engineering* function which speedily took the lead role in the Post Office Telegraph organisation. The engineers became a self-justifying entity. In addition to the anticipated works of connecting urban and rural post offices to the existing telegraph network and the rationalisation of the four networks into one, there was a frenzy of refurbishment and reconstruction of circuits that had previously functioned quite adequately. Almost at whim, overhead lines were replaced with underground cables; then cables were substituted with poles. Even with the merging of competing circuits additional strategic long lines were proposed as necessities, and many trunk circuits were doubled and quadrupled without examination of cost-benefit.

Despite, or because of, their structural dominance the engineers in the Post Office Telegraphs lapsed into technical conservatism. The long age of technical and scientific superiority that had existed prior to 1870 was superseded by inertia and a failure to modernise. Little or no attempt was made to advance instrument and circuit performance over the subsequent thirty years; co-operation with the scientific community became entirely neglected. Such advances as were introduced came through international pressure and not through internal developments.

Without "commercial" leadership the engineers assumed control at the "instrument". Post Office clerk operators, unlike their company predecessors, were expected to diagnose, adjust and fix their instruments, without any additional pay. This distracted clerks from their outward facing commercial role, reducing efficiency and performance, in as much as any measurement was taken of this vital function. Whilst company clerks were trained within their retail offices the Post Office imposed an elaborate, distant system of schools, isolating the telegraphic "scholars" from the public.

Elaborate forms were designed, and processes imposed to justify the bureaucracy rather than to assist the public, the hierarchy was extended and based on long-service rather than merit. New Controllers, Deputy Controllers, Assistant Controllers, Superintendents and Supervisors were appointed to oversee the work of the clerks.

Whereas the telegraph companies were consistently overwhelmed with applicants for clerkships and messenger positions from men and women the reputation of the Post Office was such that by 1871 it was reduced to offering a £1 bounty to existing postal employees and their families to recruit for vacancies, a week's wages.

Table 44

The Telegraph in Britain
July 10, 1868
Returns to the Board of Trade

Telegraph Companies				
Stations	*Miles Line**	*Miles Wire†*	*Sub Cable Miles Line*	*Sub Cable Miles Wire*
2,155	16,879¼	79,646¼	4,688¼	8,122½
Railway Companies				
England & Wales				
904	3,153	7,355½	-	-
Scotland				
270	1,297	2,896½	7	24
Ireland				
52	421¾	769¾	-	-
Railway Company Total				
1,226	4,871¾	11,021¾	7	24
Grand Total				
3,381	21,751	90,668	4,695¼	8,146½

From: Alphabetical Register of Facts, Dates and Events 1868. * Number of miles of posts and of underground lines constructed (sic). † Number of miles of wire used for the public or for the public and the purposes of the railway jointly.

The Post Office before absorbing the telegraphs did not employ women in any numbers, apart from a few self-managing rural post mistresses. Initially, not knowing how to cope with a mass of skilled, well-educated female employees, it retained the model used by the companies, and their number expanded. Their presence was resented by the postal officials and the other male postal employees, the latter drawn almost entirely from the ill-educated faction of society. The women undertook similar work for less pay but, initially, had far higher working conditions. The position of female labour in the Telegraph Department was rapidly eroded and the valuable capital that middle-class women brought to the companies' customer-facing operations was lost in the Post Office. Women were confined to the back office, and their working conditions (like those of the male clerks) were reduced. The roles and terms offered ceased to be attractive to ambitious and educated women.

The Post Office publicised only a few limited "headline" improvements: in particular the shilling, and later the six-penny, cheap rate, without revealing that it failed even to cover expenses of transmission; and the manifold number of new telegraph stations opened, again without any reference to their subsequent usage by the public. Between 1870 and 1895 it did not even report the miles of telegraph line it possessed, let alone any increase or decrease.

Regarding their relations with the public, there was almost immediately a policy of disinformation by the Post Office in regard to the achievements of the companies. One statement is typical, published in January 1871; "Total Number of Instruments in Use and Spare before the Transfer 1,869". The telegraph companies alone, exclusive of the railways, possessed 2,155 public offices in 1868. So, according to the bureaucrats of the Post Office 286 stations were without instruments!

It had started even earlier, on November 19, 1870 the principal of the Post Office Telegraphs wrote to Gardiner G Hubbard in Boston, an advocate of state ownership, that the telegraph companies had "about 1,900 instruments" in 1869, which he had increased to 3,300. In truth the Electric company alone possessed 7,245 telegraph instruments in 1868! He also claimed in a report to Parliament that London had "only" 95 public telegraph stations in 1869, when there were nearly double that number, 180. The proclaimed technical achievements verged on fraudulent.

The Post Office boasted in 1867 "with entire certainty" that it would be earning £600,000 in net annual revenue from the telegraphs. By 1875 it had only achieved £36,725. Working expenses alone were $96\frac{2}{3}$% of income, without allowing for the interest costs on the original purchase money, just as George Leeman and Arthur Hill has predicted in 1868.

The scandal was such that, when the Treasury exposed all of the financial and organisational misdemeanours in 1873, the Postmaster-General, the responsible Cabinet Minister, had to resign from government, and the civil servant responsible for initiating the appropriation campaign and who came to head the Telegraph Department had to flee to Ottoman Turkey in 1875.

As the economist Stanley Jevons was to say in 1875, "The accounts of the Telegraph Department unfortunately demonstrate what was before to be feared, namely, that a government department cannot compete in economy with an ordinary commercial firm subject to competition. The work done is indeed great, and fairly accomplished on the whole, and some people regard the achievements of the department as marvellous. They forget, however, that it has been accomplished by the lavish and almost unlimited expenditure of the national money, and that many wonders might be done in the same way."

One of the first acts of the new Post Office management in 1870 was to suppress press messages relating to a wide-spread strike by disgruntled workers in the telegraph department. **Ω**

17.] **TELEGRAPH STATIONS 1862**

A consolidated list of the 1,178 cities and towns in England, Scotland, Wales and Ireland with public telegraphs in the year 1862, whether worked by telegraph or railway companies. London is omitted and cities with more than one station are only counted once.

Abbey Wood	Aberdare	Aberdeen
Abergavenny	Accrington	Acock's Green
Adlington	Ainsdale	Aintree
Albrighton	Aldborough	Alderley
Alderney	Aldershot	Aldershot Camp
Alford (Lincs)	Alloa	Alne
Alnwick	Alston	Alton
Altrincham	Ambergate	Andover
Annan	Antrim	Appledore
Appley	Appley Bridge	Arbroath
Ardleigh	Ardrossen	Ardsley
Armagh	Armley	Arthington
Arundel	Ash	Ashbourne
Ashchurch	Ashford	Ashton
Ashton-u-Lyne	Aspatria	Athenry
Atherstone	Atherton	Athlone
Athy	Attleborough	Auchinleck
Audley End	Avonbridge	Axminster
Aylesford	Aylesham	Aynhoe
Ayr		
Bacup	Bagnalstown	Balbriggan
Balcombe	Balham	Ballinasloe
Ballybay	Ballybrophy	Ballyhaunis
Ballymena	Ballymor	Ballymoney
Ballymurray	Ballypallady	Ballyrag
Banbury	Banchory	Banff
Bangor	Barnard Castle	Barnes
Barnetby	Barnet	Barnsley
Barnstable	Barrow	Basingstoke
Bath	Bathgate	Batley
Battersea	Battle	Beattock
Beccles	Beckenham	Bedford
Belford	Belfast	Belmont
Belper	Belvedere	Bentley
Berkeley Road	Berwick-Tweed	Bescot
Betchworth	Beverley	Bicester
Bickley	Bideford	Biggleswade
Billingham	Billingshurt	Bilston

Bilton	Bilton Junction	Bingley
Birkenhead	Birmingham	Bishopstoke
Bishop Auckland	Bishop Stortford	Blackburn
Blackheath	Black Lane	Blackpool (Lancs)
Blackpool (Ire)	Blackwall	Blackwater
Blaina	Blairgowrie	Blaydon
Bletchley	Blisworth	Blue Pits
Bodmin Road	Bognor	Bolton
Bo'ness	Bordesley	Bosley
Boston	Bournemouth	Bow
Bowden	Box	Box Hill
Brackley	Bradford	Braintree
Brandon	Bray	Brechin
Brent	Brentford	Brentwood
Bricklayers Arms	Bridgend	Bridge of Allan
Bridgewater	Bridlington	Bridport
Brigg	Brighouse	Brighton
Brimscombe	Bristol	Britton Ferry
Brixham	Brixton	Brockenhurst
Brockholes (Junc)	Brockley Whins	Bromley (Kent)
Bromley Cross	Brompton (York)	Bromsgrove
Broughton	Brownhills	Broxbourne
Brugh	Brundall	Buckenham
Buckingham	Burgess Hill	Burnham
Burnley	Burntisland	Burnt Mill
Burscough	Burscough Brdge	Burslem
Burstwick	Burton-on-Trent	Burton Salmon
Bury	Bury St Edmunds	Burton
Byers Green	Bynea	

Caernarvon	Caermarthen	Cahir
Camberwell	Cambridge	Camborne
Canterbury	Cardiff	Cark
Carlisle	Carlow	Carnforth
Carrickfergus	Carrick (Junct)	Carrick-on-Suir
Carrightwohill	Carshalton	Carstairs
Castleblayney	Castle Cary	Castle Douglas
Castleford	Castle Howard	Castlerea
Castleton	Caterham (Junct)	Caterham
Catford Bridge	Cavan	Chapel Town
Charlton	Chartham	Chard Road
Chatburn	Chatham	Chathill
Chelmsford	Chelsea	Cheltenham
Chepstow	Chester	Chesterfield
Chesterford	Chichester	Chilham
Chilworth	Chippenham	Chipping Warden
Chitterham	Chorley	Church Fenton
Church Stretton	Cirencester	Clapham
Clapton	Clara	Cleckheaton
Clevedon	Clifton (Junct)	Clitheroe
Clones	Clonmel	Coatbridge
Cocksburnpath	Codsall	Colchester
Coleraine	Collumpton	Colne
Colwich	Congleton	Consett
Conway	Cooksbridge	Cooper Bridge
Copmanthorpe	Cork	Cornbrook
Corsham	Coupar Angus	Coventry
Cowes (Wight)	Coxhoe	Craven Arms
Crediton	Creetown	Crewe
Crewkerne	Cromer	Crook
Cropredy	Crosby	Croydon, East
Croydon, West	Crowle	Crystal Palace
Culham	Cupar	Curragh Camp
Curton		

Daisy Field	Dalbeattie	Dalkeith
Dalry	Dalry (Junct)	Dalton
Darlington	Darsham	Dartford
Dartmouth	Darwen	Dawlish
Deal	Deptford	Derby
Dereham	Derwydd Road	Devizes
Dewsbury	Didcot	Difford
Diss	Dock	Doncaster
Dorchester	Dorking	Dover
Douglas (Man)	Downpatrick	Drayton (West)
Drem	Driffield	Drogheda
Droitwich	Drumsough	Dublin
Dudley	Dudley Port	Dumfries
Dunadry	Dunbar	Dundalk
Dundee	Dundrum	Dunfermline
Dungannon	Dunkeld	Dunkettle
Dunse	Durham	Durston

Ealing	Eastbourne	East Farleigh
East Grinstead	Eastwood	Ebbw vale
Eccles	Eckington	Edenbridge
Edinburgh	Edington Road	Edmonton
Elgin	Elland	Elsecar
Elsenham	Ely	Emsworth
Enfield (Middx)	Enfield (Ire)	Ennis
Enniskillen	Entwistle	Epsom
Erith	Esher	Eskbank
Essendine	Eston	Etchingham
Etherley	Euxton (Junct)	Evenwood
Evesham	Exeter	Exminster
Exmouth		

Fakenham	Falkirk	Falmouth
Fareham	Farringdon Read	Farnborough
Farnham	Farrington	Fay Gate
Featherstone	Fence Houses	Fenny Compton
Fermoy	Ferryhill	Fiddown
Filey (Summer)	Firsby	Flaxton
Fleetwood	Flint	Folkestone
Folkestone Harb	Ford	Forest Hill
Forfar	Formby	Forres
Framlingham	Frant	Froghall
Frome	Frosterley	Furness

Gainford	Gainsborough	Galashiels
Galway	Garnant	Garston
Gartsherry	Gatehouse	Gateshead
Gathurst	Girvan	Gipsy Hill
Glanmire	Glasgow	Glamis
Glasson	Glastonbury	Glenluce
Glossop	Gloucester	Gobowen
Godalming	Godstone	Gomshall
Goole	Goring	Gosport
Gowan	Grampound Rd	Grangemouth
Grantham	Granton	Grantshouse
Gravesend	Great Bridge	Great Grimsby
Great Malvern	Greenhill	Greenhithe
Greenock	Greenwich	Grove Ferry
Guernsey	Guildford	Guisborough

Hackney	Haddington	Hadleigh

Hailsham	Halesworth	Halifax
Halshaw Moor	Haltwhistle	Hammerton
Hampstead	Ham Street	Hamilton
Handsworth	Hanwell	Harbury
Harecastle	Harling Road	Harlow
Harrogate	Harrow	Hartford
Hartlepool, Old	Hartlepool, West	Harwich
Haslingden	Hassock's Gate	Hastings
Hatfield	Hatton	Havant
Haverfordwest	Hawick	Haydon Bridge
Hayle	Hayward's Hth	Headcorn
Hebden Bridge	Heckmondwike	Hedon
Hele	Helpstone	Henfield
Hereford	Herne Bay	Hertford
Hessle	Hexham	Heyford
Heywood	Higham	Highbridge
Highgate	Hindley	Hipperholme
Histon	Hitchin	Hockley
Holme	Holmfirth	Holyhead
Hollywood	Honiton	Horbury
Horbury (Junct)	Horley	Horsham
Horwich	Howden	Howth
Huddersfield	Hull	Hunslet
Huntingdon	Huntley	Hurlford
Hurst Castle	Hythe (Essex)	Hythe (Kent)
Ilford	Inchicore	Ingatestone
Innisfeen	Inverary	Inveresk
Inverness	Island Bridge	Ipswich
Islip	Ivy Bridge	
Jedburgh	Jersey	Johnstone
Keadby	Kegworth	Keighley
Keith	Kells	Kelso
Kelvedon	Kemble	Kendal
Kenley	Keynsham	Kidderminster
Kilbirnie	Kilburn	Kildale
Kildare	Kildwick	Kilkenny
Killarney	Killeagh	Kilmarnock
Kilwinning	Kingsbridge Rd	King's Lynn
Kingston (Surry)	Kingston-on-Sea	Kingstown
Kirkby	Kirkudbright	Kirkham
Kirkaldy	Kirkley Hall (Private Telegraph)	
Kirkstall	Kirkstead	Kirriemuir
Kirton	Knottingley	Knot Will
Knowle		
Ladywell	Laister Dyke	Lakenheath
Lampeter Road	Lancaster	Langho
Langport	Laurencekirk	Leamington
Leamside	Leeds	Leek
Leicester	Leighton Bzzrd	Leiston
Leith	Leominster	Lesbury
Lewes	Lewisham	Lichfield
Lightcliffe	Limerick	Limerick (Junct)
Lincoln	Linlithgow	Linton
Lisburn	Liskeard	Lisnasfea
Littleborough	Little Bytham	Littlehampton
Liverpool	Llandilo	Llandovery
Llanelly	Llangadock	Llangollen Road
Lochanhead	Lockerbie	Londonderry
Long Eaton	Longford	Longniddry
Longport	Longstratton	Longton

Lostock (Junct)	Lostwithiel	Loughborough
Loughton	Louth	Lower Norwood
Lwr Sydenham	Lowestoft	Lowmoor
Luddenham Foot	Ludlow	Lurgan
Lymington	Lytham	
Macclesfield	Mageely	Maidenhead
Maiden Newton	Maidstone	Malahide
Malden	Mallow	Malton
Malvern	Manchester	Manea
Manningtree	Manton	March
Marden	Margate	Market Harboro'
Market Rasen	Mark's Tey	Marsh Lane
Martock	Maryborough	Maryport
Masboro'	Matlock (Bath)	Mauchline
Maynooth	Meigle	Melksham
Melmerby	Melrose	Melton Mowbray
Merstham	Merthyr Tydvil	Mexbro'
Mickley	Midleton	Middlesboro'
Middleton	Middleton (Junct)	Mildenhall Road
Miles Platting	Milford	Milnthorpe
Milton	Milford (Junct)	Milford Haven
Minety	Minster	Mirfield
Mitcham	Moate	Mogeely
Monaghan	Monasterevan	Montrose
Moreton (Junct)	Morpeth	Moses Gate
Motherwell	Mottram	Mountain Ash
Mullingar	Musselburgh	
Nairn	Nantwich	Navan
Nayland (Milford Haven)		Neath
Needham	Newark	Newark-on-Trent
Newbridge (Ire)	Newbridge or Pontypridd	
Newburgh	Newby Wiske	Newcastle-on-Tyne
Newcastle-under-Lyme		New Cross
Newhaven	New Holland	Newmarket
Newport (Hants)	Newport (Mon)	Newport (Wight)
Newry	Newton (Devon)	Newton Stewart
Newton	Newtownards	Newtownbutler
Newtownlimavady		New Galloway
New Wandsworth		Normanton
North Dean	Northallerton	Northampton
North Camp, Aldershot		Northfleet
North Road	North Shields	North Woolwich
Norton Bridge	Norton (Junct)	Norwich
Norwood (Junct)	Norwood (Lwr)	Nottingham
Nuneaton		
Oakengates	Oakham	Oakington
Oldbury	Oldham	Old Trafford
Omagh	Oranmore	Ormskirk
Orrell	Oswestry	Ottringham
Oundle	Over Darwen	Oxenholme
Oxford	Oxford Road	Paddock Wood
Paisley	Pangbourne	Pantyffynnon
Par	Parsonstown	Partridge Green
Patrington	Peckham	Peebles
Pemberton	Penistone	Pennicuick
Penrith	Penshurst	Penzance
Perth	Perry Bar	Peterborough
Petersfield	Petworth	Pickering
Picton	Pierce Bridge	Pimbo Lane
Pimlico	Pillmoor Junct	Pluckley

Plumstead	Plymouth	Plympton
Polegate	Pomeroy	Ponder's End
Pontardulais	Pontypool Road	Pontypool Town
Pontypridd	Pontefract	Poole
Portarlington	Portadown	Port Clarence
Port Glasgow	Port Rush	Portsea
Portsoy	Port Talbot	Porth
Portsmouth	Potto	Poulton
Prestonpans	Preston	Preston Junction
(Lancs)	Preston Junction (Durham)	
Preston Road, Walton-on-the-Hill		Pullborough
Purton		
Queenstown		
Radcliffe	Rainford Junct	Ramsgate
Ramsbottom	Ramsay (Man)	Rawcliffe
Rawtenstall	Reading	Redcar
Redheugh	Red Hill	Redruth
Reedham	Reigate	Reigate (Junct)
Reston	Retford	Rhyl
Ribchester	Richmond, Surry	Richmond, York
Rillington	Ringwood	Ripon
Robertsbridge	Rochester	Rochdale
Rochester	Romford	Romsey
Roscommon	Rostrea	Rose Grove
Rossett	Rotherham	Round Oak
Rowsley	Roydon	Roxburgh
Ruabon	Rugeley	Rugby
Runcorn	Runcorn Gap	Ryde (Wight)
Rye		
St Albans	St Austell	St Boswells
St Germans	St Helen's (Dur)	St Helen's Junct
St. Helen's (Lanc)	St Joes (Hants)	St Leonards
St Neots	St Thomas	Saddlethorp
Salisbury	Sale Moor	Sallins
Saltash	Sandwich	Sanquahar
Sawbridgeworth	Saxmundham	Scarborough
Scarva Junction	Seaham (Private Telegraph)	
Seaton	Selby	Selkirk
Semley	Shaftesbury	Shalford
Shap	Shapwick	Sharpness Point
Sheerness	Sheffield	Shefford
Sherbourne	Shiffnal	Shildon
Shilton	Shipley	Shipton
Shoreham	Shorehampton	Shrivenham
Shrewsbury	Silloth	Sinderby
Skipton	Sleaford	Slough
Smeeth	Snaith	Snodland
Soho	Solihull	Somerleyton
Sough	Southall	Southam
Southampton	Southboro Road	Southend
Southport	South Shields	Southwater
Sowerby Bridge	Spalding	Spennymoor
Spetchley	Spon Lane	Staddlethorpe
Stafford	Staines	Staleybridge
Stamford	Stamford Hall	Stanley Junction
Stanningley	Stanstead	Starcross
Staplehurst	Staveley	Steventon
Steyning	Stillington	Stirling
Stockport	Stockton-on-Tees	Stoke-on-Trent
Stokesley	Stoke Works	Stone

Stoneclough	Stonehaven	Stonehouse
(Gloucs)	Stourbridge	Stow
Stowmarket	Strabane	Stranraer
Stratford, Essex	Streatham	Stratford
Strood	Stroud	Sturry
Sudbury	Sunderland	Sutton
Swansea	Swan Village	Swavesey
Swindon	Swinton	Sydenham
Symington	Syston	
Taff's Well	Tallington	Tamworth
Taplow	Taunton	Tavistock
Tebay	Teignmouth	Teignmouth
Tetbury Road	Tetsworth	Templemore
Tewksbury	Theddingworth	Thetford
Thirsk	Thorne	Thornhill (NB)
Thornhill (York)	Thornton	Thrapstone
Three Bridges	Thurles	Ticehurst Road
Tichurst	Tilbury	Tillicoultry
Timperley	Tipperary	Tiverton
Tivoli	Todmorden	Topsham
Torquay	Totnes	Tottenham
Tow Law	Tralee	Tranent
Trehemetry	Tring	Troon
Trowbridge	Truro	Tuam
Tullamore	Tunbridge	Tunbridge Wells
Tutbury	Tweedmouth	Twickenham
Twyford	Tynan	Tyne Docks
Tynemouth		
Uckfield	Ulceby	Ulleskelf
Ullesthorpe	Ulverstone	Uttoxeter
Uxbridge		
Valentia	Victoria, Ebbw	Ventnor, Wight
Wadhurst	Wakefield	Walsingham
Wallingford Rd	Wallsend	Walsall
Walsden	Waltham (Essex)	Walton-on-Thames
Wansford	Wandsworth	Ware
Wareham	Warlingham	Warrington
Warwick	Washington	Waskerley
Waterbeach	Waterford	Wateringbury
Water Lane	Waterloo	Watford
Wednesbury	Weedon	Welbury
Welford	Wellingboro'	Wellington (Soms)
Wellington (Shropshire)		Wellington (Cllge)
Wells	Westenhanger	Westhoughton
Weston-s-Mare	Weston Point	West Bromwich
Westbury	West Drayton	West Grinstead
Westwood	Weybridge	Weymouth
Whalley	Wheatley	Wheatsheaf
Whitacre	Whitby	Whitehaven
Whitley Bridge	Whitstable	Whittlesea
Whittlesford	Wichnor Junct	Wickham Market
Wicklow	Wigan	Wigton
Wigtown	Willington	Wimbledon
Wimbourne	Winchelsea	Winchester
Winchfield	Windermere	Windsor
Wingfield	Winslow	Winston
Wisbeach	Witham	Withernsea
Witton (Junct)	Wokingham	Woking
Wolsall	Wolsingham	Wolverhampton
Wolverton	Wombwell	Woodbridge

Woodford	Woodgate for Bognor	
Woodstock Rd	Woolwich	Wootton Basset
Workington	Worksop	Worsboro'
Worthing	Wortley	Wrexham
Wycombe	Wye	Wymondham
Yalding	Yarmouth	Yatton
Yeovil	York	Youghall
Yoxford, or Darsham		Ystrad

The dominance of the railway interest is emphasised by the number of telegraphs at small and obscure stations at railway junctions ('Junct' above). The list is taken verbatim from the *Zeitschrift des deutsch-österreichischen Telegraphen-Vereins*, Jahrgang IX, 1862.

18.] **TELEGRAPH COMPANY STAMPS**

Several of the domestic telegraph companies issued adhesive franks or stamps to apply to their message forms to indicate prepayment. This section gives a brief summary of the franks issued between 1854 and 1868.

The currency used here is the pound sterling, the '£' or 'L', then divided into twenty shillings, the 's', each of twelve pence, the 'd'. So the pound equalled 240 pence. Average individual male earnings in this period were about £24 per year. The nationwide postage for a letter was 1d. As regards technology, the use of the word "printed" refers to reproduction from an engraved metal plate; "lithography" to reproduction from stone, a cheaper, less detailed process.

Telegraph company stamps are relatively rare as the forms they franked were handed back to the company when the message was sent, and ultimately pulped. Survivors with so-called "control numbers" (imitating numbers on banknotes) were kept by purchasers as souvenirs when the government took over; those without numbers had been disposed of by the companies as waste after 1868. Several companies used inked-rubber "obliterating stamps" to ensure that franks they received on their forms could not be re-used.

The Electric Telegraph Company issued "Franked Message Paper" at the Great Exhibition in London during 1851. This was a pre-paid message form and had a fixed price of 1s 0d for a twenty word message within a 50 mile radius of the sending station. It was 8¾ inches by 7¼ inches printed on pink, watermarked paper, embossed with the Company seal. They carried consecutive numbers and were issued between 1851 and 1853.

The Electric Telegraph Company 1854

First Stamp

On June 1, 1854 the Electric company introduced the first telegraph stamp, which it termed a "Franked Message". This was adhesive-backed, 2⅝ inches by 2 inches in size on sheets of sixteen franks, and contained a brief summary of the Company's terms. There were three "denominations", for messages of twenty words under 50 miles, on pink paper; under 100 miles, on deep-blue paper; and over 100 miles, on white paper. The sender had to sign the stamp face to show they knew the Company's terms, this meant that these large stamps could frank plain paper as well as the message forms. They were produced by Perkins, Bacon & Company, steel engravers, banknote and stamp printers, of 69 Fleet Street, London. They were not perforated.

As with most subsequent telegraph franks, they are "signed" in facsimile by company officials. In this case the initials JLR for J Lewis Ricardo, and JSF for James Sealy Fourdrinier, chairman and secretary respectively, appear in the top corners. They were the first stamps overprinted with consecutive numbers.

Second Stamp

In January 1855 the "denomination" was altered from mileage to value to make them more flexible in accounting for distance and wordage. The design was kept the same but extended: 3d on light yellow paper; 1s 0d on fawn paper; 1s 6d on pink paper; 2s 0d on light blue paper, 3s 0d on deep blue paper; and 4s 0d on white paper. These were also made by Perkins, Bacon & Company. Until 1860 they were not perforated, in June of that year Perkins Bacon acquired a perforator, these were the first stamps it was used on.

Third Stamp

In 1861, after competitive companies introduced "postage stamp sized" franks, the Electric replaced its large "Franked Message" version with small "Telegraph Stamps". There were two sorts; one for inland messages, portrait format, and one for continental messages, landscape format. They were all made by Waterlow & Sons, 66 London Wall, London, lithographers. The Telegraph Stamps were perforated. They were like as not printed on sheets of 100, 10 by 10, as were most of Waterlow's franks.

The inland Telegraph Stamps were 1¼ inches by 1 inch in size. They carried the year 1861, which never changed. They were lithographed on white paper in coloured ink: 3d ochre-brown; 1s 0d orange-yellow, 1s 6d rose-pink, 2s 0d green; 2s 6d chocolate-brown; 3s 0d blue, 4s 0d black, 5s 0d purple and 10s 0d purple-brown. All were consecutively numbered. Each stamp was "signed" or initialled by the Chairman Robert Grimston (RG) and the Secretary, James Sealy Fourdrinier (JSF) in facsimile.

The Continental Stamps were issued in denominations of 3d, 1s 6d, 4s 0d and 8s 0d; lithographed in black on white paper, to a size 1 inch by 1⅜ inches, overprinted with consecutive numbers. These were not "signed" but had the initials of the chairman (RG) and secretary (JSF) printed in small cyphers either side of the price. They carried the unchanging 1861 date in the corners.

The Continental Stamps were abandoned before 1864, when Henry Weaver became secretary, and replaced by high value inland Telegraph Stamps.

Fourth Stamp

Early in 1864, the "signatories" on the Inland design were altered to RG, Robert Grimston, and HW, Henry Weaver, and a new denomination added, 6d in bright-vermillion ink, especially for use within London and provincial cities.

Directors' Message
For a period the Company issued its directors with a private series of adhesive stamps for attachment to the ordinary message form. They appear to date from 1855 until the mid 1860s when Director's Passes were introduced. Each director was issued with stamps carrying his name and numbered in sequence. The stamps, of a size 1 inch by 1⅛ inches, were lithographed in black ink on blue paper. It is not known if these were "free" messages or had to be accounted for. They were not perforated.

The British Telegraph Company c 1854
The "Frank Stamps" of the British Telegraph Company are rare and slightly mysterious. They were missed by the authors of the first history of telegraph stamps. Existing samples have values of 1s 6d printed black on grey paper, 2s 0d, printed black on blue paper and 4s 0d printed black on yellow paper, to a size of 2⅜ inches by 1⅞ inches. Sheets of thirty-two stamps were watermarked with the Company title. They are "signed" in facsimile by Geo (George) Saward, the secretary. They were not perforated.

These franks were lithographed by Mawdesley & Company, 2 Castle Street, Liverpool.

The English & Irish Magnetic Telegraph Company c 1854
It is claimed that the Magnetic company issued its first "Frank Stamp" for messages in 1853. It is more likely that they appeared sometime in 1854 or 55, as there is no notice of them given in its published works in 1854. There were five denominations identical in design and size, 1¾ inches by 1⅜ inches, except for the value and ink colour: 1s 0d in black, 1s 6d in lilac, 2s 6d in blue, 4s 0d in pale red and 5s 0d in green, all on white stock, with either 50 or 100 franks to a sheet. The green 5s 0d stamp covered, appropriately, a twenty word message to Ireland. The stamps were "signed" in facsimile by the secretary E B (Edward Brailsford) Bright. They were not perforated.

They were made by Mawdesley & Company, lithographers, of 2 Castle Street, Liverpool.

The British & Irish Magnetic Telegraph Company 1857
Mawdesley's lithographed a new series of "Frank Stamps" for the combined Magnetic and British companies in 1857. These were to a size 1⅛ inches by 1 inch printed in black on coloured paper to a simple design. There were a wide variety of denominations: 3d on white, 6d on flesh, 1s 0d on lavender, 1s 6d on grey, 2s 0d on bright yellow, 2s 6d on pale olive yellow, 3s 0d on pink, 4s 0d on pale green and 5s 0d on pale blue. The facsimile "signature" was now spelled out as 'Edward B Bright, Secty'. This series was perforated.

There was an early version with an even simpler surface design, of which only one example exists. This had the price in a central box prefixed by the word 'Value'.

The paper sheets of the earliest franks of the British & Irish company retain the watermark of its component, the British Telegraph Company.

As noted, they were made by Mawdesley & Company, 2 Castle Street, Liverpool.

The South Eastern Railway Company 1860
In September 1860 the South Eastern Railway, then the third largest telegraph network in Britain, began to issue "Electric Telegraph Franks". These were made to a common, very handsome design by Charles Whiting, Beaufort House, Strand, London, and printed to a size 1⅝ inches by 1⅜ inches in sheets of twelve and sixteen. The denominations were 9d in red on white paper, 1s 0d in orange-yellow on white paper, 1s 2d in black, 1s 6d in lilac, 2s 3d in red-brown and 2s 9d in green. They were watermarked SER and perforated. Although only 25,000 were printed they were in use until 1868.

The Submarine Telegraph Company 1861
The Submarine company introduced "Uninsured Message" franks in December 1861 in five denominations: 4½d, 3s 9d, 4s 0d, 7s 6d and 8s 0d. These unusual values are explained by the flat rates that the Company had adopted: 3s 9d for a ten word message to Denmark, and 4s 0d for a ten word message to the German states, on its new cables, 4s 0d also was the price of a message to France; the double values for messages of twenty words. The 4½d stamp was for each additional word.

The value was spelled out at the base and rendered in tiny numbers in the four corners of a central STC monogram panel.

The Submarine company stamps were of identical design except for the value, of a size 1⅝ inches by ⅞ inches, finely printed in mauve on white paper by De la Rue & Company, 110 Bunhill Row, London. They were perforated and printed 80 per sheet. Most unusually for British telegraph franks, they were not consecutively numbered.

The United Kingdom Electric Telegraph Company 1862
First Stamp
The United Kingdom company first issued "Uninsured Message" franks in December 1861, when the spine of its network between London, Birmingham, Manchester and Liverpool was near opening. Its stamp issue ought to have been straightforward in that it had a flat rate of 1s 0d for a twenty word message whatever the distance.

They were made by De la Rue & Company, 110 Bunhill Row, London, and printed on white paper to a size 1⅛ inches by 1 inch. There were, in fact, three denominations: 3d in yellow-ochre, 6d in pink and the widely-used 1s 0d in violet. In size and quality they were close to the high-value 5s 0d postal stamps, so close in fact that the earliest United Kingdom franks were printed on blue-tinged security paper. The 3d and 6d stamps were to account for five and ten extra words respectively. All were perforated.

Second Stamp
In July 1864 the design of the United Kingdom's franks was altered to a landscape format of the same size, new values were introduced and the quality of the reproduction reduced, later versions, particularly of the 1s 0d

value, were lithographed rather than printed from metal, probably not by De la Rue.

There were then 3d stamps in orange-yellow, 6d in rose, 1s 0d in violet, 1s 6d in green and 2s 0d in brown, on white paper. The upper corners of each value contained a unique cipher. The Company abandoned the 1s 0d flat rate in July 1865.

Franks used to pay interest on its 7½% Bonds were overprinted INT in black.

The London District Telegraph Company 1862
The District company in metropolitan London made immense promotional use of its stamps. It offered them bound in booklets, six stamps to a "page", and for sale in bulk at a discounted price for most of its existence. They were all lithographed by James Truscott & Sons, Suffolk Lane, Cannon Street, London.

First Stamp
There were three denominations, 3d, 4d and 6d issued from 1862, notable for having the value appear in very large size. To a size 1⅛ inches by 1 inch, they were "signed" in facsimile by the then secretary A (Alfred) Ogan. The 3d stamp was lithographed in black on bright yellow paper, the 4d stamp on blue paper and the 6d on vermilion-faced paper. Uniquely the control numbers on the 3d and 4d issues were overprinted in red rather than the near universal black. They were perforated.

Second Stamp
A new design was issued, apparently in 1865, but probably several years earlier, with the title "Message Stamp" and "signed" by the current secretary Charles Curtoys. As previously these were lithographed in black on coloured stock, and perforated, 1¼ inches by 1 inch. There were two denominations, 3d originally on yellow paper, and 6d originally on pink paper, with the control numbers overprinted in black. Later lithographs were on greenish-blue paper for 3d, and vermillion for 6d values, the numbers entered in handwriting.

Bonelli's Electric Telegraph Company 1863
Bonelli's only worked one line, between Manchester and Liverpool, for a very short period in 1863. They still, however, provided four denominations of telegraph frank; 3d in bright green on white paper, 6d in black, 9d in blue and 1s 0d in orange to the size 1¼ inches by 1 inch, lithographed by Waterlow & Sons, 66 London Wall, London. They were perforated and printed on sheets 10 by 10.

Two booklets of stamps were also made for Bonelli's: 84 stamps in seven pages in a green paper cover, and 42 stamps in seven smaller pages in a pink paper cover, both using a reddish-brown version of the 3d stamp to a differing size of 1⅜ inches by 1 inch.

The Universal Private Telegraph Company 1864
For the convenience of the customers on its public circuits in Western Scotland and North-East England the Universal company also adopted telegraph stamps during 1864. This year was carried in the corners of all the franks.

They were lithographed by Waterlow & Sons, 66 London Wall, London, to a size 1¼ inches by 1⅛ inches, with coloured ink on white paper, one hundred to the sheet. There were two sorts, 6d in brown and 1s 0d in mauve, both were printed on sheets 10 by 10, and perforated.

The London, Chatham & Dover Railway Company c 1864
This railway worked its own telegraphs and issued at least two sorts of "Stamps for Telegraphs". These were in the value of 3d lithographed in black on yellow paper and 1s 0d in black on grey-white paper. They carry the "signature" of J S (James Staats) Forbes, the General Manager. They were not perforated.

The General Telegraph Company 1864
A 6d value perforated frank exists lithographed in black on white paper for this company. Possibly a fraud, it may be an issue of the General Private Telegraph Company of Manchester that offered the customers of retail traders "free" messages on its single circuit to Altrincham using franks.

This text is drawn in great part from *The Postage and Telegraph Stamps of Great Britain* by F A Philbrick and W A S Westoby, published by Sampson Low, Marston, Searle & Rivington, London, in 1881; with additional information from *Private Telegraph Companies of Great Britain and their Stamps* by Raymond Lister, published by Golden Head, Cambridge, in 1961.

Thanks also go to Stephen Panting of the *Telegraph Stamps of Great Britain* website for his generous advice.

19.] **THE REST OF THE WORLD**
The following is intended to add some context as to how British telegraph history fits into the development of communication in the other continents.

a.] **Cooke & Wheatstone and the Growth of the Telegraph in Europe**
The electric telegraph was introduced to France by Cooke and Wheatstone alongside of the Paris & Versailles railway in 1842; circuits by the Paris & Rouen railway in May 1845 and the Paris & Lille railway in July 1846 followed. The lines were soon absorbed into the administration of the *télégraphe aérien*, the Bonaparte-era optical system that only worked government messages; it eventually opened its circuits to the public on March 1, 1851. After the brief experiment with Cook & Wheatstone's apparatus the state circuits used the Foy-Breguet instrument that copied the indications of the aerial telegraph, but by 1852 the American telegraph, the key-and-register, was being used in all public French circuits.

There had been many successful telegraphic experiments in the German states before Cooke & Wheatstone obtained their first patent in Britain. However, of the first four commercial applications there, three were based on their work.

In 1843 Wheatstone, working with the German engineer Hannibal Moltrecht, installed a short, and short-lived, experimental two-needle telegraph line between Aachen and its suburb of Ronheide, alongside the track of the cable-worked *Rheinische Eisenbahngesellschaft,* the Rhine Railway Company.

The two subsequent efforts in Germany were also inspired by Cooke & Wheatstone:

William Fardely of Mannheim, who was born in Yorkshire, successfully installed his adaptation of Wheatstone's first capstan and dial telegraph alongside the rails of the *Taunusbahn* between Frankfurt-am-Main and Kassel in 1844. Like Wheatstone, Fardely went on to devise an electric clock and to adapt the dial receiver to print type. Two years later, in May 1846, Johann Wilhelm Wendt, a ship's master who had visited Cooke & Wheatstone's line on the Great Western Railway between Paddington and Slough in England, organised the *Bremer Telegraphenverein* with a joint stock capital of 16,000 thalers. He replaced the optical marine telegraph running from the great port of Bremen to Bremerhaven on the Weser estuary with a two-needle electric telegraph, opening the circuit in November 1846.

The Cooke & Wheatstone two-needle system was the initial public telegraph in Belgium, with a government concession dated December 23, 1845 for a line of telegraph along the Brussels – Antwerp railway. This concession passed, along with all their other rights, to *la Compagnie du Télégraphe Électrique,* as the Electric Telegraph Company was known in Belgium, which opened the circuit on September 7, 1846 and continued it until September 1, 1850 when it reverted to the state.

In Austria the telegraph was first introduced between the capital, Vienna, and Brunn in Bohemia during December 1846, extended to Prague in September 1847. This used the I & V device of Alexander Bain, modified to work as an acoustic telegraph; and retained in service until 1870. After experimenting with Bain's chemical writer, using sensitized tape, the American telegraph was introduced into Austria between Vienna and Budapest in 1850.

In Italy the electric telegraph was introduced into Tuscany between Leghorn and Pisa in 1847. This used a Breguet dial instrument. It was extended from Pisa to Florence in August 1848. The Cooke & Wheatstone single needle apparatus was adopted on the Piedmont Railway between Turin and Genoa in the Kingdom of Sardinia in April 1852. This railway was created by English engineers, led by I K Brunel. The Wheatstone instruments were used until 1865 in Piedmont-Savoy.

The first electric telegraph in the Netherlands was a Wheatstone dial circuit laid alongside of the Holland Iron Railway between Amsterdam and Haarlem, and opened on May 25, 1845. It was a joint effort of Cooke & Wheatstone and Eduard Wenckebach, who went on to create the state telegraph system in Holland.

During 1853, in Holland the Electric company's subsidiary, the *Internationale Telegraaf Compagnie* of London acquired a twenty-year monopoly concession for cable and overhead circuits between London and Amsterdam, using, initially, Cooke & Wheatstone's two-needle instruments.

The American apparatus was introduced into Europe on the *Hannoversche Staatsbahn,* the Hanover state railway, on its marine telegraph between Hamburg and Cuxhaven in July 1848 by Friedrich Clemens Gerke. This was the fourth electric telegraph line created in Germany. The *Elektro-Magnetische Telegraphen Compagnie*, a firm of Americans, was contracted to replace an optical system with the electric telegraph. Later Gerke was to adapt the American instrument's cipher to domestic needs, creating "Hamburg Alphabet", better known in Britain when it was adopted in 1855 as the "European Alphabet". It was to become the continental or worldwide telegraphic code.

The first public telegraph in Prussia was constructed by Siemens & Halske between Berlin and Cologne in May 1849, replacing the old optical telegraph. The optical and electro-magnetic apparatus worked in concert as the *königlich preussischen Telegraphen-Direktion*, the Royal Prussian Telegraph Administration. It used Siemens galvanic dial telegraph, devised by M H Jacobi, and resin-insulated underground circuits on this long line. By 1852 these had been replaced by the American telegraph and overhead lines.

It was in 1850 that what to become the *Deutsch-Oesterreichischen Telegraphenverein* was formed to unite the systems of the several German states. This adopted by mutual agreement the American telegraph as its standard instrument, then used only in a small way in Hanover. The Bain I & V telegraphs in Austria, the Kramer and Siemens & Halske dials in Prussia, the Stöhrer magneto-dial in Bavaria, and the dials of Fardely and Stöhrer in Saxony were all then abandoned for public service. It was this decision that made the American telegraph the common system not just in the German states but caused its use to become inevitable throughout the whole of Europe.

The first public telegraph in Russia was also constructed by Siemens & Halske, an underground line laid from St Petersburg to Viborg, Helsingfors and Abo in Finland, completed in June 1855 with galvanic dial telegraphs. The Prussian firm had by then contracted to put St Petersburg in circuit with Reval, Riga, Warsaw, Moscow, Kiev, Odessa and Sebastopol, as well as connecting to Prussia at Gumbinnen and Austria at Myslenitz, over many hundreds of miles, an immense undertaking for a single commercial company.

The Electric Telegraph Company of London also created circuits using Cooke & Wheatstone's apparatus in Norway and Denmark, alongside of railway lines built by the contractor, Morton Peto, one of its directors, during 1853 and 1854. These were the first telegraphs in Norway.

The electric telegraph for *public* service, rather than for experimental or railway use, was introduced in Europe in the following order: Britain 1846, Austria 1849, Prussia 1850, Bavaria 1850, Belgium 1851, France 1851, Baden 1851, Holland 1852, Switzerland 1852, Papal States 1853, Sweden 1853, Wurttemberg 1853, Norway 1854, Denmark 1854, Spain 1855, Russia 1856, Greece 1859, Portugal 1861 and Roumania 1863.

The situation regarding the other Italian states prior to 1865, when a unified telegraph authority was imposed, is unclear. According to 'Annales télégraphiques' the following are the dates of introduction: Tuscany 1847, Lombardy-Venice (then Austrian) 1850, Duchies of Modena, Massa, Carrara and Lucca January 1852, Sardinia (Turin) April 1852, Parma May 1852, the Two Sicilies (Naples) July 1852, Papal States September 1853, and the Two Sicilies (Sicily) 1856.

As well as Cooke and Wheatstone, many European countries had their own telegraphic innovators. There were in the late 1840s the short-lived instruments of Foy, Breguet, Siemens, Fardely, Gloesener, Lippens, Kramer and Stockriss, mostly dial telegraphs developed from Wheatstone's. All of these were to be swept away by the American telegraph, which became the European standard from Portugal to Russia by 1852.

Away from Europe, in British India, the East India Company's, and latterly the government's, circuits, and then the Australian states adopted the American telegraph in 1855, and the American "sounder" shortly afterwards. However the thousands of miles of British-owned and built railways in India, and many in Australia, adopted Cook & Wheatstone's more sophisticated double- and single-needle instruments for traffic control and for internal messaging; just as their iron relatives did in Britain.

---

b.] **The Telegraph in the United States**

"In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs."
Sir Francis Darwin, April 1914

In the United States the period before the creation of the Western Union Telegraph Company was dominated by the Morse Syndicate, a small group of lawyers, financiers and legislators that acquired and managed telegraph patents. S F B Morse, by profession a portrait painter with little technical education, was a figurehead to this aggressive organisation and, unfortunately, grew to believe the myths and legends propounded by the Syndicate.

The assets on which the Syndicate depended were S F B Morse's patents 1,647 of 1840 and 4,453 of 1846. The 1840 patent was used to effect a monopoly of rights to all forms of electric telegraphy, even though the apparatus, the purpose of a patent, was never used. The 1846 patent protected the rights to the *American telegraph*, with the lever-key, the dot-and-dash marking register and the local relay. None of the three essential elements were devised by the patentee but were "borrowed" from the work of others. For example, the register had been devised and made by Alfred Vail in 1844, who also created the dot-and-dash code that it used.

Morse's name was attached to no other innovations in electric telegraphy, nor to any useful contributions to science.

The Syndicate was created to make money and not to operate telegraphs. It granted licences to companies and individuals to work the several patents it controlled on a basis of $30 per mile of line and 50% of the stock of the company. It also used its considerable influence in Washington to have the patents renewed for ever longer periods and to gain verdicts in the courts against competitors. Its litigation against Henry O'Rielly (one of its disaffected licensees) and the competitive patents of Royal House and Alexander Bain revealed to the American public a network of agents and interests of mafia-like proportions.

Through this arrangement S F B Morse possessed, he revealed to the Circuit Court of the Eastern District of Pennsylvania in April 1850, $120,000 in stock in the New Orleans & Washington Telegraph Company, $33,000 in the New York, Albany & Buffalo, $4,500 in the Sandusky & Cincinnati, $3,750 in the Maine Telegraph, $12,650 in the St Louis & New Orleans, and $9,300 in the Western Telegraph; he mentioned that he had just sold out his stock in the Magnetic Telegraph Company, between Washington and New York, for a sum, along with other amounts from stock and share dealing, he chose not to reveal. All this stock he acquired without investing a single cent in the companies concerned.

In his deposition S F B Morse curiously styled himself as "a farmer" of Poughkeepsie, New York.

The other members of the Morse Syndicate, F O J Smith, Amos Kendall and Alfred Vail, the evidence to the Circuit Court revealed, had each had taken similar sums out of the patent right business during the same period.

The Syndicate bought out the owners of the Bain patents, *Henry J Rogers & Company* and the *North American Telegraph Company*, immediately the US Appeals Court found in Bain's favour in 1852. When Henry O'Rielly, who, ever combative, had become the main House licensee, was also bought out, Royal House and David Hughes both protected their interests by selling their patents in November 1855 to the *Commercial Printing Telegraph Company*, a concern owned by the Associated Press of New York, who used these instruments on their leased press circuits. The Syndicate, in response, encouraged the manufacture of a so-called combination apparatus that only they used, alongside of the key-and-register.

The Morse Syndicate survived only to the end of the patents' extended life in 1858. It had engineered the creation of the *American Telegraph Company*, which controlled the public telegraph system on the whole East Coast by gradually buying-out the major point-to-point concerns in the area, including those using the House and Bain apparatus, and latterly the Commercial Printing Telegraph Company, with their House and Hughes type-printers.

The 'renegade' telegraph companies in the western states that escaped its net formed, in 1856, the *Western Union Telegraph Company* and in 1866 that concern absorbed American Telegraph, which had been sorely tried by the necessities of civil war.

In 1850 the United States possessed 15,835 miles of line worked under the Morse Syndicate's rights; 2,200 miles under House's patents and 2,012 miles under Bain's. No reliable information exists as to the number of stations opened or messages worked in the fragmented system. There were then 953 miles of telegraph line in British North America.

In the United States the overwhelming majority of lines were single iron wires, even between the largest of cities. Very few providers possessed more than one wire between population centres.

At the moment in 1866 when the Western Union company acquired the last of its major competitors, the *American Telegraph Company* and the *United States Telegraph Company,* its line mileage across the continent had grown to an immense 37,380 miles, with 2,250 stations.

The Morse Syndicate in America in its last gasp used its formidable influence with the US Department of State in 1857 to have it lobby the European powers for "at least $500,000" (£100,000) as the price of the "cost savings" in communications that the introduction of the American telegraph had permitted. It also employed a firm of law agents in France to tout its claims across the continent. Only ten countries responded, led by France, including Russia, Sweden, Belgium, Holland, Austria, Sardinia, Tuscany, the Papal States and Turkey. These, given the lack of any legal justification in the way of patent rights, grudgingly contributed to a box of trinkets in the form of honorary awards and a pot totalling 400,000 francs (£16,000) with which to buy off the Syndicate's agents in Paris, who – in an example of "the biter bit" - took one-third of the sum for all their efforts before passing it on. It was to be payable over four years, from August 1858. In context Cooke & Wheatstone received £70,000 and David Hughes £10,000 just for the British rights to their respective telegraph patents. The Syndicate, and especially its figurehead, was desolate at this "meanness".

Technically the great difference between the electric telegraphs was that in Europe the circuits used non-continuous current with weak sources (batteries of cells); and in America the circuits worked a continuous current and consequently required much stronger electrical sources. In the United States the line of wire was always live. British circuits also employed, from the mid-1850s, double-current or current reversal in the lines that used the American telegraph, rather than the crude "on-off" key of the United States and Europe.

Although its citizens introduced the advanced and effective House and Hughes type-printing apparatus (but then quickly suppressed them) the rough-and-ready nature of telegraphy in America can be judged from the lack of any sort of galvanometer or detector, automatic telegraphy or even switchboards in its circuits until the 1870s.

A remarkable American innovation almost wholly ignored in Europe for many years was the *Fire Alarm Telegraph* of 1852, and its development the *Messenger Telegraph*, by which services, a fire-engine or a parcel carrier, could be summoned by the public from remote call-boxes in major cities.

W F Cooke and C Wheatstone secured the first patent for electric telegraphy in the United States on June 10, 1840, ten days before S F B Morse. One half of their patent rights were bought by three American partners.

---

c.] **A Statistical Comparison of the World's Telegraphs**

The following statistical comparison is drawn from the information on the world-wide state of telegraphy tabulated in 1869 by George Sauer for S F B Morse. The raw information that was gathered through US Embassies varied greatly in response and quality, so only a partial guide to development was possible.

The Austrian Empire and the Electric & International Telegraph Company did not bother to reply.

*Belgium 1851 **
257 miles; 10 offices; 14,025 messages
*Belgium 1867 **
2,424 miles; 374 offices; 1,293,870 messages

*France 1851 **
1,325 miles; 17 offices; 9,014 messages
*France 1867 **
23,090 miles; 1,486 offices; 3,213,995 messages

*Norway 1855 **
471 miles; 22 offices; 22,916 messages
*Norway 1866 **
2,205 miles; 73 offices; 269,375 messages

*Prussia 1852 **
2,070 miles; 48 offices; 48,751 messages
Prussia 1867
13,364 miles; 857 offices; 2,582,460 messages

Russia 1857
4,840 miles; 79 offices; 133,538 messages
Russia 1864
21,119 miles; 308 offices; 838,653 messages

*Switzerland 1851 **
1,000 miles (est.); 34 offices; 2,876 messages
Switzerland 1867
2,395 miles; 333 offices; 708,974 messages

United Kingdom 1850 (Company sources)
2,215 miles; 257 offices; 64,734 messages
United Kingdom 1868 (government returns)
16,879 miles; 3,381 offices; 6,438,392 messages

Sauer's Miscellaneous Returns

Australia 1865	- 3,100 miles; 79 offices
Austria 1851	- 2,175 miles; 45 offices (author)
Denmark 1867	- 950 miles
Egypt 1867	- 1,747 miles
Holland 1867	- 1,447 miles; 194 offices

India 1866	- 13,390 miles; 174 offices
Italy 1869	- 9,927 miles; 1,065 offices
Spain 1867	- 6,670 miles
Sweden 1867	- 3,519 miles; 257 offices
Turkey 1863	- 4,032 miles; 52 offices
Turkey 1867	- 17,087 miles; 310 offices

Miles here refers to miles of line. The * indicates an operating loss. Twenty-five per cent of messages in the French telegraphic system were on behalf of the government; forty per cent of Belgian messages were 'transit' traffic from other countries.

Most of the continental state telegraphs at this time had a zone (distance) tariff for a standard message (either fifteen or twenty-five words, with five word increments), charging as well for addresses and for delivery outside of the destination town. A one hundred word limit was commonly imposed on public messages.

Every sort of government traffic, even the most trivial, had priority over the public. In France and Russia *all* messages had to be inspected before transmission by an official for "objectionable" matter.

In many continental countries there were railway telegraphs working public traffic to and from their passenger stations outside of the main government systems, mostly using dial equipment rather than the American telegraph. The largest of these was probably *La Grande Société Russe des Chemins der Fer*, an Anglo-French company founded in 1857, which owned 2,693 miles of railway in Russia by 1868, and worked the Siemens magneto-electric dial telegraph throughout its system.

The railways of the German states finally abandoned the Siemens dial telegraph for the American telegraph on the re-creation of the unified Empire in 1871.

As well as the *Rijkstelegraaf* in Holland in this period there also existed two small regional joint-stock companies, carrying 6% of public message traffic in 1860, compared with the state's 92%; the balance was borne by the railway telegraphs.

The *Rijkstelegraaf* had 63 offices in 1863, with 145 instruments, employing 253 officials and 89 messengers. In that year it managed 653,261 messages. The competitive Netherlands Telegraph Company, with three stations between Rotterdam and Nieuwediep, then had a traffic of 19,205 messages; and the Rotterdam Telegraph Company with a small network of five stations between Rotterdam and Brouwershaven, carried 12,130 messages. The public telegraphs of the Holland Iron Railway, with nine stations, carried 9,206 messages, those of the Dutch-Rhenish Railway, nine stations, 1,503 messages, and the Maastricht-Aachen Railway, five stations, 266 messages.

The *Wiener Privat-Telegraphen-Gesellschaft* (WPTG) was formed in Austria during 1869 with a capital of 200,000 florins (£20,000), having a Central Bureau at Friedrichstrasse 6, Vienna. It was to possess a very large network within Vienna and its outskirts. In 1874 there were a total of 88 private stations, covering the Inner or Old City, the *Vorstadt* and the Suburbs; including 15 banks, 10 hotels, 10 post offices, 4 hospitals and sanatoria, 4 major factories, 3 steamboat operators on the Danube, 2 newspapers, a brewery, and the railway stations of the *Südbahn* and *Westbahn*, as well as secondary agencies for message-forwarding. It was organised in a similar manner to the London District Telegraph Company.

The WPTG tariff had a base message rate for up to 20 words of 25 kreuzer (6d) between any of its own stations. There was an additional charge for forwarding by the State or railway telegraphs to their stations in Vienna of 15 kreuzer (c. 3½d) and 25 kreuzer (6d) to telegraph stations outside of the city and its environs.

20. APPENDICES

a.] **A List of Telegraph Companies 1838-68:**

1. Electric Telegraph Company 1845
2. General Oceanic Telegraph Company 1845†*
3. British Commercial Electro-Telegraph Company 1845† *
4. General Commercial Telegraph Company 1845†*
5. Scottish Electric Telegraph Company 1848†
6. General Telegraph Company 1848†
7. Dublin & Holyhead Submarine Telegraph Company 1849†
8. British Electric Telegraph Company 1851
9. English & Irish Magnetic Telegraph Company 1851
10. Submarine Telegraph Company between France and England 1851‡
11. Submarine Telegraph Company between Great Britain and the Continent of Europe 1851
12. European & American Electric Type-Printing Telegraph Company 1851
13. Ocean Telegraph Company 1852†
14. Electric Telegraph Company of Ireland 1852†
15. Irish Sub-Marine Telegraph Company 1852†
16. Isle of Wight Electric Telegraph Company 1852
17. Electric Time Company 1852†
18. British Telegraph Company 1853**
19. International Telegraph Company 1853
20. The Telegraph Company 1854†
21. Société du télégraphe électrique Méditerranéen 1854‡
22. Electric & International Telegraph Company 1855**
23. Universal Electric Telegraph Company 1855†
24. Mediterranean Extension Telegraph Company 1856
25. European & American Submarine Telegraph Company 1856†
26. British & Irish Magnetic Telegraph Company 1857**
27. Atlantic Telegraph Company 1857
28. North-of-Europe Telegraph Company 1857†
29. Gloucester & Sharpness Electric Telegraph Company 1858
30. Levant Submarine Telegraph Company 1858
31. North Atlantic Telegraph Company 1858†
32. South Atlantic Telegraph Company 1858†
33. Dock Telegraph Company (Liverpool) 1858†
34. Red Sea & India Telegraph Company 1859

35. Great Indian Submarine Telegraph Company 1858†
36. India & Australia Telegraph Company 1858†
37. Poole, Bournemouth & South Coast Printing Telegraph Company 1859
38. Isle of Man Telegraph Company 1859
39. Channel Islands Telegraph Company 1859†
40. London District Telegraph Company 1859
41. British Transatlantic Telegraph Company 1859†
42. British & Canadian Telegraph Company 1859†
43. United Kingdom Electric Telegraph Company 1860
44. Universal Private Telegraph Company 1860
45. Telegraph to India Company 1861†
46. Bonelli's Electric Telegraph Company 1861†
47. European & Indian Junction Telegraph Company 1861†
48. National Telegraph Company 1861†
49. General Electric Telegraph Company 1861†
50. London & South-of-Ireland Direct Telegraph Company 1862
51. Tavistock, Princetown & Dartmoor Telegraph Company 1862
52. Private Telegraph Company 1862†
53. Oriental Electric Telegraph Company 1863†
54. Bodmin, Wadebridge, Padstow, St Columb & New Quay Telegraph Company c.1863
55. Portadown & Gilford Telegraph Company c.1863
56. Whitworth Telegraph Company c.1863
57. Abergavenny & Crickhowell Telegraph Company c.1863
58. Yarmouth & Kingston Telegraph Company c.1863
59. South-Western of Ireland Telegraph Company 1863
60. Globe Telegraph Company 1863†
61. Glasgow, Cantyre & General Telegraph Company 1864†
62. Reuter's Telegram Company 1865
63. West Highland Telegraph 1865***
64. Economic Telegraph Company 1866
65. General Private Telegraph Company 1866†
66. Anglo-American Telegraph Company 1866
67. Liverpool District Telegraph Company 1866†
68. London & Provincial Telegraph Company 1867**
69. Anglo-Mediterranean Telegraph Company 1867
70. Anglo-Indian Telegraph Company 1867†
71. British & American Telegraph Company 1867†
72. Scilly Islands Telegraph Company 1868
73. Orkney & Shetland Islands Telegraph Company 1868
74. Société du câble trans-atlantique Français 1868
75. Jersey & Guernsey Telegraph Company 1868
76. Store Nordiske Telegrafselskab A/S 1868‡
77. Indo-European Telegraph Company 1868

Including private partnerships and joint stock companies fully or provisionally registered under the Joint Stock Companies Regulation Act 1844; created by Statute, created by Charter, created under the Joint Stock Limited Liability Act 1856 and created under the Companies Act 1862.

(* These three companies were only provisionally registered, General Oceanic Telegraph Co. on June 16, 1845; British Commercial Electro-Telegraph Co. on August 2, 1845; and General Commercial Telegraph Co. on September 3, 1845. The Electric Telegraph Company was registered on September 2, 1845. ** Only a change of name. *** Trading title of the Universal Private Telegraph Company. † Failed or abortive companies. ‡ Foreign companies).

The Voltaic Telegraph Company was promoted on September 9, 1838 by Edward Davy, six years before the Joint-stock Companies' Registration Act, but never got beyond correspondence.

This list summarises the companies that operated or obtained an Act of Parliament in the period of this work. Most were incorporated in Britain, although several foreign joint-stock companies have been included where they were participants in the domestic market or were organised from London. It is not complete! The government reported in 1860 that twenty-eight companies to work electric telegraphs had been formed and that ten were still working in that year; which does not reconcile with this list. A large number of great cable companies were formed in 1869 and 1870.

---

b.] **Domestic Telegraph Companies in 1868:**
This lists the companies mentioned in the text, an abbreviated evolution and their corporate connexions. The Electric, the Magnetic, the United Kingdom, the London & Provincial, Bonelli's, the Economic, the Universal and Reuter's were appropriated by the government in 1868.

1. The Electric & International Telegraph Company (Founded 1845, a merger in 1855) including:

• Electric Telegraph Company (1845) (to Electric & International)

• Compagnie du Télégraphe Électrique (1846) (an Electric subsidiary line) (Anglo-Belgian)

• Irish Sub-Marine Telegraph Company (1852) (rights passed to the Electric 1852)

• International Telegraph Company (1852) (an Electric subsidiary) (Anglo-Dutch) (1855 to Electric)

• The Isle of Wight Electric Telegraph Company (1852) (for the Electric)

• The Isle of Man Electric Telegraph Company (1859) (for the Electric)

• The Channel Islands (Electric) Telegraph Company (1859) (for the Electric)

• London & South-of-Ireland Direct Telegraph Company Limited (1862) (for the Electric)

• South-Western of Ireland Telegraph Company (1863) (for the Electric)

• The Scilly Islands Telegraph Company (1869) (for the Electric)

2. The British & Irish Magnetic Telegraph Company (Founded 1850, a merger in 1857) including:

• British Electric Telegraph Company (1850) (was known as the British Telegraph Company by 1853)

• English & Irish Magnetic Telegraph Company (1851)

• European & American Electric Type-printing Telegraph Company (1851) (1853 to British)

3. The United Kingdom Electric Telegraph Company
(Founded 1851, active only from 1860)

4. The London & Provincial Telegraph Company
(Founded 1859 as the District Co.) formerly

• London District Telegraph Company (1859) (renamed in 1865)

5. The Universal Private Telegraph Company
(Founded 1861) (with public telegraphs in Scotland and the north-east of England)

6. Bonelli's Electric Telegraph Company
(Founded 1861, inactive until 1863) (One public line made, but inactive by 1866)

7. The Economic Telegraph Company
(Founded 1863) (One public line made, but no public circuits by 1868)

8. Reuter's Telegram Company
(Founded 1865) (a foreign news agency and cable-owner)

Domestic Underwater Cable Company:

The Submarine Telegraph Company between Great Britain and the Continent of Europe (Founded 1854) - a Royal Charter company owning cables to Belgium and latterly to Hanover in Germany and Denmark. It worked in concert with **The Submarine Telegraph Company between France and England** (Founded 1851) (French) which promoted the European Telegraph Co., above, in England, and subsequently was always closely connected with the various incarnations of the Magnetic company.

---

c.] **Telegraph Company Addresses**
Samples from Directories and Advertisements

Anglo-American Telegraph Company, 26 Old Broad Street, London, CE (1866 and 1869)

Anglo-Indian Telegraph Company, 26 Old Broad Street, London, EC (1867)

Anglo-Mediterranean Telegraph Company, 76 Palmerston Buildings, Bishopsgate Street Within, EC (1868)

Atlantic Telegraph Company, 22 Old Broad Street, EC (January 1858 and 1862) (The offices of George Peabody & Company, American merchants)

Atlantic Telegraph Company, 13 St Helen's Place, Bishopsgate Within, EC (1868)

Bonelli's Electric Telegraph Company, 69 Lincolns' Inn Fields, London, WC (1862) (a law office)

Bonelli's Electric Telegraph Company, 7 Angel Court, Throgmorton Street, City, EC, 2a Victoria Street, Manchester, and 2 Dale Street Liverpool (1864)

Bonelli's Electric Telegraph Company, 17 Leadenhall Street, City, EC (1869) (The offices of Collie & Company, cotton merchants)

Brett & Little, 140 Holborn Bars (1847) (Brett's Furnival's Inn Coffee House & Hotel)

Brett & Little, 3 Furnival's Inn, London (1848) (a set of showrooms)

British & American Telegraph Company, Crosby House, 95, Bishopsgate Street, London (1867)

British Electric Telegraph Company, Central Offices, Royal Exchange, London (1851)

British Electric Telegraph Company, 11 Ducie Street, Exchange, Manchester (the principal station in 1852)

British Electric Telegraph Company, Central Station, 29½ Royal Exchange, London (1854)

British Indian Submarine Telegraph Company, 66 Old Broad Street, London, EC (January 1869)

British Telegraph Company, 11 Ducie Street, Exchange, Manchester (This was the company's head office, 1852 to 1855)

British Telegraph Company, Chief Office, 43 Regent Circus, Piccadilly, London (1855 to 1857)

British Telegraph Company, Manufactory, 29½ City Road, Finsbury, London (1855)

British & Irish Magnetic Telegraph Company, Chief Office, 2 Exchange Buildings, Liverpool; Offices, 72 Old Broad Street, 30 Cornhill, Royal Exchange (under the Clock Tower) and 43 Regent Circus, Piccadilly (1857)

British & Irish Magnetic Telegraph Company, Manufactory, 46 City Road, Finsbury, London, EC (1862)

British & Irish Magnetic Telegraph Company, Central Office, 57 to 59 Threadneedle Street, opposite the Royal Exchange, London, EC (1865 & 1868)

Cape of Good Hope Telegraph Company, 17 Bucklersbury, London EC (1862)

Cape of Good Hope Telegraph Company, 25 Poultry, London EC (1867)

Channel Islands Telegraph Company, Founders' Court, Lothbury (1860)

Channel Islands Telegraph Company, 12–14 Telegraph Street, City, EC (1861)

W F Cooke, patentee of the electric telegraph, 1 Copthall Buildings, City (1845)

Compagnie du Télégraphe Électrique, 74 Montagne de la Cœur, Bruxelles et 1082 Place de Meir, Anvers (1846) (the Electric's Belgian subsidiary line)

Compagnie du Télégraphe sous Marin, 98 Gracechurch Street, London (September 1850) (see also Submarine Telegraph Company)

Dock Telegraph Company, 2 Exchange Buildings, Liverpool (1858)

Dublin & Holyhead Submarine Telegraph Company, 2 Palace Yard, Westminster (1849)

Eastern Telegraph Company, 16 Cannon Street, City (1855) (L Gisborne's abortive Levant company)

Economic Telegraph Company, 6 Lord's Chambers, Corporation Street, Manchester (1864)

Economic Telegraph Company, 2 Dean's Yard, Westminster, SW, and Corporation Street, Manchester (1866)

Electric Telegraph Company, 345 Strand (Chief Office, pro. tem.) (1846 and 1847)

Electric Telegraph Company's Works, 22 Church Row, Limehouse (1846 and 1847) (next the Blackwall railway)

Electric Telegraph Company, Clock Department, 142 Strand, London and 11 Hanover Street, Edinburgh (August 1847)

Electric Telegraph Company, 64 Moorgate Street; and Central Station, Founders' Court, Lothbury, City (1849)

Electric Telegraph Company, Central Station, Founders' Court, Lothbury, London (1849 - 1868)

Electric Telegraph Company, Factory, 44 Gloucester Road north, Regent's Park (1854)

Electric & International Telegraph Company, General Offices, 12–14 Telegraph Street, Moorgate Street, EC (1868)

Electric Telegraph Company of Ireland, Secretary's Office, 2 Moorgate Street, City, and the Telegraph Offices, 37 Ann Street, Belfast, and 1 Eden Quay, Dublin (1853)

Electric-Printing Telegraph Office, 29 Parliament Street, London (Jacob Brett, patentee) (1849) (a showroom)

English & Irish Magnetic Telegraph Company, 6 North John Street, Liverpool (public office) (1853)

English & Irish Magnetic Telegraph Company, 5 Royal Insurance Buildings, North John Street, Liverpool (secretary's & engineer's office) (1853)

English & Irish Magnetic Telegraph Company, Chief Office, 2 Exchange Buildings, Liverpool (1854)

English & Irish Magnetic Telegraph Company, 72 Old Broad Street, London (1854)

English & Irish Magnetic Telegraph Company, 6 College Green, Dublin (1854)

European (& American) Electric Telegraph Company, 30 Cornhill, London (1852) (as the Submarine company)

European & American Submarine Telegraph Company, 2 Royal Exchange Buildings, City, EC (1858)

European & Indian Junction Telegraph Company, 250 Gresham House, Old Broad Street, City (1856)

Gamble & Nott's Patent Electro-Magnetic Telegraph Office, 2 Royal Exchange Buildings (1847) (a showroom) see also Nott & Gamble

General Commercial Telegraph Company, 1 Bond Court, Walbrook, City (a law office) (1845)

General Telegraph Company, 9 John Street, Adelphi (1849) - Whishaw's Office (a showroom)

General Private Telegraph Company, 4 Blue Boar Court, Manchester (1866)

Gisborne & Forde, 6 Duke Street, Adelphi, London, WC (1861) (office of Lionel Gisborne and Henry Charles Forde, telegraph engineers to HM government)

Globe Telegraph Company, 2 St Anne's Churchyard, Manchester (1861 and 1865)

Gloucester & Sharpness Electric Telegraph Company, Commercial Road, Gloucester (1863)

Great Northern Telegraph Company, 7 Great Winchester Buildings, City, EC (1869)

Holyhead Telegraph Office, Chapel Street, Liverpool (marine telegraph) (1828 to 1849)

Holyhead Telegraph Office, summit of Tower Buildings, Liverpool (marine telegraph) (1849 to 1860)

Indo-European Telegraph Company, 16 Telegraph Street, City, EC (1870)

International Ocean Telegraphic Company, 32 Charing Cross, West Strand, WC (1864) (William Rowett's French cable to Canada)

International Telegraph Company, Continental Telegraph Offices, 1 Royal Exchange Buildings, London (1853)

Irish Channel Submarine Telegraph Company, 15 Great Bell Alley, Moorgate Street, City (1852) (predecessor of the Electric Telegraph Company of Ireland)

Irish Sub-Marine Telegraph Company, 38 Parliament Street, Westminster, Commercial Buildings, Dublin, and at the Dublin & Drogheda Railway terminus, Amiens Street, Dublin (1852)

Isle of Man Electric Telegraph Company, 64 Atholl Street, Douglas, Isle of Man (1860 and 1863)

Isle of Wight Electric Telegraph Company, York Street, Cowes, Isle of Wight (1854)

Jersey & Guernsey Telegraph Company, Hill Street, St Helier, Jersey (1870)

Levant Submarine Telegraph Company, 24 Abingdon Street, Westminster, SW (R S Newall's office) (1860)

Levant Submarine Telegraph Company, 2 Westminster Chambers, Victoria Street, SW (1867)

Liverpool District Telegraph Company, 95 Islington, Liverpool (1866)

London & South-of-Ireland Direct Telegraph Company, 7 Broad Street Buildings, City, EC (1862)

London District Telegraph Company, Chief Office, 90 Cannon Street, London, EC (1865)

London & Provincial Telegraph Company, 101 Cannon Street, EC (1868) (same address as above, the street renumbered)

Magneto-Electric Telegraph Company, 4 New Broad Street, City (1852) (the first address of the Magnetic Co., the offices of Charles Kemp Dyer, merchant)

Malta & Alexandria Telegraph Company, 47a Moorgate Street, EC (1860) (became a government concern)

Mediterranean Electric Telegraph, 117 Bishopsgate Street, City, and Paris and Turin (1854) (a *Société en Commandité* incorporated in France, see below)

Mediterranean Electric Telegraph Company, 2 Hanover Square, London W (1859) (John Watkins Brett's house)

Mediterranean Extension Telegraph Company, 158 Gresham House, Old Broad Street, EC (1862)

North Atlantic Telegraph Company, 61 Moorgate Street, EC (1862) (Shaffner's America cable via Iceland)

North Atlantic Telegraph Company, 140 Gresham House, Old Broad Street, EC (1866) (James Wyld's cable via Iceland)

Nott & Gamble's Telegraph Office, 78 Cornhill, London (1846) (a show-room) see also Gamble & Nott

Oriental Electric Telegraph Company, 1 Victoria Street, Westminster, SW (1863) (Bright & Clark's office)

Orkney & Shetland Islands Telegraph Company, 8 Great Winchester Street Buildings, London, EC (1871)

Railway Electric Signals Company, 30 Cornhill, London and rue Richelieu 83, Paris (1855)

Red Sea & India Telegraph Company, Offices, 62 Moorgate Street, London, EC (1865)

Julius Reuter, Continental Telegraph Office, 1 Royal Exchange Buildings, London (October 14, 1851)

J Reuter trading as 'S Josaphat', Continental Telegraph Office, 7 Exchange Buildings, Liverpool (June 1, 1852)

J Reuter trading as 'S Josaphat', Continental Telegraph Office, 33 & 34 Exchange Arcade Buildings, Manchester (July 1, 1853)

Reuter's Telegram Company, Offices, 1 Royal Exchange Buildings, London, EC (1862)

Reuter's Telegram Company, 5 Lothbury, EC (1867)

Reuter's American News office, 2 King Street, Finsbury Square, EC (1862)

Reuter's West End News Office, 9 Waterloo Place, Pall Mall, SW (1862)

Scilly Islands Telegraph Company, 6 Old Jewry, City, EC (1869)

Scilly Islands Telegraph Company, 8 Great Winchester Street Buildings, London, EC (1871)

Scottish Electric Telegraph Company, 20 St Andrew Square, Edinburgh (1848)

Société du câble trans-atlantique Français, Bartholomew House, Bartholomew Lane, EC (1868) (an English company)

Société du télégraphe électrique Méditerranéen, rue Richelieu 83, Paris (1853) became:

Société du télégraphe électrique sous-marin de la Méditerranée, rue Notre-Dame-de-Lorette 10, Paris (1861)

South Eastern Telegraph Office, 1 South Eastern Arcade, London Bridge, SE (1859)

South-Western of Ireland Telegraph Company, 23 Old Broad Street, City, EC (1864)

South-Western of Ireland Telegraph Company, 17 Leadenhall Street, London, EC (1867) (The offices of Collie & Company, cotton merchants)

Submarine Electric Telegraph Office (Julius Reuter, agent), 1 Royal Exchange Buildings, City (1853) (Alternate title for Reuter's business)

Submarine Telegraph Company (France & England), 9 Moorgate Street, later 30 Cornhill (1851)

Submarine Telegraph Company between France and England, 10 Place de la Bourse, Paris (1852)

Submarine Telegraph Company between Great Britain and the Continent of Europe, bureau de télégraphe sous-marin anglo-belge, rue des Princes 2, Bruxelles, Belgium (1854)

Submarine Telegraph Company, 58 Threadneedle Street, London, EC (1865) (same as the Magnetic)

Telegraph to India Company, 62 Moorgate Street, City, EC (1864)

United Kingdom Electric Telegraph Company, 18 Cannon Street, City (1853)

United Kingdom Electric Telegraph Company, 101 Gresham House, Old Broad Street, EC (1860)

United Kingdom Electric Telegraph Company, Central Offices, 237 & 247 Gresham House, Old Broad Street, EC (1862 - 1868)

Universal Electric Telegraph Company, Offices, 5 Ludgate Hill, London (1853)

Universal Private Telegraph Company, 3 Hanover Square, W (1861) (Lewis Hertslet's office)

Universal Private Telegraph Company, 448 West Strand, W (1862) (i.e. the Electric Telegraph Company's Charing Cross office)

Universal Private Telegraph Company, 4 Adelaide Street, Strand, W; and 11 St Vincent Place, Glasgow; 52 Brown Street, Manchester; and Printing Court Buildings, Akenside Hill, Newcastle (1864)

Voltaic Telegraph Company, 5 Exeter Hall, Strand, London (1838) (Edward Davy's abortive promotion)

Watson's General Telegraph Association, 83 Cornhill, City (marine telegraph) (1841)

This list illustrates the connection between the several companies through their common offices; and particularly the proximity of the International Telegraph Company offices in Royal Exchange Buildings to Julius Reuter, and to Nott & Gamble's office.

The components of the largest of the cable concerns, the Eastern Telegraph Company, the Falmouth, Gibraltar & Malta, the Anglo-Mediterranean, the British Indian Submarine, the British Australian and the China Submarine companies, were all located at 66 Old Broad Street, City, EC, by 1870.

All of the public telegraph companies' chief offices were adjacent to the Bank of England and the Stock Exchange in the City of London, the financial centre of the country. The Royal Exchange, Royal Exchange Buildings and Gresham House were essentially horizontal blocks of small offices in multiple occupancy. Post Codes (EC, W, etc) came to London in 1857.

---

d.] **Domestic & Foreign Cables**
This is a list of underwater cables with British circuits laid between 1850 and 1869, the owning company and the main contractor for armour; the Gutta-Percha Company made virtually all the insulated cores. Immediate failures are not noted.

1851 *Dover – Calais* STC
- 25 miles, RSN, England to France

1852 *Hurst Castle – Sconce Point* IoW
- 1 mile, Binks, England to Isle of Wight

1853 *Dover – Ostend* STC
- 76 miles, RSN, England to Belgium

1853 *Port Patrick – Donaghadee* EIM
- 25 miles, RSN, Scotland to Ireland

1853 *Orfordness – Scheveningen* ITC
- 119 miles, RSN, England to Holland

1853 *Tay Estuary* ETC
- 1 miles, RSN, Scotland

1853 *Forth Estuary* ETC
- 5 miles, RSN, Scotland

1854 *Port Patrick – Whitehead* BET
- 26 miles, RSN, Scotland to Ireland

1854 *Holyhead – Howth* ETC (duplicated in 1855)
- 73 miles, RSN, North Wales to Ireland

1858 *Orfordness – Zandvoort* EIT
- 130 miles, GEC, England to Holland

1858 *Cromer – Emden* STC
- 280 miles, GEC, England to Hanover

1858 *Weymouth – Alderney* CIT
- 69 miles, RSN, England to Channel Isles

1858 *Alderney – Guernsey* CIT
- 18 miles, RSN, Channel Islands

1858 *Guernsey – Jersey* CIT
- 15 miles, RSN, Channel Islands

1859 *Cromer – Heligoland – Tonning* STC
- 376 miles, GEC, England to Denmark

1859 *Folkestone – Boulogne* STC
- 24 miles, GEC, England to France

1859 *Liverpool – Anglesey* MDH
- 25 miles, GEC (marine telegraph)

1859 *Point Cranstal – Saint Bees* IoM
- 36 miles, GEC, England to Isle of Man

1859 *Jersey – Pirou* STC
- 21 miles, GEC, France - Channel Islands

1861 *Holyhead – Howth* EIT (replacing 1854-5 cables)
- 73 miles, RSN, North Wales to Ireland

1861 *Beachy Head – Dieppe* STC
- 80 miles, GEC, England to France

1862 *Abermawr – Wexford* LSI
- 63 miles, GEC/SWS, South Wales to Ireland

1862 *Cork Harbour & Blackwater at Youghal* LSI
- 5 miles, GEC/SWS, part of the line to Wexford

1862 *Lowestoft – Zandvoort* EIT
- 130 miles, GEC, England to Holland

1863 *Cape Clear – Baltimore* BIM
- 2 miles, GEC, (Irish marine telegraph)

1863 *New Passage, across River Severn* BIM
- 1 mile, GEC

1865 *West Highlands of Scotland* UPT
- 5 ½ miles, Reid, across lochs and estuaries

1865 *South Foreland – Cap Griz Nez* STC
- 25 miles, IRG, England to France

1866 *Lowestoft – Norderney* Reuter
- 224 miles, TCM/WTH, England to Hanover

1866 *South Foreland – La Panne* STC
- 47 miles, WTH, England to Belgium

1866 *Killantringan – Whitehead* EIT
- 25 miles, TCM, Scotland to Ireland

1866 *Valentia – Heart's Content* ATC (two cables)
- 3,748 miles, TCM, Ireland to Newfoundland

1868 *Newbiggin – Sondervig* DNE
- 342 miles, RSN, England to Denmark

1869 *Peterhead – Egersund* GNT
- 375 miles, WTH, Scotland to Norway

1869 *Lands End – St Mary's* SIT
- 27 miles, RSN - England to Scilly Isles

Owners: ATC – Anglo-American Telegraph Co. BET - British Electric Telegraph Co. British & Irish Magnetic Telegraph Co. CIT – Channel Islands Telegraph Co. DNE – Dansk-Norske-Engelske Telegrafselskab. ETC – Electric Telegraph Co. EIT – Electric & International Telegraph Co. EIM - English & Irish Magnetic Telegraph Co. GNT – Great Northern Telegraph Co. IoM – Isle of Man Electric Telegraph Co. IoW – Isle of Wight Electric Telegraph Co. ITC – International Telegraph Co. LSI – London & South-of-Ireland Direct Telegraph Co. MDH – Mersey Docks & Harbour Board. Reuter – Reuter's Telegram Co. STC – Submarine Telegraph Co. SIT – Scilly Isles Telegraph Co. UPT - Universal Private Telegraph Co.

Contractors: Binks – Binks & Stephenson. GEC – Glass, Elliot & Co. WTH – W T Henley. IRG – India Rubber, Gutta-percha & Telegraph Works. RSN – R S Newall. Reid – Reid Brothers. SWS – S W Silver. TCM – Telegraph Construction & Maintenance Co.

---

e.] **Personalities – The Company-Men & Women**
Cooke and Wheatstone have had several biographers over the years, as have many other scientific innovators to electrical progress. I have here included background detail on some of the minor, unsung characters, and

also some not so minor. However, little information exists about many of the most important connections of the British & Irish Magnetic Telegraph Company.

Thomas Allan (1812-1883)
Electrician, engineer and company promoter. An Edinburgh printer and publishers, owner of the 'Caledonian Mercury' newspaper and printer of the 'Encyclopaedia Britannica', he was notable for his submarine "light cable" of 1853, which had an iron wire core and several external unarmoured conductors, the reverse of conventional practice. Allan projected at least a dozen telegraph companies between 1848 and 1867, including the United Kingdom Electric Telegraph Company and very many cable concerns, to connect with America and to India. He contrarily advocated the adoption of the telegraphs by the Post Office in 1854. Allan also devised improvements in needle telegraphs, electro-motors and automatic telegraphs, continuing to "improve" his light cable, with fourteen patents in several areas to his name. On his bankruptcy in 1866 he took up litigation against the telegraph companies and their directors, this lasted to his death in 1883 and beyond, the last suit (of over ten, all unsuccessful) by his executors was dismissed in 1894.

The writer of these pages has published a short biography of Thomas Allan on the Atlantic Cable website.

William Stratford Andrews (1832-1906)
Electrical engineer and telegraph company manager. The son of Thomas Stratford Andrews, a landowner of Westbrook, Elstead, Surrey, he was initially employed on the telegraphs of the South Eastern Railway. In 1852 he became electrician to the Submarine Telegraph Company; by 1855 he had also been appointed Commercial Superintendant in London for the British Telegraph Company, with which the Submarine company was connected. In 1860 he was appointed electrician and shortly after Secretary and General Manager of the United Kingdom Electric Telegraph Company. He oversaw the United Kingdom company's national expansion until it was taken over by the State in 1870, including the successful introduction of the Hughes type-printing telegraph into Britain in 1863. As an engineer and electrician Andrews supervised cables laid to Germany and Denmark in 1858-9, devising improved current reversal instruments for underwater circuits, and resin-coated-wood insulators for pole telegraphs in 1860 whilst working with the Submarine Telegraph Company, and later new galvanic batteries for the United Kingdom company. Declining to join the Post Office Telegraphs, in 1871 he became Secretary and then Managing Director of the Indo-European Telegraph Company, and shortly after a Director of the West India & Panama Telegraph Company. He married Annie Lamb in 1869. Their son, Thomas William Stratford Andrews (1870-1923), was also to become Managing Director of the Indo-European Telegraph Company in 1900. More ought to be known about W S Andrews.

William Thomas Ansell (1822-1904)
Born in Bromley-by-Bow, Middlesex, but brought up in the West Indies, the son of a medical doctor, W T Ansell joined the Electric Telegraph Company in London on its foundation in July 1846, eventually becoming District Superintendent for North West England in Liverpool. He took leave of absence due to illness between 1858 and 1861, during which period he advised R S Newall on cable operations in the Eastern Mediterranean. Returning to the Electric company in 1861 he was appointed General Superintendant for Ireland, located in Cork, responsible for creating its network there during the 1860s. In 1870 W T Ansell chose not to join the Post Office and became Secretary and Manager of the Falmouth, Gibraltar & Malta Telegraph Company in London, before being appointed Traffic Manager to the Eastern Telegraph Company. He practised as an Electrical Engineer in his later years, retiring to Southsea, Portsmouth by 1900. Ansell married Sarah Jaques of Bow in 1860, and they had one son and two daughters, all born in Cork, Ireland. He was Fellow of the Royal Geographical Society.

Alexander Bain (1811-1877)
He has his own chapter in this work.

Frederick Collier Bakewell (1800-1869)
A scientific writer, inventor and patent agent. His family came from Wakefield, Yorkshire, and established Bakewell & Company, 13 Tavistock Row, Bedford Square, soda-water manufacturers, in the 1820s. In March 1832 F C Bakewell patented an ingenious "portable apparatus for the production of aerated waters" which continued in production until the 1850s. By the 1840s he was well-known as a writer of books and articles on scientific matters, especially electricity, living at Haverstock Hill, Hampstead, London. In 1847 he was editing the 'Spectator' magazine and was in communication with Alexander Bain (q.v.). In 1848 F C Bakewell patented the "copying telegraph" using Bain's chemical principles to produce the first distant facsimiles of writing and drawings. This was shown to approbation at the Great Exhibition of 1851 but was never used commercially. He latterly continued as a successful writer and commentator on telegraphy, with a sideline in practising as a patent agent.

Eugene George Bartholomew (1828–188?)
Telegraphic engineer. Born in Ipplepen, Devon, Bartholomew first comes to notice in 1851 working for the Electric Telegraph Company in Scotland. In 1853 he became telegraph superintendent of the London, Brighton & South Coast Railway in Brighton, Sussex; in this role he introduced his own needle telegraph for traffic control. Between 1856 and 1858 Bartholomew was assisting Prof William Thomson as electrician for the Atlantic Telegraph Company; during the cable-laying expedition he represented Thomson on the steamer HMS *Agamemnon* and became Superintendent of the Valentia station in Ireland. In 1860 he was an electrician with the Universal Private Telegraph Company in London. By 1864 he was an independent telegraph engineer, working in Scotland and Spain, obtaining several patents, before rejoining the Electric Telegraph Company as a District Superintendent. In 1871 he became a manufacturer of electrical instruments and batteries as

E G Bartholomew & Company with workshops at 21 & 22 Frederick Street, Hampstead Road, London, employing twenty-six hands. He was declared bankrupt in January 1878, paying just 9d in the pound (3.75%) on his debts. Latterly he lived in Edinburgh, Scotland. He married in 1850 and had six children. Bartholomew was Member of the Society of Engineers.

Charles Vincent Boys (1825-1900)
Superintendent of the Intelligence Department of the Electric Telegraph Company and the telegraph news combine from 1848 until 1870. The son of John Boys, a merchant of Camden Cottages, Camden, "CVB", as he was commonly known, was first employed as a clerk with the British Consulate at Frankfurt-am-Main. From 1848, at age twenty-three, he was editor-in-chief for all news telegraphed to the provinces, as well as responsible for the press private wires, and as such was important in the company's hierarchy and in journalism. A skilled manager, with just three sub-editors, under his management the company's income from news was four times the cost of collection. With the end of the Intelligence Department in 1870 CVB had a pension from the Post Office and received a widely-reported testimonial from the London press, presented by the Duke of Beaufort and, among others, Julius Reuter. Latterly Boys ran the office of Charles Bright, the famous cable engineer, but was drawn back into press telegraphy, managing the private wires of the Submarine Telegraph Company in London and on the Continent, in the 1880s. CVB lived and died close to the Strand in London; with his widowed mother, Jane, at 6 Cecil Street in 1851, lodging in 1861 at the telegraph office at 448 Strand, and dying at the Adelphi Hotel, after a period living at Ryde, Isle of Wight. Associated with the theatre, music and horse racing, as well as journalism, he was married only briefly late in life. CVB was a long-time member of the Savage Club, populated by authors, journalists and artists.

John Watkins Brett (1805-1863)
The son of William Brett, a carpenter of Bristol in the west of England, he was an artist in his early life and became a notable collector and dealer in works of art. Brett was living in America between 1832 and 1842. With his brother Jacob, and with Thomas Watkins Benjamin Brett, he was involved in promoting electric telegraphy from 1846. John Watkins Brett became justly famous for his advocacy and successful introduction of submarine telegraphy in England, France, Italy, Austria and America. He was promoting companies to further underwater electrical communication as early as the Railway Mania Year of 1845, going on to create the pioneering Submarine Telegraph Company and manage it to success. Brett founded the Atlantic Telegraph Company and was involved with this and the earliest plans for cables to India through the 1850s and 60s. Brett died in a lunatic asylum just before all of his plans came true.

Jacob Brett (1808-1897)
The younger brother of John Watkins Brett, was an electrical engineer whose name appears on several telegraphic patents in the 1840s and 1850s. There was "an appeal in favour of pecuniary assistance" for him in 1882.

The writer of these pages has published a short biography of John Watkins Brett and his brother, 'The Moving Fire", on the Atlantic Cable website.

Charles Tilston Bright (1832-1888)
He was employed by the Electric Telegraph Company in their electrical department for five years, before joining the British Telegraph Company for a short period. He became Engineer to the Magnetic Telegraph Company, as it then was, in 1852 until 1860, inventing, among other devices, the Bell telegraph. After forming a partnership with Latimer Clark (q.v.) in 1861 he remained as Consultant Engineer to the Magnetic company until 1868. His achievements for the Magnetic included the first successful Irish cable (after two previous attempts) in 1852 and his very efficient acoustic Bell telegraph which was widely used in its circuits from 1855 onward. His other affairs much reduced his contribution to the Magnetic company's business after 1861, causing concern by the board. He was also, and famously, promoter and engineer of the Atlantic Telegraph Company from 1856 until 1862; after the failure of the first cables he parted on very bad terms with the board of directors. He was promoter of and consulting engineer to the early cables in the Mediterranean, the Persian Gulf and the West Indies between 1861 and 1873, and later to several in the South Atlantic. He was more accomplished in company promotion than in his technical ability, carefully managing his image as the father of the intercontinental cable through several books and many articles, aided in this by his brother, Edward (q.v.). Bright was Member of Parliament for Greenwich between 1865 and 1868, and was knighted, prematurely, on the apparent success of the second Atlantic cable in 1858.

Edward Brailsford Bright (1831-1913)
The older brother of C T Bright, he was also an electrical engineer, and was Secretary and General Manager of the Magnetic Telegraph Company in Liverpool from 1851 until 1868. As well as being chief executive he devised fault-finding instruments and undertook important research into retardation in cables. For a period after 1870 he was in partnership with his brother as a civil engineer in submarine telegraphy. In the 1870s E B Bright patented a widely-used system of electrical fire alarms. He was, in the 1880s, Chairman of the British & Irish Telephone Company and of the British Electric Light Company. He wrote extensively throughout his life and was an early historian of the telegraph industry and biographer.

John Brittan (1809-1886)
"The first mechanic who was called upon to construct an apparatus for the transmission of signals by electricity and magnetism," Brittan was employed by Moore Brothers, Clerkenwell Close, to work on W F Cooke's earliest telegraphic instruments in 1836, in which year he made a mechanical one the size of a "barrel organ", the very first of Cooke's designs; during 1837 and 1838

he also made several clockwork machines and electrical alarms for Cooke. Brittan was present at the first demonstration of the telegraph to the London & Birmingham Railway in 1838. This was all confirmed in correspondence with Cooke in December 1867. Britten joined the Electric Telegraph Company during 1849 and rose to become Superintendent of the Instrument Department at their Gloucester Road factory in London, retiring to live in Bath, Somerset, in 1870. He also worked in the 1850s as a clockmaker at 3 Bowling Green Lane, Clerkenwell. His son, *Thomas Brittan*, became a telegraph instrument maker with his own workshops at 22 Tysoe Street, Clerkenwell.

Colin Brodie (1830-192?)
Telegraph engineer. Born Perth, Scotland, Colin Brodie was employed as "line assistant" to Nathaniel Holmes of the Universal Private Telegraph Company in 1861, rising to become Assistant Engineer in 1864 and Engineer in 1867. Brodie joined the Post Office in 1870 and served as Surveyor of Private Telegraphs until the 1890s. He was also appointed Secretary of the Telephonic Department in 1881, retiring from the Post Office in 1895. He introduced the *telegraph exchange* in 1865, interconnecting four subscribers in Newcastle-upon-Tyne using the *umschalter* or switchboard. In 1872 he created a 60 line exchange in Newcastle connecting 40 private wire subscribers and 20 post offices; this was converted to a telephone exchange in 1881. Brodie married his wife Sarah in 1868; they had three daughters and three sons, several of which became telegraph clerks. The family lived in St Pancras, London, between 1868 and c. 1914. He was one of the original members of the Society of Telegraph Engineers.

Sir James Carmichael Bt. (1817-1883)
Sir James Robert Carmichael, 2nd Baronet, was born on 11 June 1817. He was the son of Major-General Sir James Carmichael Smyth, 1st Bt., an eminent military engineer, and Harriet Morse (no relation!). The Smyth part was dropped in 1841. Joining the British Army he gained the rank of Ensign in the 86th Regiment of Foot, selling out on succeeding to the baronetcy in 1838 to manage his small estate at Oakdene, Edenbridge, Kent. He became acquainted with John Watkins Brett and the telegraph in 1845, probably though their mutual interest in art, and, as an able diplomatist, negotiated for him with government in Britain and Europe. He was a director of the Sovereign Life Assurance Company from its founding in 1846 until his death, and dabbled in joint-stock promotions for a short period in the 1860s, but otherwise confined his interests to the telegraph. Carmichael joined Brett as one of his partners in acquiring the French and Belgian cable concessions, eventually becoming Chairman of the Submarine Telegraph Company and a director of the Mediterranean Telegraph Company. He remained chairman of the Submarine company until his death and was effectively its chief manager. He also was on the board of the British & Irish Magnetic Telegraph Company in the 1860s, but, curiously, was never associated with Brett's great project, the Atlantic Telegraph Company. Carmichael was a close friend of the writer W M Thackeray and was executor to the estate of John Watkins Brett in 1863. In later years he held the office of Deputy Lieutenant of Kent. He married Louisa Charlotte Butler in 1841, they had three children. The baronetcy ceased with his son, James Morse Carmichael, a Liberal politician and Member of Parliament, who died unmarried in 1902.

Edwin Clark (1814-1894)
The elder brother of J Latimer Clark (q.v.). He worked with Robert Stephenson on the Britannia Bridge over the Menai Straits between Wales and Anglesey for the London & North-Western Railway. He was Chief Engineer to the Electric Telegraph Company from August 1850 until 1854, managing its construction and mechanical works; being retained subsequently as Consultant Engineer. He obtained several patents for improved telegraph apparatus, railway signalling, the Electric company's first standard pole insulator and for suspending wire. He was also an accomplished hydraulic and dock engineer, to which profession he reverted in the partnership of Clark, Stansfield & Clark.

(Josiah) Latimer Clark (1822-1898)
Younger brother of Edwin Clark (q.v.). He was originally a chemist and later a railway surveyor during the Railway Mania of the 1840s, and worked for Robert Stephenson on the great railway bridge across the Menai Straits. He became Assistant Engineer to the Electric Telegraph Company in August 1850, and succeeded his brother Edwin as Chief Engineer in 1854, responsible for its mechanical works, especially cable-laying, a post he held until 1861 when he became its Consultant Engineer. From that time he was also Engineer to the Atlantic Telegraph Company. He devised improvements in resin coating of underground wires in the 1850s, the Clark cell for electric batteries, a new insulator and a pneumatic message-transfer system. He went into partnership as a Consulting Engineer with C T Bright (q.v.) from 1861 until 1868. Clark then formed a partnership with Forde and Taylor in that year as cable engineers and together they engineered submarine cables in the Mediterranean, in the Far East, around Africa and across the South Atlantic.

William Fothergill Cooke (1806-1879)
John Monro provided a concise biography of him in 'Heroes of the Telegraph' in 1891 to which all are recommended. Latimer Clark summarised in his obituary; "none but those who were engaged in the early struggle of the English telegraphists know the energy, determination and patience" of W F Cooke.

Maria Craig (1823-188?)
Lady Superintendant or 'Matron' of female clerks for the Electric Telegraph Company. Mrs Craig, a widow, was born in Dublin in 1823, and lived in Streatham, South London, with her five children, relying on her elder sister, Margaret, to manage her household. Mrs Craig was responsible for recruiting, training and supervising all women *télégraphistes*, numbering several hundred, employed by the Company from around 1856 when she came to London, until 1868. She personally trained each new female recruit and saw to their wel-

fare. Two of her sons and one of her daughters were to be employed by the Company as clerk operators. She went on to be senior 'Matron' with the Post Office Telegraphs, in her words, "growing grey in their service". A pioneer in management.

(Alexander) Angus Croll (1811-1887)
"An experimental and manufacturing chemist, a gas engineer and superintendent, and a considerable proprietor of gas works". Angus or A A Croll was born in Perth, Scotland to a worker in the textile industry. Apprenticed to the family business he built a model gas works in his teen years, which industry became his enduring vocation. In 1836 Croll came to London as a manufacturing chemist, patenting several improvements in gas manufacture. When his business failed in 1843 he joined London's Chartered Gaslight & Coke Company as an engineer, managing their Bow works. After six years Croll became lessee of gasworks in Coventry, Tottenham and Winchester. In 1849 he became contractor to the Great Central Gas Consumers' Company in London, running their works at Bow Common, investing in the concern and eventually becoming its Managing Director. The company was created to break the gas light monopoly in the City of London with a cheap tariff and a limit of 10% in dividend.

In 1860 Angus Croll became an investor in and director of the United Kingdom Electric Telegraph Company, Limited, which had a similar ethic to that of his Gas Consumers' Company. In 1861 he became Managing Director and the engine of its public image as the "consumers' friend". Although in no way as successful as his gas enterprises, the United Kingdom company was perceived as having brought down the cost of public telegraphy during the 1860s. On the appropriation of the telegraphs by the state in 1868, the Company and Croll were singled out by Parliament for having introduced the one shilling flat rate message. A magnificent silver testimonial in the form of a fountain valued at over £1,000 was presented to him in 1871 for his work with the United Kingdom company.

Croll, however, was far more important in reforming and improving the gaslight industry and chemical engineering, with which he continued to the end of his life, as well as with many works for the public good, including prison reform, local government, the volunteer rifle movement and Christian charities.

Richard Spelman Culley (1818-1901)
Telegraph engineer. Son of John Culley, a Norwich wine merchant, he was an early associate of Cooke and Wheatstone in the 1840s. He became Superintendent for the Electric Telegraph Company in his home town of Norwich, Norfolk, in July 1846. Culley was to be one of the most widely experienced managers and engineers in the Company's service. By May 1848 he was Superintendent at Derby, a vital centre for traffic north and south, and assisting W H Barlow with experiments recording electrical phenomena. In November 1853 he was Superintendent in Manchester for the North West of England, moving once again in 1855 to superintend the works in Scotland. By December 1859 Culley was Superintendent in Bristol for the West of England, where he stayed for seven years. With his experience it is unsurprising that Culley was appointed engineer-in-chief to the Company in January 1866 living for the first time in London. He joined the Post Office Telegraphs in January 1870 as Chief Engineer, retiring in 1877. For the rest of his life he returned to the West of England, dying at Weston-super-Mare, Somerset, age 83.

Culley's publication of 'A Handbook of Practical Telegraphy', a basic reader in electrical technology, in 1863 went through eight editions for over forty years, being recommended by the directors of the Electric & International Telegraph Company, by the Post Office Telegraphs and by the Department of Telegraphs in India; and translated into French, Italian and Romanian.

Richard Spelman Culley was a Member of the Institution of Civil Engineers, the Manchester Literary and Philosophical Society and the Royal Scottish Society of Arts, as well as being as a founder member of the Society of Telegraph Engineers. He married his wife Harriett, who he met at Derby, in Manchester in 1853. They had three children, the eldest, William Richard Culley, became a significant telegraph engineer in his own right.

Charles Henry Davis Curtoys (1828–1900)
Telegraph company manager. Born in Edmonton, London, he was the son of Charles Lockyer Curtoys, a miller and coal merchant, who brought his family up at Lee Park, Blackheath, Kent. By 1855 Curtoys was working for the Electric Telegraph Company, rising to be District Superintendent for the West-of-England. He was Assistant Secretary in London for the British & Irish Magnetic Telegraph Company in 1860, before becoming Secretary and Manager of the London District Telegraph Company in 1861. Only Curtoys' determination and imaginative marketing enabled the District company to survive until 1868. He was a close friend of the engineer Charles Bright (q.v.), acting as agent when Bright became Member of Parliament for Greenwich. Retiring from business in 1870 for many years, he became secretary and manager of the Consolidated Telephone Construction & Maintenance Company, licensees of the Gower patents, on its foundation in 1881. Curtoys lived at Heath Lodge, Old Charlton, Kent, near to his family home, for most of his life, and died at Blackheath, Kent. He appears not to have married.

George Edward Dering (1831-1911)
Apparently tutored by the telegraphic pioneer Henry Highton (q.v.) at Rugby School, he was a landowner with an estate at Lockleys, Welwyn, England, and was an inventing dilettante. He acquired twenty patents in Britain between 1850 and 1881 relating to telegraphy, chemistry, and iron- and brick-making. His single needle telegraph of 1850 was used experimentally after 1852 on some railways, by the Bank of England and by the Electric Telegraph Company of Ireland. Dering developed in 1853 theories that were said to anticipate radio transmission, although none of his other telegraphic inventions were successful.

Robert Valentine Dodwell (1831-1904)
An interesting career; born in Vauxhall, London; a telegraph clerk in Liverpool in 1851, married in 1857; a very active District Manager for the Magnetic Telegraph Company, Manchester, in 1859, rebuilding the circuits of the Lancashire & Yorkshire Railway and marketing Henley's dial telegraph; lecturer and writer on telegraphy, 1861-62; engineer to Bonelli's Telegraph Company, Manchester, in 1863; patentee of insect repellent, 1863; bankrupt in September 1863; commission agent to the Universal Private Telegraph Company, Manchester, July 1864; consulting telegraph engineer, 4 Blue Boar Court, Manchester, April 1865; probably engineer to the General Private Telegraph Company, 1865 - 1866; continued as contractor for private wires until January 1871 when he sold that business to John Bailey & Co., Albion Works, Oldfield Road, Salford, brassfounders and turret clock makers, for whom he managed their new telegraph instrument department; moved to London, compiled 'The Social Code', a telegraph code book, with George Ager, 1874; managing director of the Oriental Telegram Agency, Leadenhall Street, London, 1875, which used his abbreviating code to correspond with agents in India, China, America, Australia and Europe on behalf of subscribers; then again an electrical engineer, 1876, on the agency's failure. After leaving Salford, he lived in Fulham, London, and then Epsom, Surrey, with his wife, Blanche, and their grown-up children, until he died, age 73, in 1904.

James Sealy Fourdrinier (1805-1870)
Secretary to the Electric Telegraph Company between March 1849 and December 1863. Born in the City of London, he was the son of Sealy Fourdrinier, one of the partners in the rights to the first paper making machine, through which the family acquired considerable wealth from the early 1800s. The machine patent was owned by John Gamble, the pioneer in canning of foodstuffs. J S Fourdrinier relied on the family fortune until the death of his father in 1847. His tenure as Secretary, though long, was judged unsatisfactory, as he was to demonstrate poor people management and decision-making skills. He was, it has to be said, much older than most managers in the telegraph business. It was also said that he owed his position in the Company to the influence of Douglas Pitt Gamble, son of John Gamble and personal secretary to the chairman, who he had supported in a law suit. J S Fourdrinier was compelled to retire, age 58, in 1863, moving then to Bath, Somerset, where he died in August 1870. He never married.

Robert Grimston (1816-1884)
Most noted as a gifted amateur sportsman, excelling in cricket between 1833 and 1855, as well as being a boxer, at Harrow School, Oxford University and with the Marylebone Cricket Club; Grimston on leaving Oxford in 1838 entered Lincoln's Inn, one of London's Inns of Court, after qualifying he practiced as a barrister between 1843 and 1852. He abandoned the law to join the board of the Electric Telegraph Company in 1852. He succeeded Robert Stephenson as Chairman on his death in 1859 and remained so until 1868. Latterly the guiding management personality for the Electric company, he joined the board of the Atlantic Telegraph Company in 1867, and was Chairman of the Indo-European Telegraph Company from 1868; remaining until his own death in 1884. Grimston had represented the Electric's interests on domestic cable companies' and other boards before the government took over. One of several sons of the Earl of Verulam, he remained unmarried. Little else is known about this important individual.

James Gutteres (1818-1898)
Telegraph manager. The son of M Guttères of Sidmouth, Devon, he studied law and qualified at the Middle Temple, London. Although he practised as a barrister in 1847, by 1851 he was a "clerk" with the Electric Telegraph Company in London. He was appointed Secretary of the International Telegraph Company in 1853 but was dismissed in the same year. Gutteres joined the English & Irish Magnetic Telegraph Company and was Superintendent in Cork, Ireland in 1856, and at Leeds in England four years later, being promoted to Manager of the British & Irish Magnetic Telegraph Company's chief office in London in 1861. Early in 1864 he became Secretary of Bonelli's Electric Telegraph Company. On the failure of that concern he became a close associate of Charles Bright, late engineer of the Magnetic and promoter of the Atlantic Telegraph Companies, in his many cable enterprises. In 1870 he was Superintendent of the West India & Panama Telegraph Company in Jamaica where he remained for several years with his family. Returning to England by 1880 he became chairman of a number of mining companies. Gutteres died on Jersey, in the Channel Islands, in 1898. He married Susan Gooch in September 1847, they had several daughters.

William Henry Hatcher (1821-1879)
Professional manager, civil engineer, chemist, and telegraph patentee. Born in Salisbury, Wiltshire, the son of Henry Hatcher, a well-known antiquarian and historian, he studied at King's College, London, Wheatstone's campus, becoming a civil engineer. He was employed by the Electric Telegraph Company as Secretary and Chief Engineer shortly after it formation in 1846; whilst there he encouraged the Hancock family, then developing india-rubber, to use gutta-percha as a cable insulator in 1847. He also patented an early dial telegraph and the mercury trembler switch. Hatcher was replaced as Secretary in March 1849, but was retained as Engineer until August 1850; keeping up a connection with the company for another year or so. He joined the provisional board of the Magnetic Telegraph Company when it was created in 1851. Hatcher wrote widely on engineering and technical matters in the late 1840s and early 1850s, and was a Member of Institution of Civil Engineers from 1843. He became connected with Price's Patent Candle Company, Belmont Works, Battersea, London, in 1850 and was its chemical engineer and manager until his death in August 1879.

William Thomas Henley (1814-1882)
Electrician. From being a maker of electrical apparatus he introduced the magneto-electric telegraph without

galvanic batteries and pioneered underground cables. He patented a wide range of telegraphic apparatus and tools; metallic troughs, pole insulators, chemical telegraphs, improvements in magneto-electric machines and, latterly, magneto- and galvanic-dial telegraphs for private circuits. From being an instrument maker in the early 1840s Henley became a major telegraph contractor, erecting Cooke & Wheatstone lines for the South Eastern Railway in 1846. He was the main promoter of the English & Irish Magnetic Telegraph Company in 1850. Henley provided materials for the Magnetic company and later for the United Kingdom Electric Telegraph Company. In the 1860s his firm was manufacturing galvanometers to his design in quantity, as well as military telegraphs for the Army. He expanded his equipment factory into a joint-stock company for producing electrical and submarine cable equipment in 1868. Henley was an inventor not a manager; the works only flourished after he had left them in 1876.

Edward Highton (1817-1859)
A civil engineer, telegraph engineer and company promoter, working in concert with his elder brother, the Reverend Henry Highton. Henry Highton patented a high-tension telegraph in 1844 and the sensitive gold-leaf telegraph in 1846. Edward was to develop from 1848 and patent a simplified, inexpensive needle telegraph using tappers (or keys) rather than commutators, and to make several innovations in overhead wire telegraphy, as well as being an early advocate of resin-insulated subterranean circuits. Edward Highton, having been a civil engineer, was telegraph superintendent of the London & North-Western Railway between 1846 and 1848. He went on to found the British Electric Telegraph Company to work their patents in 1849 but had sold his interest to others by 1855. Born in Leicester St Margaret Edward Highton did not marry; he supported his three sisters. He lived at 5 Gloucester Road, Regent's Park, from c 1845. The brother, *Henry Highton* (1816 – 1874), was a minister in the Church of England and was Principal of Cheltenham College from 1859 until 1862, as well as engaging in developing telegraphic apparatus from the 1840s into the 1870s. He married and had twelve children. Edward Highton's single-needle telegraph was one of the most widely used in Britain, but the family's contribution to telegraphy remains largely unrecognised.

Nathaniel John Holmes (1824-1888)
An electrical engineer. Descendent of a family of leather merchants in London, at age 23 he was both manager of the Electric Telegraph Company's central station, having designed its electrical circuitry, and manager of its instrument workshops. Dismissed in 1849 he worked with Francis Whishaw (q.v.) for a short period. Holmes journeyed to Glasgow, Scotland, in 1851 to become manager of its Polytechnic Institution in Jamaica Street. In 1853 he set up as N J Holmes & Company, "ornamental draughtsmen, lithographers, embossers and printers" in Cochran Street, Glasgow. The firm failed in November 1856. After meeting Charles Wheatstone at a lecture in Glasgow he took up telegraphy once more, with several patents. Settling his financial affairs, Holmes returned to London in 1859 to work with Wheatstone, for whom he promoted, engineered and managed the Universal Private Telegraph Company from 1860 until 1866. He became, under Wheatstone's guidance, involved with submarine telegraphy, initially as engineer to the London & South-of-Ireland Direct Telegraph Company in 1862. Holmes also worked closely with the American navigator and inventor, Matthew Maury, developing electrically-detonated torpedoes for the Confederate States in 1865. Holmes later in the 1860s became engineer to the Orkney & Shetland Islands Telegraph Company and then, for many years, to the Great Northern Telegraph Company of Copenhagen. After bitter experiences cable-laying in the Orkney Islands in the 1870s he patented life-saving maritime air horns and instantaneous signal lights, forming the "Holmes Marine Life Protection Association". Always interested in acoustics, he was in the 1870s famous for his organ music. Holmes became bankrupt again in May 1878. He was married in Croydon, south of London, in June 1850, and lived from 1860 until his demise in 1888 at Primrose Hill, Hampstead, London. He was described as the last of the first telegraphers.

The writer of these pages has published a short biography of N J Holmes on the Atlantic Cable website.

Thomas Home (1825-1898)
The first manager of a public telegraph, between 1843 and 1847. Born in Hadnall, Shropshire, son of an agricultural labourer, Home was an assistant to W F Cooke on the telegraph line between Paddington and Slough in 1843. He became licensee to work the Cooke & Wheatstone patents there paying them a fee of £170 a year until displaced by the Electric Telegraph Company. Although only 19 years old Home worked closely with both Cooke and Wheatstone, for the first time developing the telegraph as a business, widely publicising it in newspapers and posters. By 1851, after a short period in Cheshire, he had become a coal-dealer in Bicester, Oxfordshire, before starting a business as a brick, tile and pipe maker at the Cross Road Kiln, Brill, Oxfordshire, in 1860. Home had married Emma Burge in 1848 and they had ten surviving children. He lived in Brill for the rest of his life.

John Lavender (1829-189?)
Telegraph engineer. Educated at Manchester Grammar School, after a period at sea, he joined the British Telegraph Company in 1851. He was an assistant-engineer with special emphasis on erecting and rigging pole telegraphs in the Manchester and Eastern districts; in particular, from 1853, with high masts across rivers and roof tops in cities. In 1858, with the failure of the Magnetic company's underground lines he started substituting overhead wires on the route between Manchester and London, but was soon relegated to a clerical role and left in 1859. Subsequently he became a "telegraph constructor" in Manchester, employed by railways and by the Magnetic company to build overhead circuits, with his speciality of very high over-house poles of 60 and 70 feet length. Lavender rejoined the Magnetic

company around 1866 as a District Superintendant in Leeds and Cambridge. He resigned his position rather than join the Post Office Telegraphs and became Telegraph Superintendent of the Lancashire & Yorkshire Railway Company – the British Telegraph Company's original partner of 1851. Latterly he became involved in the provision of electric light in Manchester.

John Pender (1816-1896)
Merchant, of London, Glasgow and Manchester. John Pender was undoubtedly the most important individual in 19th Century communications; although his influence on domestic electric telegraphy in Britain was relatively modest he effectively controlled the intercontinental cable business for half a century. Born in Leven, Dumbartonshire, Scotland, he was a successful merchant, trading, primarily in textiles, with India, China and America.

From his business hub in Manchester, in 1852 Pender invested in the newly formed British Electric Telegraph Company, the first concern to challenge the patent monopoly of the Electric Telegraph Company, and became one of its Directors. From this early speculation, an adjunct to his mercantile activities and related to his portfolio of railway shareholdings, Pender became an early investor in the even riskier Atlantic Telegraph Company of 1856. Despite the failure of the Atlantic cable in 1858 he retained confidence in the project to the extent of personally guaranteeing £250,000 for materials used in the successful cable of 1866. Realising the profits to be generated from intercontinental telegraphy he invested subsequently in over thirty cable companies that connected Britain with the entire populated world; from America, to India, China, Australia, Southern Africa, the West Indies and Latin America. The main vehicles for these were the Anglo-American Telegraph Company, the Eastern Telegraph Company and the Globe Telegraph & Trust Company, in which Pender was chairman and controlling shareholder. He also invested in the cable contracting concern, the Telegraph Construction & Maintenance Company.

Throughout his career he styled himself "Merchant", from which trade the bulk of his considerable fortune derived, as well as from many investments in railways in Britain and overseas, and in telegraphy.

Pender married twice and raised two sons and two daughters. His eldest son succeeded him in managing his cable interests. He held property in Scotland and the South of England, and was awarded many honours from countries around the world for the connections his cable companies afforded.

William Powell (1826-188?)
Telegraph engineer, creator of two substantial domestic networks in Britain. Born in Kemberton, near Shifnal, Shropshire, Powell joined the Electric Telegraph Company in 1848 in Northampton, eventually becoming Inspector of Works for the Midlands. In 1852 he left to join the newly-created British Telegraph Company as Engineer in Manchester, being responsible for its overhead lines in the north of England. Overlooked in the merger between the Magnetic and British companies in 1857, he took up farming at Aspinal Smithy, near Denton in Lancashire. Powell was to join the United Kingdom Electric Telegraph Company in London during 1861 as Engineer of its works and oversaw the remarkable expansion of its national network in 1863 and 1864, despite considerable financial difficulties. In the later 1860s he became a consulting telegraph engineer, maintaining his relationship with the United Kingdom company until 1868, having offices at No 1 Circus Place, Finsbury, London. He married in Northampton and had six children.

William Henry Preece (1834-1913)
An electrical engineer. Educated at King's College, London, he joined the staff of Edwin Clark, engineer to the Electric Telegraph Company in 1852. He rose to become District Superintendent for the Company in Southampton during 1856, where he supervised the works of the Channel Islands Telegraph Company in 1858. His first post of authority was as Telegraph Superintendent of the London & South-Western Railway between 1860 and 1870, where he developed an electrical railway signalling system in 1862. In 1870 Preece was appointed one of the District Engineers in the Post Office Telegraphs and then in 1877 became Electrician for the whole system. Although he did little to advance electrical technology in that job Preece's lasting claim to fame was his work at the end of his life with Guglielmo Marconi, the inventor of wireless telegraphy. He managed to accumulate an immense fortune whilst working for the Post Office Telegraphs.

His brother, *George Edward Preece* (1836-1895), was also a significant telegraph engineer, working as submarine electrician and district superintendent for the Electric Telegraph Company, as engineer and electrician of the British government's Malta and Alexandria cable, and then as chief electrical engineer to W T Glover & Company, the cable makers, in Manchester.

William Reid (1798-186?)
A Scottish-born philosophical and scientific instrument maker whose firm dated from 1820; the first ever telegraph contractor in Britain. He constructed many of the early instruments for Cooke and Wheatstone, and subsequently for the Electric company, becoming a major line-building and maintenance contractor in the early days of both the Electric and Magnetic companies; for example constructing most of the lines in Scotland and Ireland for the latter concern. He was involved with the laying of the first submarine telegraph cables across the Channel and patented several widely-used improvements in subterranean cable-laying to protect the resin insulated wires; he handed over management of his eponymous firm (q.v.) to his sons in March 1856 but lived on well into the 1860s. On retirement he became a critical shareholder in several telegraph companies whose stock he acquired in the course of his business. When he moved from Glasgow he lived initially "above the shop" at 25 University Street, St Pancras, then at 27 Chalcot Villas (a.k.a. 63 Adelaide Road), Primrose Hill.

His firm continued trading as electrical instrument makers until 1922.

(John) Lewis Ricardo (1812–1862)
Son of the financier, Jacob Ricardo, and nephew of the economist, David Ricardo. An athlete in his youth he intended to join the Army but the early death of his father caused Lewis Ricardo to take over the family mercantile firm with his brother Samson. He became Member of Parliament for Stoke-upon-Trent, an industrial constituency, as a Liberal in 1841; a seat he retained until his death. Ricardo was an active Free Trader, campaigning for the repeal of the Corn Laws and the Navigation Acts that restricted trade. As well as being Chairman of the Electric Telegraph Company for over ten years he was a director of the North Staffordshire Railway, the Norwegian Trunk Railway, the Metropolitan Railway and the London & Westminster Bank. He was fortunate to inherit, through his wife's family, a large estate in Scotland. When he resigned as Chairman of the Electric the staff presented him with one thousand books for his library in recognition of his stewardship of the company. Then, when he died in 1862 after an eight month illness, the offices of the Electric, Magnetic and District Telegraph Companies closed for a day in commemoration.

The 'Electrician' magazine was to write in 1862; "There can be no question that it was Mr Ricardo who succeeded in establishing the electric telegraph on a firm and successful footing in this country".

George Saward (1822-1873)
Professional manager. From being secretary or manager of a small railway company in 1847, he was successively secretary to the British Telegraph Company and to the Atlantic Telegraph Company. The success of these concerns owes much to the determination of Saward. Living modestly in Islington, North London, with his wife and family from c.1850, he was out-of-place by 1871. His widow published his telegraphic memoir in 1878. An unsung stalwart of telegraphy.

(Johannes Matthias) Augustus Stroh (1828-1914)
A mechanician and inventor. Born in Frankfurt-am-Main, coming to London in the Exhibition year 1851, he worked for Charles Wheatstone from then until 1875, making models and manufacturing apparatus; perfecting his universal telegraph in 1863 and his automatic telegraph in 1866. Stroh had workshops at 42a Hampstead Road, London NW in the 1860s, employing fifty-four men and ten boys, then was engineer to the British Telegraph Manufactory until 1881, after which he worked for the Post Office. Like many in telegraphy he was interested in acoustics, devising the disc sound recorder in 1892 and the "phonographic violin" in 1900.

Edward Tyer (1830-1912)
Most noted as a railway electric signal engineer. Born in Enfield, London, he was associated with Dalston in east London for much of his life. Tyer was trained as an accountant but by 1851, age 21, he had patented a simple, single needle, single wire railway signal system, which he continually developed until 1870. In 1856 he was engineer to the *Railway Electric Signals Company*, a promotion of telegraph interests, formed to work Tyer's new patents "to ascertain the position and distance of an engine or train", in Britain and France. This firm did not survive and in 1858 he became electrical engineer to the London District Telegraph Company for several years, adapting his patent signal equipment for use as a compact single-needle telegraph and managing their subterranean and overhead works. In 1862 he was in partnership with John Musgrove Norman as Tyer & Norman at 15 Old Jewry, City, with workshops at Sash Court, Wilson Street, City, manufacturing "Tyer's Train Signalling Telegraph". Their apparatus was shown at the International Exhibition in London in that year. By 1874 the firm was much enlarged and became Tyer & Company, electric telegraph engineers and contractors, with works at Beech, later renamed Ashwin, Street, Dalston Junction. In 1878 Tyer patented the "Electric Train Tablet" for safely controlling railway traffic. His apparatus was to dominate railway electric signalling in Britain for well over one hundred years.

Cromwell Fleetwood Varley (1828-1883)
Electrician. Born in Kentish Town, London, to a family of artists and engineers. The family were of the Sandemanian spiritualist sect, of the same congregation as Michael Faraday. He joined the newly-founded Electric Telegraph Company in 1846, becoming Electrician for the London region by 1852 and for the entire Company by 1861. He was appointed on the advice of W F Cooke. Varley was appointed to the Board of Trade committee to investigate the failure of the first Atlantic cable in 1858, which led to his appointment as honorary Chief Electrician to the Atlantic Telegraph Company, as well as to the Electric company. Varley devised several major electrical improvements: the 'killing' of wire, removing bad parts and preventing springing; perfecting the 'loop test' - the localisation of faults in submarine cables; and the ability to make cables "self-repairing"; introducing more efficient current reversal or double current working for the American telegraph; inventing the double coil relay, the translating (relay) system for very long distance traffic, as well as, more prosaically, the Company's last standard insulator. The "Varley Unit" (c. 23.5 ohms) was the Company's measurement of electrical resistance. He was long associated with Charles Wheatstone. Varley was an astute businessman and he latterly went into partnership with William Thomson and Fleeming Jenkin to develop their telegraphic patents, which proved highly profitable.

His brother (*Samuel) Alfred Varley* (1834-1921) was employed as electrical engineer by the Electric Telegraph Company from 1852 to 1861. He was appointed civilian superintendent firstly of the British Army's field telegraph in the Crimea and then of the Varna to Constantinople cable during the war with Russia in 1855. He retired from his position as District Superintendent for Metropolitan London with the Electric company to join his father Cornelius Varley in instrument manufacture in 1862 and then, in 1875, he became assistant manager of the British Telegraph Manufactory. He devised the chronopher for accurate time-transmission, and made many other electrical innovations.

Charles Vincent Walker (1812-1882)
Electrician to the South Eastern Railway Company from 1845 until his death in 1882. Prior to this he had been a member of the experimental London Electrical Society from 1838, becoming secretary to that group in 1843. He was editor of the short-lived 'Electric Magazine' in 1845 and 1846. With the South Eastern Railway he made several improvements in Cooke & Wheatstone's instruments, in railway signal telegraphy and in transmitting time-signals. In January 1849 he laid a two-mile lightweight gutta-percha insulated submarine cable, the first "ocean" cable, off a steamer from Dover into the English Channel. C V Walker was one of the few involved in the new industry to realise the need for a public record of its achievements, co-operating fully with journalists and historians.

Walker's wife, Susanna Maria, worked a private two-needle telegraph between their home and his office in Tunbridge Wells, Kent, where they lived for most of their lives. They had no children.

His brother or step brother, *Alfred Owen Walker* (1834-1878), was also employed in the telegraph department of the South Eastern Railway. In 1871 A O Walker was appointed telegraph superintendant of the Stockton & Darlington Railway.

Henry (Edward) Weaver (1826-1893)
One of the most important managers in British telegraphy. Clerk-in-charge at Hull for the Electric Telegraph Company in 1854, he transferred to become managing clerk at The Hague and then the Amsterdam offices of the International Telegraph Company in the Netherlands, rising to the position of secretary to the International company and, simultaneously, District Superintendent for London for the Electric company in Britain in 1856. In January 1864 he became Secretary and Chief Manager to the Electric Telegraph Company, leaving in 1868 to become Secretary of the Indo-European Telegraph Company. In 1871 he became General Manager of the Anglo-American Telegraph Company, latterly he was Managing Director. He also joined the board of the West India & Panama Telegraph Company. He married in 1853 and had three children, one of which was born in Amsterdam. His eldest daughter was to marry a Hollander.

Frederick Charles Webb (1828–1899)
Telegraph Cable Engineer. A Londoner, he was apprenticed as a marine surveyor with the Royal Navy at age 15. During the Railway Mania of 1845 he left to become a surveyor for several new lines, learning civil engineering with James Walker CE. In 1850 Webb became an assistant to Edwin Clark, engineer to the Electric Telegraph Company. For him he surveyed the underground circuits in London and many new telegraphs along the railways. In 1853 he became assistant engineer to the International Telegraph Company, responsible for its cables to The Hague, Dublin, and across the Tay, Forth and Humber rivers. In 1857 he joined the Atlantic Telegraph Company, subsequently working as a consultant engineer on many submarine works, on the Dover – Calais, Cagliari – Malta, Red Sea and India, Isle of Man and Cromer – Emden cables. When the cable business became slack he continued surveying for new railways and writing for technical journals. He was to engineer the Key West – Havana, the second Persian Gulf, the Marseille – Algiers, Bilbao – Porthcurno, Marseille – Barcelona, and River Plate – Brazil cables. Webb's health was damaged by his travels in the tropics and he ceased active work in 1878. He died by his own hand after a surgical operation in 1899. He was a Life Member of the Institution of Civil Engineers, an artist of some talent and a keen musician all of his life.

Charles Samuel West (1803-1881)
Telegraph cable engineer. Born in Clerkenwell, London, and originally an author, reporter and proprietor of a railway magazine, he advocated india-rubber insulation of electrical wire from 1838. In 1845 he laid the first successful underwater cable, which lasted over fifteen years, in Portsmouth harbour. He gained permissions in England and France along with the Electric Telegraph Company for a circuit from Dover to Calais in 1847, but negotiations were prolonged and the Brett family pre-empted the works. He also successfully laid india-rubber insulated wires in several railway tunnels, including that at Box on the Great Western Railway. Bankrupt as a "manufacturer of insulated wire for electric telegraphs" in July 1850, he became engineer to the Irish Sub-Marine Telegraph Company and several speculative cable concerns. His cables comprised a copper core insulated with india-rubber, protected by a thin cotton and shellac outer, and armoured with plaited iron wire. One such was made to connect England with the Isle of Wight in 1853 for the Electric Telegraph Company. Working with S W Silver & Company (q.v.) in 1859 he perfected the machine for insulating wire with caoutchouc. Known pejoratively as "India-Rubber" West by his peers, he believed that his pioneering of submarine telegraphy was inadequately acknowledged. It seems that Charles West died a pauper in the Liverpool Workhouse in 1881, in which city he had been a wireworker for the previous 20 years. He married his wife Martha in 1850 when practising as an 'electric engineer' in West Mersea, Essex, and they had one daughter, Edith. A telegraphic mystery.

Charles Wheatstone (1802-1875)
His personality may be summarised; "Sir Charles Wheatstone was small in feature, childlike to a degree, short-sighted and with a wonderful rapid utterance, yet seemingly quite unable to keep pace with an overflowing mind." Otherwise the reader is referred to 'Heroes of the Telegraph' of 1891 by John Munro for a fine biographical article.

Francis Whishaw (1804-1856)
A civil engineer who had minor roles in several railway projects in the 1830s. In 1836 he developed and publicised a hydraulic telegraph, using a pipe filled with water. He wrote the classic description of the railways of Great Britain in 1840. He became secretary to the

Royal Society of Arts & Sciences for a short period, where he presented papers on Cooke & Wheatstone's apparatus and introduced William Siemens to gutta-percha, before joining the Electric Telegraph Company from 1846 until 1848, creating their message department. He established the General Telegraph Company as contractors and engineers in 1849 where he marketed electrical, mechanical, hydraulic and speaking telegraphs, and fire and burglar alarms; becoming a consultant to the Gutta-Percha Company at about the same time. His advice was sought on introducing the telegraph to India in 1849. Although an engineer by profession, Whishaw's forte was organising publicity and lobbying; organising exhibitions, writing articles for the press and public speaking. He wrote widely on electric telegraphy from 1840 until his death, and was an early and vociferous advocate of underground circuits insulated with gutta-percha.

Henry Schütz Wilson (1824-1902)
Telegraph Company Manager. One of the fifteen children of Effingham Wilson, the City of London's leading commercial publisher and stationer, of 11 Royal Exchange, Schütz Wilson was privately educated before working for ten years in a foreign merchant's business, where he learned French, German and Italian. He then joined the Electric Telegraph Company as Assistant Secretary in 1853, handling administrative matters before becoming in the 1860s responsible for developing the Company's foreign connections. He did not join the Post Office Telegraphs in 1870, taking a pension and becoming a prominent critic, essayist and novelist, contributing to many literary journals. Schütz Wilson edited the first editions of the Journal of the Society of Telegraph Engineers in 1872. He wrote many books, novels and factual works, from 1860 and was a vigorous member of the Arts Club from 1864, and of the Alpine Club. He never married.

Some Minor Characters
There are several individuals associated with the early telegraph companies whose names briefly appear in the public press of the 1840s, 1850 and 1860s. These are a few of them with their subsequent history:

Frederick Ebenezer Baines (1832-1911)
Post Office bureaucrat. Baines worked as a clerk for the Electric Telegraph Company between 1848 and 1855, working at Founders' Court, Lothbury, and Seymour Street, Euston Square, as an operator; rising to be clerk-in-charge of the Company's telegraph at the General Post Office in St Martin's-le-Grand. He then transferred to the Post Office in 1856 as a clerk, becoming, based on his "experience", its expert on telegraphy. Something of an *eminence gris,* he worked in the background advocating the appropriation of the telegraphs, a master of disinformation and ambition, he rose high in the bureaucracy, cleverly avoiding any responsibility for the subsequent financial disaster that cost his superiors their jobs. On retirement in 1896 he wrote widely justifying his work at the Post Office. Baines owed his position in the Company and in the Post Office to the influence of Rowland Hill.

Jacob Thompson Bidder (1834-1874)
Born in Yeovil, Somerset, son of a dissenting minister, J T Bidder had become clerk-in-charge of the Central Telegraph Station at Ducie Buildings in Manchester for the Electric & International Telegraph Company by 1860, managing that office for the rest of the decade. In 1870 he chose not to join the Post Office Telegraphs and moved to London, living in Penge, to become Secretary to the Press Association. J T Bidder married in 1870, having a son and a daughter. He died in 1874 at Croydon, Surrey, and his family moved back to Manchester. No relation to G P Bidder.

Theodore George de Chesnel (1828-1857)
Born in France, T G de Chesnel was grandson of Samuel Bentham, the naval architect, whose daughter, Mary, married a French military officer. At age 20, in 1848 he replaced Thomas Home as manager of the telegraph line between Paddington and Slough on the Great Western Railway as Agent for the Electric Telegraph Company. By 1852 he was styled Civil Engineer and had become District Superintendant for the Company in York and was later District Superintendant for Scotland in Edinburgh. In 1855 de Chesnel became engineer to the Mediterranean Electric Telegraph Company's lines and cables between France, Savoy, Corsica, Sardinia and Africa, but contracted "ague", probably malaria, whilst working in Corsica, dying at Genoa in March 1857.

William Charles Daniell (1820-188?)
Telegraph Manager. Born in Dedham, Essex, he was a Clerk in the British Electric Telegraph Company's office in the Royal Exchange, London, during 1851 and by 1868 had become Assistant Secretary of British & Irish Magnetic Telegraph Company in London. He did not join the Post Office Telegraphs, but became Agent for the Eastern Telegraph and the Anglo-American Telegraph companies, as well as several insurance concerns, in 1871 at Manchester, trading as Daniell & McGrath. He married Mary Lundy from Kingston-upon-Hull, sister to several telegraph engineers, in 1850.

Alfred Eggington (1841-1917)
Born in Lichfield, Staffordshire, son of a solicitor, Alfred Eggington had an exotic career in telegraphy. He joined the Submarine Telegraph Company as a Clerk in 1857, but left them for government service three years later to serve in a cable-laying expedition in the Far East. Shipwrecked in the Malacca Straits he returned to England in 1860 to work for the United Kingdom Electric Telegraph Company, leaving within a year to join Glass, Elliot & Company as a Clerk at Benghazi, "on the Barbary Coast", working the Malta to Alexandria cable. In 1865 he became a Clerk on the Telegraph Construction & Maintenance Company's leased line in Italy connecting the Malta cable with France, promoted to Clerk-in-Charge in Turin in 1868. Eggington left to be Clerk-in-Charge of the Brest station of the French Atlantic cable in 1869, but returned to Italy as Superintendant of the Anglo-Mediterranean Telegraph Company's cables and land lines at Otranto and shortly after to be made Agent in Italy for its successor, the Eastern Tele-

graph Company. He died in Rome, after being created Chevalier of St Maurice by the King of Italy.

Frederick Evan Evans (1835-1914)
Born in London, F E Evans replaced Basil Holmes as District Secretary of the Universal Private Telegraph Company in Manchester in 1864. He joined the Post Office Telegraphs and was posted to Birmingham in 1871 as superintendent, at which post he remained until retirement in 1900, living in Edgbaston. He married his wife, Helena, late in life, retiring to Salcombe, Devon.

Henry Charles Fischer (1833-1905)
Born and educated in Munden, Hanover, H C Fischer worked for the Royal Hanoverian Telegraph Administration between 1852 and 1856, when he joined the Electric Telegraph Company in London. He managed the Foreign Gallery at the Lothbury station, supervising the company's entire continental traffic, from 1856 until 1870. Fischer became Controller of the Central Telegraph Office of the Post Office in 1870, retiring from that role in 1898. He married Sarah Sawyer in 1878, from which time they lived in Bromley, Kent. They had two children, one becoming a clerk with the Eastern Telegraph Company. Uniquely for one in middle management, Fischer was awarded a knighthood and was made a Companion of the Order of St Michael and St George for his contribution to international relations.

Charles Alexander Gerhardi (1837-1905)
Born 1837 in Belgium, C A Gerhardi joined the Belgian government telegraphs in 1853, moving to England in 1856 to join the Electric Telegraph Company as a Clerk. He worked for the Atlantic Telegraph Company in 1857 on board the USS *Niagara*, and at Heart's Content on Newfoundland between 1858 and 1859. In 1859 he became Superintendent for the Submarine Telegraph Company in St Helier, Jersey, whose island cable connected with circuits in France and Continental Europe, where he remained until 1871. During 1872 Gerhardi became Manager of the Direct Spanish Telegraph Company, and lasted over twenty years in their service.

Adolphus Graves (1838-1903)
Born in Clifton, Yorkshire, the son of an Army officer, he joined the Electric Telegraph Company in York as a clerk in 1852 with his elder brother, Edward. By 1861, when age 23, he was the Company's District Superintendent at York. Choosing not to join the Post Office Graves became Telegraph Superintendent of the North Eastern Railway Company in January 1870 until a paralysis compelled his retirement in 1902, introducing block signalling, the telephone and electric lighting. An original member of the Society of Telegraph Engineers, his "retiring disposition" prevented him from speaking at the many meetings he attended. Graves married in 1864, and he had one daughter. His younger brother, Anthony Graves, was to become a telegraph clerk, age 14, in York during 1861.

Edward Graves (1834-1893)
The elder brother of Adolphus Graves (q.v.), Edward Graves, also joined the Electric Telegraph Company as a Clerk in York in 1852 and was to replace T G de Chesnel as District Superintendent for Northern England in 1856. After 1870 he was appointed by the Post Office Telegraphs as District Engineer in Birmingham, and succeeded R S Culley as Engineer-in-Chief in 1878.

James Graves (1833-1911)
Born at Chesterton near Cambridge, Graves wrote a highly-detailed diary of his career in the telegraph industry, published on-line by Dr Donard de Cogan. He joined the Electric Telegraph Company in Lothbury as a 'Learner' in December 1852, transferring to Southampton as a Clerk in February 1853 and back to the Foreign Galley in Lothbury in 1857. He became Clerk-in-Charge of the Jersey station of the Channel Islands Telegraph Company in 1860, then Submarine Electrician to the Electric company in 1861 and Assistant to the Chief Electrician between 1862 and 1863. In 1864 Graves joined the Atlantic Telegraph Company and became Superintendant of the Valentia station, the cable end in Ireland, until his retirement in 1909.

John Henry Greener (1829-18??)
One of the earliest telegraph engineers, J H Greener was first employed on the circuits of the London & Blackwall Railway in 1843, joining the Electric Telegraph Company in 1847. He became Superintendent of Telegraphs for the Blackwall Railway in 1849. Rejoining the Electric company in 1853 he was responsible for new lines they had contracted to build alongside railways in Norway and Denmark. In 1860 joined the British India government telegraphs, surveying and constructing circuits in Turkey and Persia between 1861 and 1865. In 1865 he returned to London as Inspecting Engineer of Telegraph Stores for India and the Colonies.

James Humphrey Hammerton (1802-1898)
Hammerton had an early interest in electricity, supervising construction of lines on the Great Western Railway and in north-east of England for the Electric Telegraph Company. In September 1848 he was Superintendant of the Company's "Central District" at the Central Telegraph Station, Lothbury, London. By the early 1850s Hammerton had become a Commercial Agent in London, from which occupation he retired in 1880.

Frederick Troake Jago Haynes (1844-18??)
Haynes was born in Exeter, becoming a Clerk for the Electric Telegraph Company at Exeter St David's station on the Bristol & Exeter Railway, in 1857, moving to the District office in Taunton during 1858. He became Clerk to the Telegraph Superintendent on the Exeter railway in 1859. During 1865 and 1869 he was responsible for introducing electrical block signalling, and in 1874 Haynes was appointed Superintendent of Telegraphs for the Bristol & Exeter Railway.

Arthur West Heaviside (1844-1923)
A nephew of Charles Wheatstone, the son of Thomas Heaviside, a draughtsman and engraver of St Pancras, London, A W Heaviside joined the Universal Private Telegraph Company as an "electric telegraph assistant" in London during 1861, age 16. He became District Secretary for the Company in Newcastle-upon-Tyne by 1864. In 1870 he joined the Post Office Telegraphs in

Newcastle as an engineer, eventually becoming superintendant engineer for the North East of England, employing his brother, Herbert, as his clerk. A W Heaviside married his wife Isabella in 1870; of their three sons, one was named Basil, after Basil Holmes, and one Colin, after Colin Brodie, colleagues in the Universal company. He was elder brother to Oliver Heaviside, the electrical theorist.

Edward Moseley (1829-188?)
Telegraph Manager. The eldest son of Edward Moseley, a wine merchant, of Camberwell, he became a "clerk at the electric telegraph" in Manchester in 1851 along with two of his brothers, Thomas Beeby and Litchfield Moseley, after the failure of their father's business. He became connected with the newly-formed English & Irish Magnetic Telegraph Company in 1852 initially in Manchester then in 1853 as Manager of their station at Old Broad Street, London. By 1857 Moseley was Assistant Secretary in London of the British & Irish Magnetic Telegraph Company, their second most important management position. Sometime before 1868 he joined the broking firm of his younger brother, Thomas Beeby Moseley, who also had been a telegraph clerk, and became a member of the London Stock Exchange. Moseley joined the 7th Surrey Rifle Volunteers in 1860 as an ensign, along with Charles Bright (q.v.), and rose to be Lieutenant-Colonel of that Corps in the 1870s. He married his wife, Emily, in 1856, and had three children.

John Muirhead, senior (1807-1885)
Telegraph Engineer. Born Salton, Haddingtonshire, Scotland; after assisting Edwin Clark (q.v.) in the construction of the Conway and Britannia bridges on the Chester & Holyhead Railway, Muirhead was appointed storekeeper to the Electric Telegraph Company in 1851, and then managed its warehouse in Lambeth from 1855. He became Superintendant of the Company's new factory in Gloucester Road North, Regent's Park in 1858, and there introduced several innovations in batteries and electrical equipment. Retiring in 1870, age 62, rather than work for the Post Office, Muirhead practiced as a telegraph engineer for some years. He married Margaret Lauder in 1845; their eldest son, also John, was the famous electrical engineer. Another son, Alexander, a doctor, also became a telegraph engineer.

Joseph Nelson (1828-189?)
Telegraph Manager. Nelson shows typical progress in the provincial service of the Electric Telegraph Company. Born in Wakefield, Yorkshire, the son of John Nelson, a plasterer, he joined the Company as a learner in 1849. By 1851 he was, age 23, a Telegraph Clerk at the important "transmission station" between the north and the south at Normanton, Yorkshire, still living at Wakefield, with two of his sisters. In 1854 he was Telegraph Clerk at Bradford, Yorkshire. In 1860, age 32, Nelson became Clerk-in-Charge of the busy telegraph station in Leeds, living in Hunslet. In the mid-1860s, in addition to managing the Leeds station of the Electric company, he became Agent for the Universal Private Telegraph Company which ran several private wires from about the city into the public office for retransmission. Nelson did not join the Post Office Telegraphs in 1870 but took a pension, age 42; in that year he was earning the remarkably large annual salary of £235 from his two positions. To supplement his annuity he became an insurance agent in Leeds. Nelson met and married his wife, Mary, in Wakefield in 1850; they had three sons and three daughters, and never left Yorkshire. His eldest son, John, became a telegraph clerk.

George Glanville Newman (1834-1892)
Telegraph Engineer. Born in Brighton, Sussex, son of a coach proprietor, G G Newman joined the Electric Telegraph Company as a clerk in Uxbridge, Middlesex, around 1851; by 1864 he was District Superintendent for the North West at Liverpool, until 1869, where he devised the electrical apparatus for measuring the muzzle velocity of cannon. He joined the London & North-Western Railway in 1870 as Superintendent of Telegraphs, working in Manchester, later being moved to London; he became a consulting telegraph engineer by 1881. Newman had retired by 1891 and returned to Brighton in that year, where he died. Unmarried, he lived in lodgings for virtually all of his life.

Selina Gabrielle Oppenheim (1827-1905)
Lady Superintendent of the London District Telegraph Company and *pro bono* Secretary of the Telegraph Clerks' Provident Fund. Born in Holland, Selina Oppenheim was the eldest daughter of Gabriel Oppenheim, a Belgian bronze merchant. Having a nomadic life in Belgium, Holland and France she, her brother and three sisters settled in London c 1855. After working with the District company from 1861 until 1870, Miss Oppenheim became a scholastic agent with her sister Hannah at 68 Berners Street, London. She died in Fulham, West London, age 79, and never married.

Samuel Percy (1826-1875)
Born in Boscombe, Wiltshire, Percy was in 1851 a prison officer at the Middlesex House of Correction Coldbath Fields, Clerkenwell. He joined the British Electric Telegraph Company in 1851 and rose to become its Commercial Superintendent or general manager at its head office in Manchester by 1855. On the merger with the Magnetic company in 1857 he remained in Manchester with the decreased status of District Superintendent, leaving their employ at age 36 in 1862. Latterly, and until his death, he was a Telegraph Agent in Manchester. He married his wife, Agnes, in 1850 and they had a son and a daughter.

Henry Pomeroy (1841-18??)
Born in Westbury, Wiltshire, Pomeroy first joined the engineering department of the Great Western Railway in Westbury in 1856, transferring to the telegraph department in the following year. In 1858 he became a Clerk with the Electric Telegraph Company in Bristol and in 1860 was temporarily posted to work in the Company's office in Amsterdam, Holland. Returning to Bristol in 1861, Pomeroy also worked in Cardiff and Worcester before becoming Clerk-in-Charge in Dublin in 1862, being appointed Engineer in 1863. He became Superintending Engineer of the Post Office Telegraphs in Ireland in 1878.

John Pope Cox (Age 29 in 1851)
Agent and superintendent of the Electric Telegraph Company's Manchester station in July 1847; later seconded to Ireland; being superintendent in Liverpool in 1850. Pope Cox was a key individual in developing the telegraph in the north-west of England, but in July 1851 he left to become Superintendent of Agencies for the Athenaeum Life Insurance Society in London until the firm was wound-up. He became Secretary of the English Widows' Fund & General Life Assurance Association in London during 1856, then Secretary of the Metropolitan & Provincial Bank on its founding in 1864, as well as being promoter of the Marine Mansions Company, a property speculation, of 1865. The bank failed in 1866, as did Pope Cox. He became an estate agent and auctioneer in the 1870s. In London Pope Cox remained a friend of C V Boys (q.v.) of the Electric company in the 1860s.

Charles (Ernesto Paulo del Diana) Spagnoletti (1832-1915)
Telegraph Engineer - Born in Brompton, London, son of Paulo Spagnoletti, a renowned violinist of Sardinian descent. After a brief period as a civil servant in the National Debt Office, Spagnoletti assisted Alexander Bain in making his chemical telegraphs and electric clocks in 1846 and then, from 1847, worked for the Electric Telegraph Company as a telegraph clerk. He joined the Great Western Railway in May 1855, quickly rising to become Superintendent of Telegraphs and Chief Electrician, devising an effective electric train controlling telegraph in 1863. Spagnoletti was also allowed to work on the signals of the Metropolitan Railway; his system permitted intense train working on the underground line. He retired from the Great Western in 1886 and became a Consulting Electrical Engineer advising the City & South London, Central London, Metropolitan and District Railway companies on introducing electric trains, and on electric lighting in London. His son, James, was also an electrical engineer.

William Suter (1824-1861)
A telegraph and cable engineer. Suter was born in Byfleet, Essex, and by 1851 was working on the railways as a platelayer. In August 1852 he was assisting one Wainwright, a contractor on the Great Northern Railway, then in January 1853 he was assistant to F C Webb of the Electric & International Telegraph Company, with whom he worked on the Hague cable and the landlines to Amsterdam in Holland, remaining in that role until July 1857. Suter then had a position on HMS *Agamemnon* in the laying of the first Atlantic cable, joining the British & Irish Magnetic Telegraph Company between 1857 and 1858, re-joining HMS *Agamemnon* for the second Atlantic cable expedition. In 1859 he was an engineer with the Mediterranean Extension Telegraph Company, repairing their cable between Cagliari and Malta. Later in that year Suter worked with Charles Bright and Latimer Clark in the Red Sea, attempting to restore the cables to India. He died at Aden in May 1861. Suter married his wife Emma in 1849, she and their children were left destitute on his death; an appeal on their behalf was made to the telegraph industry.

Thomas Bray Webber (1813-1896)
Superintendent of the Telegraphs on the South Devon Railway from 1848 until 1876. Born and died in Exeter in Devon, the son of a farmer, Webber managed the independent messaging and signal telegraphs of the railway until 1851 when the public circuits were absorbed by and then connected to the Electric Telegraph Company, and the remaining signal circuits until the South Devon was amalgamated with the Great Western Railway in 1876. The South Devon wires primarily worked Cooke & Wheatstone's two-needle instruments, but also trialled W H Hatcher's dial and W T Henley's magneto telegraphs before 1851. Later Webber practised as a telegraph engineer and apparatus maker in Exeter. He married Charlotte Dodd in 1836 with whom he had one son and five daughters. She died in December 1852. His son, Thomas George Webber, was trained as a telegraph clerk and engineer but emigrated to America in 1855, where he adopted the Mormon faith and made a considerable fortune in business in Utah.

---

f.] **Telegraphic Suppliers 1836 – 1870**

There were relatively few specialist suppliers of telegraphic materials, apparatus, insulators, and so on, in this period. In London during the 1850s there were only three suppliers of instruments; W T Henley, William Reid and John Sandys. This is a fairly complete list:

Alexander Bain & Company, 43 Old Bond Street, London: This, briefly, was the showroom for Bain's electric clocks during 1852 and 1853 just before his bankruptcy. His chemical telegraph instruments were manufactured by William Reid (q.v.). Bain had previously manufactured his own telegraphic apparatus at 11 Hanover Street, Edinburgh, Scotland, between 1844 and 1847. In 1860, just before he emigrated to America, he was living in Perceval Street, Clerkenwell Green, among the clock- and instrument-makers.

Joseph Bourne & Son, 126 London Wall & No 4 Wharf, south side, Paddington Basin, London, and Denby Pottery, Derbyshire: Stone bottle and jar manufacturers. They were one of earliest, largest and most enduring makers of stoneware insulators for the telegraph industry, commencing in this from before 1850. Patentees of the three-chamber kiln for stonewares, most notable for making bottles for blacking, inks and ginger beer; as well as teapots and jugs, in large volumes.

British Telegraph Manufactory, 172 Great Portland Street, London W, later 374 Euston Road, London NW: A partnership formed to manufacture Charles Wheatstone's Universal telegraph, automatic telegraph, exploder, clock and other instruments in 1870, as well as his original magnet-and-bell signal. It initially took over the workshops of Cornelius Ward, a renowned maker of musical wind instruments, before moving to the Euston Road in 1879. As the government appropriated the Universal telegraph its principal product was Wheatstone's Magnetic Clock. It became a joint-stock company in 1874 with a capital of £30,000; Wheatstone owning 1,010 of the 3,000 £10 shares on which £5 10s was paid-up. Latterly it produced the Gramme dynamo-electric machine and varieties of telephones. The manufactory closed in 1881. Robert Sabine, to be Wheatstone's son-in-law and executor, was manager, having been employed in Siemens & Halske's factories in Berlin since 1860, and Augustus Stroh was its engineer.

As well as Gramme dynamos, its product list in the 1870s included automatic telegraphs, sounders, cryptographs, magnetic exploders, lightning protectors, dial indicators, double current keys, testing keys, magnetic counters, magneto-electric clocks, type-printing receivers, portable or military magneto dial telegraphs, magneto dial telegraphs, resistances and switches.

Elliott Brothers, 268 High Holborn, London: Around 1804 William Elliott opened a scientific instrument shop in London. The firm became Elliott Bros. in 1853, and survived as a joint-stock company until 1966. Elliott Bros. supplied the Admiralty, Ordnance, India Board, and Board of Trade. William Elliott had specialized in drawing instruments. Elliott Bros. offered a wide range of mathematical, optical, and philosophical apparatus. After absorbing the firm of *Watkins & Hill*, in 1857, they increasingly focused on electrical instruments.

J & T Forster, india-rubber and gutta-percha manufacturers, Streatham Common, Surrey: Working in concert with C V Walker, W H Hatcher and the eminent civil engineer, W H Barlow, John and Thomas Forster originated the first successful process for covering copper wire with gutta-percha resin for insulation. This involved hot-pressing together two narrow sheets or fillets of gutta-percha, cowrie gum and sulphur through several rollers, compressing copper wires between them; the fillets being trimmed by the rollers and wound on to reels. It was patented on April 28, 1848, and the rights acquired by the Electric Telegraph Company, used by them and the South Eastern Railway in underground and underwater circuits. Forsters abandoned the cable-making business early in the 1850s when a more efficient process evolved, but continued to be successful in the resin business until the 1930s.

W M Foxcroft's Telegraph Case Manufactory, 54 Compton Street, Clerkenwell: Advertising single and double needle instrument cases, disc cases, Morse boards and Bell cases in stock. Also teak clock cases. This is a small example of the division of labour in mid-nineteenth century technology.

Glass, Elliot & Company, East Greenwich, London: They were initially created as Heimann & Küper, Grand Surrey Canal Basin, Camberwell, manufacturers of wire rope, in 1841 to work the patent of John Baptist Friedrich Wilhelm Heimann. As Heimann was a merchant in partnership with John George William Küper, it is likely that the patent for "untwisted wire rope" was a communication from Germany. They were one of the first manufacturers of wire rope in Europe, however the firm was declared insolvent in November 1846. New capital to continue the business was then provided by George Elliot and Richard Atwood Glass. It then traded as Wilhelm Küper & Company, with wire rope works still at Grand Surrey Canal Basin, Camberwell. Just after the Great Exhibition of 1851 the firm became Glass, Elliot & Company, 115 Leadenhall Street, City, with works at Camberwell and new premises at Morden Wharf, East Greenwich, as a partnership between Richard Atwood Glass, Ralph Glass and George Elliot. It began to cover the resin-insulated conducting wire for submarine telegraph cables with the 'armour' of iron wire in 1854, starting with a circuit from Denmark to Sweden. In the same year it undertook to make the long cables of French Mediterranean Telegraph Company of J W Brett. The cables it subsequently armoured proved to be remarkably long-lasting, not least because it introduced anti-corrosive compounds to coat the finished cable during the later 1850s. The firm merged with the Gutta-Percha Company in 1864 to form the Telegraph Construction & Maintenance Company; Richard Glass became its managing director.

Readers may be interested in this writer's short history of this company, it predecessors and its competitors, 'Troubled Parents' on the Atlantic Cable website.

Gutta-Percha Company, High Street, Stratford, then 18 Wharf Road, City Basin, London: Founded on February 4, 1845, proprietors of, among many other patents relating to gutta-percha wares, the patent machinery to coat wire with resin, which they acquired of Charles Hancock. In 1849 it supplied Siemens & Halske with hundreds of miles of wire insulated with "sulphuretted gutta-percha" for the Prussian government telegraph lines. It had a monopoly on insulating underwater cables until the 1860s when vulcanised india-rubber was applied for a period by other concerns. The Gutta-Percha Company manufactured a huge range of resin products, not just covering for telegraph wires, including "pump buckets and valves, tubing for conveying messages (Whishaw's principle), and for water, gas, oil, &c., driving bands, soles for boots and shoes, bowls, buckets, picture frames, brackets, mouldings, surgical instruments, vases, cups, inkstands, balls, &c." Its proprietor and manager in its early years was Henry Bewley who, it is claimed, fraudulently displaced the Hancock family interests to acquire the whole company. The Hancocks went on to found the neighbouring West Ham Gutta-Percha Company in 1850; the family were anyway better known and far more successful in the rubber industry devising most of the common techniques and equipment, including the 'masticator' and 'vulcanising', before merging with the legendary Macintosh to become the competitors in Britain of the Goodyear interests. The Gutta-Percha Company's chief personality in the 1850s was its superintendent, Samuel Statham. On his death in 1861 he was replaced by John Chatterton, whose *Chatterton's Compound* was to be vital in preserving underwater cables.

Readers may be interested in this writer's short history of this company, it predecessors and its competitors, 'Troubled Parents' on the Atlantic Cable website.

W T Henley's Telegraph Works Company, 27 Leadenhall Street, London EC, and North Woolwich (next to Silvertown), London: A joint-stock company succeeding William Thomas Henley's smaller works in the Minories in Stepney and his larger instrument factory at St John Street Road, Clerkenwell, all in London. W T Henley was an electrician, telegraph patentee and company promoter from the 1850s. He contracted for building overhead and underground lines for the South Eastern Railway and then for the Magnetic, London District and United Kingdom Telegraph Companies. The works commenced at Enderby's Wharf, East Greenwich, in 1857 and moved to North Woolwich in 1859. By the latter year Henley had constructed 5,000 miles of underground wire and 280 miles of submarine cable. The works manufactured instruments, insulators, metallic pipes and cables, contracting to build public and private circuits, and became a joint-stock company in 1874. The company was to become a leading maker and layer of submarine cables until it failed in 1876. The firm was reconstructed and continued to prosper under the same title well into the next century.

Hooper's Telegraph Works Company, 31 Lombard Street, London EC, and works at Millwall Docks, Isle of Dogs: William Hooper improved vulcanised india-rubber in 1859 and applied it to cable insulation. In 1870 he founded his cable-making company but originally, in the mid-1860s, he had offices at 7 Pall Mall East, London and works at the London India Rubber Mills, Mitcham, Surrey, making caoutchouc goods. His original india-rubber insulated cables of 1866 for India were manufactured by the India-Rubber, Gutta-Percha & Telegraph Works Company of Silvertown (q.v.). Hooper became a successful insulator of oceanic cables, working latterly with the Great Northern company in Europe and China in the 1870s and 1880s.

India Rubber, Gutta-Percha and Telegraph Works Company, 100 Cannon Street, City, and Silvertown, London; St Denis and Persan-Beaumont, France; and Menin, Belgium: Founded in 1864, a joint-stock company, it was an opportunist merger of several firms in the rubber and gutta-percha trade; not all connected with the telegraph industry. It included the original patentees of the wire-coating machine and their West Ham Gutta-Percha Co, and was led by Stephen William Silver. *S W Silver & Company,* of 66 Cornhill, City, (q.v.) founded by Stephen Winckworth Silver as makers of rubber-coated waterproof garments in 1840, gave their name to the company town in east London. Silver & Co had previously patented and provided caoutchouc insulation for the aerial cables of the Universal company, the caoutchouc insulation for the Southern Irish cable and patent "ebonite", vulcanised india-rubber, insulators in the early 1860s. The India-Rubber Company became an important supplier of insulation to the international submarine cable industry during the nineteenth century. It became British Tyre & Rubber in the 1930s and still survives (just).

Henry Izant & Company, 408½ Oxford Street, London and 24 Grosvenor Place, Queen Street, Pimlico: Telegraph Engineers, established in 1850, makers of all manner of electrical instruments, including detectors, American printers, double-needle, single-needle, and bell telegraphs, batteries, poles, arms, insulators, wire, brackets, shackles, tools and other stores. Izant was the principal maker of Spagnoletti's railway telegraph.

London Caoutchouc Company, 36, King Street, Cheapside, London with works in Holloway and Tottenham: A 'patent' company formed to work Robert William Sievier's processes for rubberising fabrics in 1836, caoutchouc being the original name for india-rubber. They were large-scale manufacturers of elastic driving bands for machinery, rope for mines, waterproof cloths and garments, and waterproof canvas, as well the first rubber-insulated wire used by Cooke and Wheatstone. It also made the first telegraph "cable" for Cooke in 1841. The Caoutchouc company was superseded in the later 1840s by the Hancock and Macintosh rubber interests, and their patent machinery. Its india-rubber cloth interests seem to have passed to S W Silver & Company of Cornhill, the rubber works in North London passed to and were continued by William Warne & Company.

R S Newall & Company, 130 Strand, London and Gateshead: Makers of wire-rope, and then for a period a major, if controversial, manufacturer of wire 'armouring' for submarine cables. Newall created the first successful underwater cable for the Submarine Telegraph Company between England and France in 1851. He claimed to have invented wire rope (untrue) and the submarine cable-laying apparatus. Although the first was an enduring success several of the many Newall cables subsequently failed, including those in the Channel Islands and the Levant - apparently due to the light weight of their armour. There were also criticisms of Newall's financial affairs. The firm left the submarine cable business with the failure of their 1858 Atlantic and Red Sea cables, and with the start of a court case over the sabotage of a competitive cable. Siemens Brothers acquired the good-will of their telegraphic cable business during 1860, after having been electrical advisors to the firm since 1858; although Newall returned to cable-making briefly in 1870.

Christopher Nickels & Company, 2 Guildford Street, 20 York Road, 17 York Street, Lambeth and a warehouse at 13 Goldsmith Street: Long-standing india-rubber manufacturers and patentees from the early 1830s. Nickels owned a share of Hancock's gutta-percha wire-covering machine and provided his first gutta-percha insulated telegraph wire for the South Eastern Railway Company in 1852, in a large quantity; it failed after two years. Nickels then manufactured underground (and, probably, submarine) gutta-percha insulated two core cables for the Electric Telegraph Company of Ireland whilst trading as the 'Gutta-Percha Company of Lambeth'. By 1855 the 17 York Street site in Lambeth (on the river Thames) had become the 'old' Electric Telegraph Company's Stores, when the firm appears to have merged into the original Gutta-Percha Company.

William Reid & Company, 25 University Street, London: Makers of scientific instruments from 1820, who became telegraph engineers, manufacturers of telegraph instruments, underground troughs, and so forth, in 1836 - the oldest telegraphic engineering firm, and one of the largest such, in Britain. The firm manufactured the initial commercial instruments for W F Cooke and Charles Wheatstone, subsequently providing equipment for the Electric, European, Submarine, Magnetic and other telegraph companies in Britain. Reid also manufactured electric clocks and chemical telegraphs to Alexander Bain's patents. The firm became *Reid Brothers* on March 28, 1856, comprising William Jnr, James and Robert Nichol Reid, prospering as electrical engineers for another sixty years. The firm had works in several locations, concentrating eventually at 12 Wharf Road, City Road, London NW, manufacturing electrical instruments and equipment in large quantities until they failed in January 1922.

The firm possessed a remarkable collection of some of the earliest telegraphic instruments which, by implication, they had made: including Bain's electric clock 1845, Cooke & Wheatstone's original two-needle telegraph 1843, Cooke & Wheatstone's original one-needle telegraph 1846, Nott & Gamble's dial telegraph 1846, Wheatstone's magneto & bell machine 1840 and Wheatstone's dial telegraph 1840.

John Sandys' Electric Telegraph Works, 72 Upper Whitecross Street, London: Electric telegraph instrument makers. John Sandys (1814-1857) was from the mid-1840s a clockmaker in partnership with John Watson, a cabinetmaker, becoming "telegraphic instrument makers and telegraphic engineers" at 72 Upper Whitecross Street, London, one of the first concerns to concentrate on telegraphic equipment. From December 24, 1851 he was trading on his own as an "electric telegraph instrument- and clock-maker". In 1852 his workshop in Upper Whitecross Street was employing fifty to sixty men in manufacturing needle telegraphs, time-transmitters, galvanometers, batteries and wire work, as well as large clocks. In addition to being a very large supplier of telegraph instruments to the Electric Telegraph Company he had a shop dedicated to making roof-top "time-balls". In the later 1850s he had developed pneumatic current reversing keys and was making American telegraphs, both for the Submarine Telegraph Company. Sandys' family and works moved to 158 Aldersgate Street, City, in 1856. When he died in 1857 his widow, Dora Elizabeth Sandys, attempted to continue the business; this failed on October 15, 1862. Mrs Sandys is the only known *female* "electric telegraph instrument manufacturer". Latterly her works manager was George William Guy.

Julius Sax, 108 Great Russell Street, Bloomsbury, London; Domestic telegraph instrument maker. Sax, born in 1825, emigrated from Sagarre (sic), Russia, to London in 1851 after apprenticeship as an optical instrument maker and working for Siemens & Halske in Berlin. He established his own philosophical instrument firm in 1855. Sax had workshops in several parts of London until, in 1864, he took premises at 108 Great Russell Street, where his firm remained for a half-century. He is best known for his domestic electric telegraph instruments, bells and alarms for houses, hotels and offices. His first domestic telegraph was introduced in 1864 and he patented several varieties of electric bell. Sax's bells were widely used in the head offices of banks and insurance companies in London from the mid-1860s but he did not provide messaging telegraph instruments in any quantity. Sax, a supplier to Michael Faraday, also made more substantial optical and electrical instruments, latterly manufacturing telephones as well as electric bells. He married in 1863 and had four children. After his death in August 1890 Julius Sax & Company became a joint-stock concern in 1892.

Siemens Brothers, 3 Great George Street, Westminster; Cable Works, Charlton Pier, Woolwich; Instrument Works, 12 Millbank Row, Westminster, and at Berlin and St Petersburg: Telegraph engineers and contractors. This partnership was the British arm of the Prussian electrical firm of Siemens & Halske who had pioneered the telegraph in Europe since 1849 and introduced gutta-percha insulation into Prussia, Denmark and the smaller German states. On the failure of its gutta-percha insulation system in 1851 the firm was excluded from the Prussian market for over ten years and from then concentrated on its works in Britain and Russia. In these countries it successfully introduced their improved American 'writer', their dial telegraphs, relays and current-reversing keys; in Germany its business was confined to water-metering equipment. Starting in London as an agency in 1851 represented by William Siemens, it became a joint-stock manufacturing firm as Siemens, Halske & Company in 1858. It latterly went into submarine cable works, which Halske thought too risky and the firm was reorganised as Siemens Brothers in 1865. The firm in the period described had disputes with the Elkingtons, M H Jacobi, Wheatstone, the Hancocks and others over electro-plating, telegraphic and insulation patents and origination of ideas. Siemens Brothers became involved in steel-making as well as having immense successes in electrical equipment and cable-making in Britain until 1935.

S W Silver & Company, 4 Bishopsgate Street, London, EC, and Silvertown: India-rubber manufacturers. The firm was founded in 1840 as waterproofers, making clothing, tents and paulins, mainly for emigrants and travellers. They acquired a new works at North Greenwich in 1852 and subsequently extended their india-rubber interests, becoming involved in electric telegraphy. Silvers' were the first to manufacture wire insulated with india-rubber in quantity. H A Silver perfected and patented in 1859 the process devised by Charles West in which three thin coverings of warmed, spiral-wound india-rubber were applied to the copper core to create the insulation; as part of their patent Silver's treated the copper wire with a gum lacquer to prevent any reaction with the india-rubber. The active partners by 1860 were Stephen William Silver and Hugh Adams Silver. John Fuller, who had previously been a junior engineer responsible for the Electric Telegraph Company's cables in London, was their manufacturing superintendent, telegraph engineer and electrician. The firm became the India Rubber, Gutta-percha & Telegraph Works Company in 1864 (q.v.).

Telegraph Construction & Maintenance Company, 54 Old Broad Street, City, and its wire-core works at Wharf Road, London, and armour works at East Greenwich: A joint-stock company, a merger of the Gutta-Percha Company and Glass, Elliot & Company on March 17, 1864. This company became manufacturers and layers of the majority of the world's oceanic submarine cables, totalling 250,000 miles, commencing with the Atlantic cables of 1865-6, when it provided much of the capital for the near-bankrupt Anglo-American Telegraph Company. It survived until 1935 as TELCON.

M W Theiler & Sons, 156 Barnsbury Road, Islington: Telegraph and scientific instrument makers. Meinrad Wendel Theiler had been employed in managing the Swiss state telegraph workshops. In 1854 he visited London to patent a new type-printing telegraph and stayed to develop an improved American telegraph for the Electric Telegraph Company, which he patented. Encouraged by this Theiler returned with his family in 1861 and set up a manufactory in north London. Here he and his sons, Richard and Meinrad Jnr, produced portable single-needle instruments, American inkers, American embossers, keys and relays, alarms, and galvanometers. The firm flourished and was eventually absorbed into Elliott Brothers in 1891.

Tupper & Company, Galvanized Iron Works, 6 Berkeley Street, Broad Street, Birmingham, and at Limehouse, Regent's Canal, London: Formed by Charles William Tupper in 1844 as the 'Galvanized Iron Company' with offices at 3 Mansion House Street, London, to work a patent protecting iron plate and iron wire with a zinc coating. W F Cooke was a partner-shareholder. Tupper & Co were the original manufacturers of galvanized iron wire for telegraphy, and continued to do so for several decades. In the 1860s the London office was at 61A Moorgate Street, City. C W Tupper was to be a founding director of the Atlantic Telegraph Company.

Frederick George Underhay, Crawford Passage, Clerkenwell, London EC: engineer and brass founder, maker of C F Varley's complex valves to manage the Electric Telegraph Company's "air circuits" or pneumatic tubes that connected their city offices in London, Manchester, Birmingham and Liverpool from 1862. Underhay was far better known as a maker of patent regulator water closets and gas meters which business he carried on for over 50 years. He also produced the mechanism for "The Crank" or "hard labour machine" used in prisons.

William Marston Warden & Company, 27 Great George Street, Westminster SW and Edgbaston Street, Birmingham: Electric telegraph contractors, manufacturers of wire, instruments, batteries and all kinds of telegraphic apparatus and stores. The firm constructed overhead telegraphs overseas in the Channel Islands, Russia and in India during the 1860s. Latimer Clark and John Muirhead Jnr were W M Warden's technical advisors, and latterly took over the firm. Eventually it became Muirhead & Company. Cited here as a typical general supplier of the 1860s.

Watkins & Hill, 5 Charing Cross, London - scientific and philosophical instrument makers: Established in 1747, by the 1830s it was a partnership between Francis Watkins and William Hill who both died in 1847, leaving their workshops to be managed for their families by Abraham Day. Watkins & Hill made the experimental models of Wheatstone's early needle and dial telegraphs in their small workshop of between four and six craftsmen. In addition the firm made and sold all manner of optical and electrical apparatus, miniature steam engines, hydraulic presses, magneto-electric machines, theodolites and cameras, utilising nearly sixty outworkers or sub-contractors. They were taken over by Elliott Brothers in 1857, who continued and expanded their electrical and magnetic instrument business.

Welch & Berthan, Eden Works, 306 Euston Road, London NW; Electricians, telegraph engineers and contractors. Manufacturers of dial telegraphs as well as electric bells for domestic and engine purposes, electric bells to protect against thieves for doors, windows, gates and closets self-acting against burglars, ringing secretly with secret switches, and electric thermometers against fire or frost. This seems to be a typical middle-sized firm that also supplied iron piping, brass work and bicycle velocipedes in the 1860s.

Wells & Hall (aka Hall & Wells), 60 Aldermanbury, City EC, and Steam Mills, (later Telegraph Works) Mansfield Street, Southwark, London; A partnership between Walter Hall and Arthur Wells, originally as india-rubber web manufacturers from the mid-1840s, they patented a method of spirally winding india-rubber around copper cores and of making hemp-bound cables in 1858. The firm made india-rubber insulated wire and cable for over two decades, although the partnership was dissolved in September 1867. Walter Hall continued in the india rubber web and telegraph cable business at Southwark until May 1879, when he failed. Their main customer was the British Army for whom they made field electric telegraph cable.

West Ham Gutta-Percha Company, Abbey Road, West Ham, Stratford, Essex, and then, from 1858, West Street, Smithfield, London: Manufacturers of telegraph wire covered with gutta-percha using Charles Hancock's patent wire-covering machine of 1848, as well a range of gutta-percha products. It was formed in July 1850 when Hancock left the original Gutta-Percha Company. Charles Hancock was the managing director and John Branscombe was manager until it eventually became a component of Silver's Telegraph Works Company when that firm was created in 1864.

James White, 95 Buchanan Street, Glasgow: Founded by an optician in 1849, who became instrument maker to Glasgow University. White is famous for making the electrical instruments devised by William Thomson (Lord Kelvin), including the mirror-galvanometer used on the Atlantic cables of 1858 and 1866. The firm later became Kelvin & White. He is one of the few manufacturing instrument makers outside of London.

This list of the major telegraphic suppliers is drawn from contemporary articles and advertisements up to 1870. Incidentally, the major potters in England all produced earthenware or 'porcelain' insulators for the telegraph companies.

---

g.] **Telegraph Companies in Great Britain incorporated by Special Act of Parliament**

The following is a list of all Bills deposited with Parliament to form a telegraph company, along with the date recorded on their initial application, until 1870 according to the 'London Gazette'; those marked with an asterisk* were either abandoned or rejected:

Electric Telegraph Company
February 16, 1846

British Electric Telegraph Company
November 14, 1849

Magneto Electric Telegraph Company
November 12, 1850

European & American Electric Printing Telegraph Company
November 14, 1850

Submarine Telegraph Company between Great Britain and Ireland
November 14, 1850*

Submarine Telegraph Company between England and France
November 15, 1850*

United Kingdom Electric Telegraph Company (1)
November 25, 1850

Irish Sub-Marine Telegraph Company
March 9, 1852

Electric Time Company
November 1, 1852*

Electric Telegraph Company of Ireland
November 25, 1852

Universal Electric Telegraph Company
November 9, 1853*

Atlantic Telegraph Company
November 13, 1856

European & Indian Junction Telegraph Company
November 13, 1856

Red Sea & India Telegraph Company
November 8, 1858

Indian & Australian Telegraph Company
November 15, 1858*

London District Telegraph Company
November 17, 1858*

Great Indian Submarine Telegraph Company
November 10, 1858*

British & Canadian Telegraph Company
November 15, 1858

Universal Private Telegraph Company
November 6, 1860

Bonelli's Electric Telegraph Company
November 27, 1860

United Kingdom Electric Telegraph Company, Limited (2)
November 8, 1861

United Kingdom Electric Telegraph Company, Allan's (3)
November 11, 1861*

General Electric Telegraph Company
November 16, 1861*

National Telegraph Company
November 11, 1861*

Private Telegraph Company
November 12, 1862*

Globe Telegraph Company
November 9, 1863

Economic Telegraph Company
No date of deposit, but in 1866

The following is a complete list, including the intercontinental cables, of telegraph companies actually formed through statutory incorporation and any subsequent amending legislation from official records of Parliament contained in the *Index to the Statutes* up to 1871 with additional commentary by the writer and explanations of obvious omissions. The necessity for Special Acts is explained in Appendix *k*;

Anglo-American Telegraph Company
(see Atlantic Telegraph Company)

Atlantic Telegraph Company
Incorporation of Co.
20 & 21 Vic. cap. cii 1857
Preference Capital
21 & 22 Vic. cap. cxlviii 1858
Borrowing Powers
22 & 23 Vic. cap. xxiii 1859
Additional Capital
30 & 31 Vic. cap. xxviii 1867
Dissolution of Company and merger with Anglo-American
33 & 34 Vic cap. xcix 1870

A company formed to lay the cable between Ireland and Newfoundland: its several Acts primarily affected its ability to raise additional capital. Its cable rights were transferred subsequently to the circuits financed and laid by the Anglo-American company.

Bonelli's Electric Telegraph Company
Acquisition and working of patents
24 & 25 Vic. cap. xcii 1861
Powers of Co., &c.
26 & 27 Vic. cap ccxii 1863

A domestic company formed to work Gaetano Bonelli's printing telegraph, and which built a single public line. It was inactive by 1868; even so it was appropriated by the government under the Telegraph Acts.

British & Canadian Telegraph Company
Incorporation
22 & 23 Vic. cap. cvi 1859
Further Powers
29 & 30 Vic. cap. xciv 1866

A company formed to lay the so-called "Northern Line" to America in a chain of cables from the mainland of Britain to the mainland of Canada by way of the Orkney & Shetland Islands, the Faroe Islands, Iceland and Greenland. It was rendered superfluous by the success of the Atlantic Telegraph Company's lines of 1866.

British Electric Telegraph Company
Regulation,
13 & 14 Vic. cap. lxxxvi 1850
Working of patents, &c.
16 &17 Vic. cap. clix 1853

A domestic company formed to purchase and work the patents of Edward Highton; it altered its title to the *British Telegraph Company* on receiving a Royal Charter in 1853. It united with the European company in 1853, and with the Magnetic company in 1857 to create the *British & Irish Magnetic Telegraph Company.* As the Joint-Stock Limited Liability Acts from 1855 generally regulated capital powers no further Special Acts were required.

Economic Telegraph Company
Re-incorporation and powers,
29 & 30 Vic. cap. clxxxv 1866

A company re-incorporated from a previous registration. It experimented with public lines but ended up as working a few private wires. It was still acquired under the Telegraph Acts as a possible competitor.

Electric Telegraph Company
Formation, &c.
9 & 10 Vic. cap. xliv 1846
14 & 15 Vic cap. lxxxvi 1851
(both repealed by the 1853 Act)
Additional Powers
16 & 17 Vic. cap. cciii 1853
17 & 18 Vic. cap. cciii 1854
Consolidation of stock with the International Telegraph Co.'s capital stock
18 & 19 Vic. cap. cxxiii 1855

The original and by far the largest domestic telegraph company, formed to work the master patents of Cooke & Wheatstone, by which it had a monopoly of public telegraphy between 1845 and 1851. The subsequent Special Acts were to increase and reorganise its capital-raising powers. The 1851 Act divided its £100 shares into four £25 shares. The 1854 Act provided the shareholders with limited liability. The Act of 1855 authorised a merger with its foreign subsidiary, the *International Telegraph Company,* which had cables to Europe.

Electric Telegraph Company of Ireland
Formation, &c.
15 & 16 Vic. cap. cxxiii 1853

A company, unconnected with the original Electric concern, formed to make a line from Dumfries in Scotland to Belfast and Dublin in Ireland. Although it completed many of its land lines its underwater cables failed and it was wound-up in 1856, the works being abandoned.

(Note: the coincidental "chapter" numbers for the above two companies' 1853, 1854 and 1855 Acts are just that, coincidences! It confused the compiler of the *Index to the Statutes* as well as this writer)

European & American Electric Printing Telegraph Company
Incorporation, &c.
14 & 15 Vic. cap. cxxxv 1851

A domestic company ostensibly formed to acquire and work the patents owned by Jacob Brett (i.e. the printing telegraph of Royal Earl House). It was in fact a creation of the *Submarine Telegraph Company between England and France*, a French concern having the cable concession for France, to allow it to connect its cables with lines to British cities and towns. Its capital and business was acquired by the *British Telegraph Company* in 1853.

European & Indian Junction Telegraph Company
Incorporation, &c.
20 & 21 Vic. cap. xc 1857

The sole foreign overland, rather than underwater cable, telegraph company authorised by Parliament was formed to connect planned (but never laid) submarine cables in the Mediterranean Sea at Seleucia across the Ottoman Levant to the East India Company's cables in the Persian Gulf at Kornah. The Special Act allowed a subsidy from the Treasury. There was an abortive railway covering the same route and it did not build its line either.

Globe Telegraph Company
Powers
27 & 28 Vic. cap. cl 1864
The Globe was an abortive domestic concern formed to work Henry Wilde's electro-magnetic dial apparatus. It was unrelated to John Pender's *Globe Telegraph & Trust Company* of 1873, a long-lasting investment vehicle for financing foreign cables.

International Telegraph Company
See Electric Telegraph Company

Magnetic Telegraph Company
Incorporation, &c.
14 & 15 Vic. cap. cxviii 1851

A domestic company formed to acquire and work the patents of W T Henley; it subsequently acquired other patents, particularly those owned by C T Bright. It altered its title on receiving a Royal Charter in 1852 to the *English & Irish Magnetic Telegraph Company.* It laid the first domestic cable between Britain and Ireland in 1853. It merged with the British Telegraph Company in 1857 to form the *British & Irish Magnetic Telegraph Company,* the country's second largest domestic company, and the principal advocate of submarine telegraphy.

Red Sea & India Telegraph Company
Incorporation
22 & 23 Vic. cap. iv 1859
Amendment of preceding Act
24 & 25 Vic. cap. iv 1861
Arrangements with Treasury
25 & 26 Vic. cap. xxxix 1862

A cable company formed to lay a series of inshore submarine wires from Suez around Aden to the Persian Gulf, connecting the British governments' Malta and

Alexandria cable with India. Its Special Acts allowed a subsidy of the Treasury. The cables failed after a short period in 1861; as the circuits had actually worked for a period the Act compelled the subsidy to continue even though the circuit was dead, causing a political scandal.

Submarine Telegraph Company
Although the promoters lodged a Bill in Parliament to raise £200,000 in April 1851 for a circuit from England to France it was abandoned on June 2, 1851 and the 'French' company proceeded without an Act. The second or 'Belgian' Submarine Telegraph Company obtained a Royal Charter, an administrative rather than legislative process. They worked as one concern, with continental cable-landing concessions that eventually expired in 1890, when the government acquired its remaining assets for a small sum.

United Kingdom Electric Telegraph Company
Purchase of Patents
14 & 15 Vic. cap. cxxxviii 1851
Power to carry on business
25 & 26 Vic. cap. cxxxi 1862

A domestic company originally formed to acquire and work the patents of Thomas Allan; it was dormant for ten years until revived in 1861, when it abandoned, without use, Allan's apparatus for the American telegraph, which it continued to use in many of its circuits to the end. It famously adopted the type-printing telegraph of David Hughes in 1862 for its longest, busiest lines. Vigorous opposition from the existing companies required a second Special Act for it to lay wires alongside of public roads without challenge.

Universal Private Telegraph Company
Incorporation, &c.
24 & 25 Vic. cap. lxi 1861

A domestic company formed to acquire and work patents granted to Charles Wheatstone and to use such apparatus to connect private subscribers. It had powers to work public telegraphs so was appropriated by the government.

---

h.] **Telegraph Companies in Great Britain incorporated by Royal Charter on the advice of the Board of Trade and the Colonies**

The charter allowed these companies joint-stock limited liability for their capital but few powers within Britain.

The Submarine Telegraph Company between Great Britain and the Continent of Europe
Charter applied for on February 18, 1851 and granted on April 14, 1851 – for the cable between England and Belgium

The English & Irish Magnetic Telegraph Company
Charter applied for on February 20, 1852 and granted on April 5, 1852 – primarily altering the name of the Magnetic Telegraph Company

The Irish Sub-Marine Telegraph Company
Charter applied for on March 9, 1852 and granted on May 15, 1852 – for a cable between North Wales and Ireland. The hyphen is deliberate

The British Telegraph Company
Charter applied for on December 30, 1852 and granted on June 13, 1853 – giving limited liability to the shareholders in the British Electric Telegraph Company, changing its name and authorising the laying of cables to Ireland

The International Telegraph Company
Charter applied for on October 21, 1852 and also granted on June 13, 1853 – for the cable between England and Holland

also

The United Kingdom Electric Telegraph Company
Applied for a Charter on April 3, 1852 but withdrew

The Telegraph Company
Applied for a Charter on January 6, 1854 but withdrew

---

i.] **Government Acts affecting the Telegraphs**

Regulation of Railways Act 1844
7 & 8 Vic. cap. lxxxv 1844

Clauses in this Act obliged railways companies to allow access to and permit laying of electric telegraphs alongside of their lines, with priority for government service, subject to payment; otherwise to treat all public messages over these circuits on equal terms.

Enacted before the creation of telegraph companies, until 1863 this was the only legislation affecting telegraphy. Its only actual affect was to compel the companies to carry government messages in emergency; but the state had to pay for the service, the cost of which, apparently, came as a shock.

Telegraph Act, 1863
Regulating powers and works
26 & 27 Vic. cap. cxii 1863

This Act applied to all future and existing telegraph companies authorised by Special Act, except as far as it countered any existing Special Act.
1 It gave general authority for telegraph wires underground, overhead and over or under buildings and by roads, railways or canals, with restrictions as below.
2 The companies might alter gas and water mains but only with permission and superintendence.
3 It required the laying of underground wires in the Metropolis or towns over 30,000 population where the public authority so insisted, and that notice be given to the street or road authority and the sewerage and drainage authority of any such works.
4 It required notice be given to the street or road authority and to occupiers of adjacent parks or mansions where overhead wires were to be erected.
5 The companies might open-up public roads and streets but only with notice and under superintendence of the authority, except in emergency, and make-good and maintain the work for six months.
6 The companies might affect private land or buildings (access or over-running) only by consent. Poles might not be set-up within 10 yards of such without consent of the occupier (not owner). The companies must publish notice of intent of work.

7 Subsequent alterations to roads, buildings, etc., affecting the wires required the company to move or remove the wires once given notice.
8 The companies might not place any work under, in, upon, over, along or across any railway or canal with out consent, except when following a public road or street.
9 The companies might not place work along any seashore without consent, and without notice to the Board of Trade.
10 The lines of the companies must be open to all messages without preference; the sale of a company or its works was prohibited without consent of the Board of Trade, except for the privately-used works of the UPTC and other company's on lease.
11 The government was to have powers for message preference. The Queen was to have the telegraph for her exclusive use provided at cost.
12 The government was to have powers to take possession of the works in emergency by authority of the Secretary of State.
As with other statute-regulated utilities the annual dividend was limited.

Telegraph Act Amendment Act, 1866
Additional minor regulations
29 & 30 Vic. cap. iii 1866

This Act gave authority to the Lord Lieutenant of Ireland to take possession of works. The powers of 1863 Act now applied to all incorporated companies. Railway companies might erect and work private telegraphs between coal-pits, ironworks, factories, warehouses and offices in connection with the stations of the company or over their line.

Telegraph Act, 1868
Enabling the Postmaster General to acquire, work and maintain electric telegraphs as a monopoly
31 & 32 Vic. cap. cx 1868

As this Act determined the final moment of the public domestic telegraph companies it is appropriate here to record the précis published in *Bradshaw's Railway Manual, Shareholders' Guide, and Official Directory for 1869* of what it termed the Telegraph Purchase Act 1868:

"This Act, which received the royal assent on July 29, 1868, carries out in twenty-four sections, and sets forth the recital in the preamble that the means of communication within the United Kingdom are insufficient, that many districts are without it, and that it would be attended with great advantage to the State as well as to merchants and traders, and to the public generally, were a cheaper, more widely extended, and more expeditious system of telegraphy established, and to that end the Postmaster-General is empowered to work telegraphs in connection with the administration of the post- office."

"The uniform rate, subject to regulation, of message throughout the United Kingdom, and without regard to distance, is to be at a rate not exceeding 1s for the first 20 words and not exceeding 3d for each additional five words or part of five words. The Postmaster-General is authorised, with the consent of the Treasury, 'out of any moneys which from time to time may be appropriated by Act of Parliament, and put at his disposal for that purpose, to purchase for the purpose of this Act the whole or such parts as he shall think fit of the undertaking of any company'. Telegraph companies are empowered to sell their undertaking, under certain conditions specified, with a provision as to the appointments of their servants by the government, or compensation by way of annuity."

"The Postmaster-General is to enter into contracts with certain railway companies mentioned in the Act, and very specific directions are given as to such acquisition."

"The Postmaster-General is to transmit to their destination all messages of a railway company in any way related to the business of the company in the United Kingdom free of charge. All matters of difference between the Postmaster-General and the railway companies are to be settled by arbitration."

"The sums to be received by the directors of Reuter's Telegram Company are to be applied in the first instance to the payment of the debts and liabilities of that company."

"There are provisions in the statute to enable the Postmaster-General to acquire the right of way over canals."

"Special agreements may be made with newspaper proprietors and with the occupiers of news-rooms, club, or exchange-rooms, to transmit messages at a rate not exceeding 1s for every 100 words between nine o'clock a.m. and six o'clock p.m., and a special use of a wire to be obtained under regulations, without undue priority or preference; messages having priority are to be specially marked, and all telegraphic messages are to be paid by means of stamps, and such stamps are to be kept for sale to the public at offices under the control of the Postmaster-General, to be appointed for that purpose."

"It is constituted a misdemeanour in any person having official duties to disclose or to intercept messages."

"Copies of all contracts and agreements made under the Act are to be laid before Parliament."

"In the schedule annexed to the Act thirteen agreements with railways and telegraph companies are referred to, subject to the approbation of Parliament, and it declares it to be expedient that agreements should be made with other railways set forth, including the Metropolitan District. Three months' notice is to be given by the Postmaster-General to the companies."

"By the statute the Postmaster-General, with the approbation of the Treasury, can purchase the undertakings of telegraph companies, but no purchase or agreement to purchase is to be binding, unless the same has been laid for one month on the table of both Houses of Parliament without disapproval. The concluding enactment is to the effect that if no Act be passed in the next session of Parliament placing at the disposal of the Postmaster-General such moneys as may be requisite for carrying into effect the objects and purposes of the Act, then the agreements made to be void, and the Postmaster-General to pay the expenses incurred."

Telegraph Act, 1869
Authorising expenditure for purchase of telegraphs
32 & 33 Vic. cap. lxxiii 1869

The government omitted to include any financial clauses in the Act of 1868, so had to return to Parliament the following year for a money Act.

The Schedule attached to the Telegraph Act 1869 contained the following amounts that the Post Office anticipated paying to create a telegraph monopoly:

Electric & International Telegraph Company
£2,938,826 9s 0d
British & Irish Magnetic Telegraph Company
£1,243,536 0s 0d
Reuter's Telegram Company
£726,000 0s 0d
United Kingdom Electric Telegraph Company
£562.264 9s 11d
Universal Private Telegraph Company
£184,421 10s 0d
London & Provincial Telegraph Company
£60,000 0s 0d

Total: £5,715,048 8s 11d

These were the only figures presented to Parliament for approval. The detail of the odd pence in these costs contrasts with the blithe absence of any costs applicable to buying out the public telegraphs owned and worked by railway companies, or for the wayleaves or rights-of-way on which the telegraph depended.

Belatedly, on April 15, 1869, the Post Office acknowledged that its monopoly powers extended to the acquisition of the powers previously vested in fourteen Acts of Parliament, which might otherwise be resurrected:

British Electric Telegraph Company Act 1850
British Electric Telegraph Company Act 1853
Bonelli's Electric Telegraph Company Act 1861
Bonelli's Electric Telegraph Company Act 1863
Electric Telegraph Company of Ireland Act 1853
Electric Telegraph Company Act 1853
Electric Telegraph Company Amendment Act 1854
Electric Telegraph Company Consolidation Act 1855
Economic Telegraph Company Act 1866
Globe Telegraph Company Act 1864
Magnetic Telegraph Company Act 1851
Universal Private Telegraph Company Act 1861
United Kingdom Electric Telegraph Company Act 1851
United Kingdom Electric Telegraph Company Act 1862

The Post Office had gratuitously ignored several of these Acts it in its drive for the monopoly, and would require additional public money to buy them out.

Telegraph Acts Extension Act, 1870
Purchase of domestic cable companies
33 & 34 Vic. cap. lxxxviii 1870

By this Act the government acquired all the separate companies owning the domestic cables to Britain's off-shore islands. It had already authorised the consolidation of the ownership of the many British continental cables into the existing *Submarine Telegraph Company*, now a regulated monopoly, deferring the purchase of that concern until 1890 when its French and Belgian concessions finally expired.

---

j.] **Significant Patents**
This is not comprehensive; it only lists the important apparatus *used* by the telegraph companies and their most important material suppliers in Britain and any significant alternatives.

English patents were numbered consecutively until October 1852, when the number series restarted annually. Until that year separate, differing patent regulations applied in Scotland and Ireland.

Cooke & Wheatstone's Patents - assigned to the Electric Telegraph Company on its establishment in 1845.

Patent 7,390/1837 - signals and alarums (Joint)
Patent 7,614/1838 - signal and alarums (Cooke)
Patent 8,345/1840 - signals and alarums (Joint)
Patent 9,022/1841 - magneto-electricity (Wheatstone)
Patent 9,465/1842 - telegraph wires (Cooke)
Patent 10,655/1845 - electric telegraphs (Joint)

Thomas Allan's Patents
Patent 13,352/1850 – electric telegraph
Patent 1,889/1853 – light cable

William Andrew's Patents
Patent 228/1859 – electric telegraphs, "pump" key
Patent 2,548/1860 – insulators, resin
Patent 710/1861 – insulators, ceramic and resin
Patent 1,620/1863 – sheds or covers for insulators

Alexander Bain's Patents
Patent 8,783/1841 - electric clock
Patent 9,204/1841 - printing telegraph
Patent 9,745/1843 - chemical telegraph, clocks
Patent 10,450/1844 - clock, log, depth sounder
Patent 10,838/1845 - clocks and telegraphs
Patent 11,480/1846 - chemical telegraph
Patent 11,584/1847 - electric clocks

Frederick Collier Bakewell's Patent
Patent 12,352/1848 - copying telegraph

William Henry Barlow and Thomas Forster's Patent
Patent 12,136/1848 gutta-percha insulation

Gaetano Bonelli's Patent
Patent 861/1860 – typo-telegraph

Jacob Brett's Patents
Patent 10,939/1845 –printing telegraph
Patent 12,054/1848 – printing telegraph

Charles Tilston Bright's Patents
Patent 14,331/1852 – instruments & apparatus
Patent 2,103/1855 - bell telegraph
Patent 2,610/1858 - double shed insulator

Edwin Clark's Patent
Patent 13,336/1850 – metallic-shed insulator

Latimer Clark's Patents
Patent 212/1854 – pneumatic message tube
Patent 1,641/1857 – pneumatic message tube
Patent 2,831/1856 – bell insulator

Edward Davy's Patent
Patent 7,719/1838 – telegraphic communication

George Edward Dering's Patents
Patent 13,427/1850 – intelligence by electricity
Patent 1,909/1853 – electric telegraphs

Edward Highton's Patents
Patent 12,039/1848 – electric telegraph
Patent 12,929/1850 – electric telegraph
Patent 13,938/1852 – electric telegraph

David Edward Hughes' Patents (UK)
Patent 938/1858 – printing telegraph
Patent 241/1863 – printing telegraph

Charles Hancock's Patent
Patent 12,223/1848 – gutta-percha insulation

William Thomas Henley's Patents
Patent 12,236/1848 – magneto telegraph
Patent 185/1853 – magneto telegraph
Patent 1,779/1853 - spilt pipes for cables
Patent 734/1861 – magneto-dial telegraph
Patent 2,464/1861 – magneto-dial telegraph

William Reid's Patents
Patent 11,974/1847 – electric telegraphs
Patent 14,166/1852 – troughs for cables

John Obadiah Newell Rutter's Patent
Patent 11,762/1847 – electric burglar and fire alarm

Charles Shepherd's Patent
Patent 12,567/1849 – working clocks by electricity

Ernst Werner Siemens Patent
Patent 13,062/1850 – galvanic dial telegraph

Charles William Siemens Patent
Patent 512/1859 – magneto dial telegraph

The above are just two of more than 200 patents obtained by the Siemens in Britain.

H A & S W Silver's Patents
Patent 951/1859 – india-rubber insulation of wire
Patent 3,331/1862 – electrical insulation

Meinrad Wendel Theiler's Patents
Patent 1,110/1854 - type-printing telegraph
Patent 2,453/1857 - direct printing telegraph
Patent 2,147/1861 - improved type-printing telegraph

Edward Tyer's Patents
Patent 13,906/1852 – railway and signal telegraphs
Patent 52/1854 – giving signals on railways
Patent 2,895/1855 – railway and signal telegraphs

Cromwell Fleetwood Varley's Patents
Patent 371/1854 – double current & key relay
Patent 1,318/1855 – translator relay
Patent 3,078/1861 – double-shed insulator

Charles Samuel West's Patents
Patent 2,321/1858 – insulating and covering wire
Patent 1,806/ 1861 - insulating and covering wire
Patent 194/1862 – improvements in insulation

Charles Wheatstone's Patents
Patent 1,239/1858 - automatic telegraph
Patent 1,241/1858 - Universal telegraph
Patent 2,462/1860 - telegraph, aerial cable
Patent 220/1867 - electric telegraph
Patent 2,897/1870 - automatic telegraph
Patent 2,172/1871 – miniature type-printer (with Augustus Stroh)

*Francis Whishaw's Registered Designs (*not *Patents)*
Design 1,454/1848 – Telekouphonon
Design 1,477/1848 – Uniformity of Time Indicator
Design 3,046/1851 – Telekouphonon

For comparison:
Cooke & Wheatstone's Patent (US)
Patent 1,622/1840 – electric telegraph

This was W F Cooke's and C Wheatstone's one and only patent in America; they sold-off a half-interest. The Western Union Telegraph Company was to acquire the rights to Wheatstone's automatic telegraph in 1874.

Alexander Bain's Patents (US)
Patent 5,957/1848 – chemical telegraph
Patent 6,328/1849 – fast telegraph
Patent 6,837/1849 – chemical telegraph
Patent 7,406/1850 – chemical telegraph

The first and third of these Bain patents in the United States were as his English patents of 1843 and 1846. The patent of 1850 was in the name of Henry J Rogers and introduced the disk receiver, the commonest Bain telegraph. Although all of these were challenged by the Morse Syndicate they were confirmed by the US Supreme Court.

S F B Morse's Patents (US)
Patent 1,647/1840 – telegraph
Patent 3,316/1843 – wire in pipes
Reissue 79 in 1846 of 1840 patent
Patent 4,453/1846 – telegraph
Reissue 117 in 1848 of 1846 patent
Patent 6,420/1849 - chemical telegraph

The technical elements of Morse's 1840 patent were never used commercially, but his general claims were used in an attempt to establish a monopoly in the United States. A provisional patent was also obtained in France on October 30, 1838, two years before that in America; no other country recognised his original claims. Morse's patent of 1846 was the first to detail the elements of the enduring *American telegraph*, the key, the register or recorder and the relay, which was used world-wide. The 1849 patent was a cynical device to counter Bain.

Royal Earl House's Patents (US)
Patent 4,464/1846 – printing telegraph
Patent 9,505/1852 – printing telegraph

R E House was obstructed in his patent applications by the Morse Syndicate. Jacob Brett had already patented House's initial apparatus in England during 1845. The second instrument, "the most ingenious and beautifully constructed printing telegraph" (Marshall Lefferts, 1856), was in use on major circuits in America by 1850.

David Edward Hughes' Patents (US)
Patent 14,917/1856 – printing telegraph
Patent 22,770/1859 – printing telegraph

Hughes was born in London of Welsh decent but lived his early life in the United States before returning to live in France in 1857. The Hughes apparatus was successively improved by Gustave Froment in France and Werner Siemens in Germany. Although adopted worldwide during the 1870s it was scarcely used in the United States.

---

k.] **British Legal Context:**

Periculum privatum utilitas publica!
'At private risk for public service',
the motto of the Stockton & Darlington Railway Company of 1818

The Statutory Company - The majority of the companies mentioned here were each created under a Special Act of the British Parliament that defined their capital, structure, activities and legal powers. The use of the Special Act procedure was necessary for several reasons: 1] until 1856 this was the principal way in which joint-stock shareholder *limited liability*, where the proprietor was liable *in extremis* only to the nominal value of their share, could be acquired and 2] that the powers these companies required affected the public domain to which Parliament had to assent to and regulate. The procedure gave *statutory companies* considerable legal powers, particularly over property. They were granted, in effect, the power of Parliament to override private and municipal interests. With such security these companies were the only ones enabled to raise mass capital. The powers granted were contended in Parliament, although the legislature had no further effect on their management.

Many hundreds of statutory companies were created and directly regulated by Parliament in the 18th and 19th Centuries, occupying an enormous amount of legislative time. Railways, Canals, Gasworks and Waterworks were the principal statutory incorporations, as well as public trusts for turnpike or toll roads. Insurance, Cemetery and companies to work various Patents were among the others.

Where capital has been mentioned in this text generally it refers to the amount authorised by Parliament for issue to shareholders. Until 1855 the maximum amount was fixed and could only be altered by further application to Parliament. In addition to this sum statutory companies were commonly authorised to issue debentures (bonded debt) up to one-third of the value of the issued share capital.

The capital raised could *only* be used for the authorised purpose - which was rarely varied by Parliament. A company authorised to build a railway, for example, could not expend the money it raised on ships, gasworks or public telegraphs.

The statutory companies did not have common constitutions apart from a selection from some standard clauses inserted from those previously authorised. Financial reporting was basic. Essentially each company had to have two auditors and hold one annual general meeting for its proprietors. Information for shareholders and the public was generally limited to a statement of account from the auditors without detail or commentary. The statement was not to a format and even the account categories varied from year to year (i.e. as the auditors changed) – making real comparison of performance (and honesty) difficult. The statutory general meetings were an opportunity for shareholders to obtain answers from the board of directors; but the press were often excluded. Information from companies regarding performance generally became available when they were about to go to Parliament for permission to raise further capital or in answer to some crisis publicised in the press.

The company was controlled by a Board of Directors elected by all of the shareholders; directors retired in rotation year by year but were eligible for immediate re-election. They were responsible for every matter, however trivial; authorising, at least in theory but often in practice, every expenditure and every appointment. The directors were usually the largest shareholders in the company. The decisions of the Board were communicated by the Secretary, the most important salaried official. All other management appointments and their tasks were at the whim of the Board.

The Charter Company – Some proprietors might apply to the government, actually to the Board of Trade & Colonies, for a grant of a Royal Charter for their enterprise. This gave certain privileges – in particular joint-stock *limited liability* - to the proprietors. Commercially the grant of a Charter was most often granted to "trading" concerns, shipping firms and colonial companies whose work did not require particular powers in Britain or otherwise need protective legislation. A Charter was also used to secure charitable and academic institutions with substantial capital; with the advent of general limited liability for companies in 1855 this became the primary use of the privilege.

Five public telegraph companies each obtained a Royal Charter; the Submarine, the English & Irish Magnetic, the Irish Sub-Marine, the British, and the International.

The Joint-stock Company – Although joint-stock companies with *unlimited liability* for the proprietors had been permitted since 1828 it was only in 1844 that the government obtained an Act for their registration and regulation. Until then they had been organised as very large common partnerships executed under a variety of deeds of trust with little or no protection for their members. All of the companies mentioned here were registered under the 1844 Act, which made lawful the dividing of capital into shares and gave a slight degree of security to investors in identifying the promoters and in mandatory regular financial reporting, but still with unlimited liability.

It was not until 1855 that general *limited liability* for proprietors of joint-stock shares was permitted in Britain by simple registration of their company's articles of association. Even subsequent to the Limited Liability Act 1855 the individual capital sums raised were relatively small compared with the enormous amounts raised by statutory companies.

Concerns formed under the 1855 and later Company Acts, but not the statutory incorporations, had to include "Limited" after the word "Company" in their title. That necessity has been assumed throughout this work, though not applied.

Patents – In most countries the patent or brevet was an administrative process that gave legal recognition to an invention or improvement. It had to be a tangible or material innovation, carefully described in a written specification and with, if appropriate, accompanying drawings and submitted to a government official to prove its originality. It was a costly process, consuming much time in its drafting, and requiring substantial fees to the government over its lifetime. Once granted it gave the owner or owners of the patent, twelve or less in number in British law, the sole right to use the invention for a period of time, or to assign use of it to others under licence.

In England patents were granted for a period of fourteen years without right of renewal. As monopolies in trade had been illegal since James I, major variations to a grant of patent (i.e. apart from a simple licence) had to go before Parliament: this was particularly so where a body of capitalists originally of more than five persons wished to acquire and work a patent and form a so-called *Patent Company*, actually identical to a Statutory Company. The number of individuals permitted to own a patent was increased to twelve in May 1832. With isolated exceptions each domestic telegraph company mentioned here was formed to acquire and work, by permission of Parliament, particular patents relating to electric telegraphy. Each patent gave the company sole rights to use the components of the patent for a period of time to the exclusion of all others.

Registered Designs – By an Act of Parliament of 1838 and subsequent Acts in 1842, 1843 and 1850, the appearance of manufactures could be recorded to establish legal priority and prevent copying. The Act was meant to apply to works with aesthetic merit and other visual properties, falling between copyright and patents, but was also used as a cheap method of protecting inventions from imitation.

---

l.] **Glossary:**

Spelling and usage throughout this paper is contemporary with the period. Special care has been taken over the accuracy of personal names and company titles and their evolution.

Currency - £. s. d. or Libra, Sesterce, Denarius, the currency used throughout this paper is the pound sterling, the '£' or 'L', then divided into twenty shillings, the 's', each of twelve pence, the 'd'. So the pound equalled 240 pence. To give some idea of relative value average individual male earnings were about £24 per year.

The pound in the mid-nineteenth was worth twenty-five French francs, ten Austrian florins, ten Russian roubles, seven Prussian thalers or five United States dollars. These values held true for most of the century as systemic inflation of currency had yet to be invented.

Armour – a sheath of iron wire bound around tarred, resin-insulated wires as a protection against the effects of sea-water and sea creatures to make a 'cable'

Cable – an armoured and resin-insulated underwater copper wire (or wires) or a subterranean resin-insulated wire or group of wires with a fabric sheathing

Code - With the exception of the original Wheatstone five-needle telegraph and the type-printing telegraphs of House and Hughes virtually all other *public* telegraphs, needle and acoustic, of the period transmitted code, actually cipher, in which movements or sounds are interpreted to represent characters, numbers and symbols. The original "Morse" code was devised by Alfred Vail in 1835 with 36 characters; there was also a different, extended Austro-German code, the "Hamburg Alphabet" that evolved into the "European Alphabet" in 1851 with 44 characters; and a particular Russian code that had 30 characters as well as numbers to suit an abbreviated Cyrillic alphabet. The "European Alphabet" or code was first used in British domestic circuits in June 1853 (See also *Telegraphs, Dial*)

The China Submarine Telegraph Company solved the problem of telegraphing the 50,000 characters of the written Chinese language. It reduced its messages to several thousand common names and phrases and had each office provided with small numbered wooden printing blocks for each. The sender selected the appropriate phrases and the clerk transmitted their numbers. On receipt the appropriate numbered blocks were printed on to the outgoing message form. The Great Northern Telegraph Company compiled a "dictionary" giving numeric equivalents to Chinese characters for transmission in its China and Japan circuits in 1871; this caused some offence as its construction and the selection by clerks was arbitrary

Duplex – the ability to send two messages through a single circuit was discovered by Dr Wilhelm Gintl, an Austrian, in 1853 but only perfected by Joseph Stearns in America during 1868 as the third generation of electric telegraph technology. It was introduced to general service in the 1870s

Galvanic – using batteries of chemical cells to produce electricity. During the period 1836 to 1870 and for long after virtually all telegraphs were 'galvanic' (but see also *Magneto*)

Insulators – In overhead or pole telegraphs an earthenware (often called "porcelain"), glass or hard-resin device used to insulate each of the overhead wires from the supporting pole

Key – In Britain during the 1850s and 1860s a Key, Private Key or Telegraph Key commonly referred to a code used for concealment in messages. The mechanical "key" used on the Highton, Bright and American telegraphs was hence known as a "tapper"

Magneto – using the local mechanical generation of electricity. In the period discussed only Henley's needle telegraph of 1849, Wheatstone's Universal telegraph of 1858 and Siemens dial telegraph of 1859 used 'magneto-electricity' rather than batteries of cells

Messages – the record for public traffic breaks down into domestic and foreign, and *ought* to exclude company or "service" messages, as well as news and railway-related traffic

Miles of line – unduplicated route miles (i.e. 100 miles from London to Birmingham)

Miles of wire – absolute length of wire in circuit (i.e. 100 line miles of line by four wires = 400 miles)

Overhead (or Pole) telegraph – an iron wire or wires hung above ground between wooden or iron poles

Relay or Repeater – an electro-magnetic device that received a weak incoming signal and retransmitted it using its own battery so amplifying its strength and increasing the length of the circuit without manual input. These instruments saw great development, causing them to be wholly automatic, to work two directions without switching and increasing their sensitivity.

The relay had several alternate titles in Britain, varying in dignity from "pecker", through repeater and translator, to the grand "perænode", all performing the same basic function

Resin-insulation – a copper-wire conductor coated with an insulator of tar, india-rubber or (after 1848) gutta-percha and covered with a protective, anti-abrasive cotton outer for underground or underwater telegraphy

Telegraph, Acoustic – an instrument in which code is communicated by sound rather than visually by needles or in print. The earliest was Wheatstone's magnet and bell of 1841, with a magneto worked by a lever. The American and needle galvanic telegraphs could also receive by sound alone as they made distinctive "dot" and "dash" or "left" and "right" noises. Bright's Bell of 1858 and the American sounder of about the same date were specifically designed to receive acoustically

Telegraph, American – this bears little resemblance to the apparatus originally patented in the United States by S F B Morse in 1840. The real, hugely-successful American telegraph, of the key, register and relay, was only patented in 1846 and owed all of its elements to Morse's collaborators. Alfred Vail devised the "register" in 1844; this was the essential and most original element of the American telegraph. One of the first two Vail registers still survives at Cornell University, but only because Vail took extraordinary precautions to keep it out of S F B Morse's hands. Morse somehow managed to 'lose' its companion. Outside of Britain this was *the* world-wide "telegraph system" after 1850. It was also used, it must be said, throughout the British dominions overseas

Telegraph, Automatic – the second generation of electric telegraphy, utilising a division of labour to multiply message rates by at least a factor of five. Messages were punched in code into paper tape and the tape fed into a clockwork-driven transmitter and received distantly by a clockwork-driven receiver that printed the code on to tape. The initial version ran at 100 words a minute, subsequently increased to 600 and 800 words a minute. This is Wheatstone's system of 1858

Telegraph, Chemical – the apparatus used electricity to mark a chemically-treated cloth or paper though a stylus controlled by a press-key. This had *no electro-magnetic* element, although being silent in operation it required an electro-magnetic alarm to warn the operators of a message. It is the basis of facsimile transmission and was devised by Davy in 1836 and perfected by Bain in 1846. The last Bain chemical telegraph was operating between Boston and Ogdensburg in North America during 1868

Telegraph, Copying – the apparatus is a variant of the *chemical telegraph* by which original writing is reproduced at a distance. The writing (or a line drawing) had to be undertaken on conductive material (foil), placed on a rotating metal drum and 'scanned' by a moving metal feeler. A similar metal drum in circuit with the first was covered in chemically-prepared paper was marked in sympathy by a metal stylus to reproduce the original. It was a mechanical telegraph with electro-chemical recording, relying on external power to rotate the drums synchronously and to move the sending feeler and receiving stylus. This is Bakewell's perfected system of 1851. The Caselli copying telegraph of 1860, with a flat-bed and swinging arm rather than a rotating drum, was used experimentally for a time. Fax or facsimile transmission is essentially a copying telegraph

Telegraph, Dial – the apparatus comprised a dial upon which the letters of the alphabet were indicated by a rotating index-hand or pointer, so that any person could read it. The pointer might be driven by clockwork and released to rotate by an *electro-magnetic* ratchet, becoming a mechanical telegraph, or might be itself driven around the dial by the electro-magnetic ratchet. The mechanism for controlling the ratchet, that is the sender, might be a galvanic commutator (Wheatstone's 1840, Siemens 1850 or Breguet's 1852) or a magneto-electric device (Wheatstone's Universal of 1858 or Siemens 1859) or even a mechanically-rotated galvanic commutator controlled by a piano-like keyboard (Froment's 1849). Dial telegraphs were by nature overly complex and expensive, so little, if at all, used in public message telegraphy

Telegraph, Marine - a line, whether optical or electrical, used to report ship arrivals to docks and wharfs in major cities from a distant coastal station; not offering a public service

Telegraph, Mechanical – the apparatus uses electricity to moderate an external mechanical power-source to produce communication. Typically this was an *electro-magnetically*-controlled ratchet that released a clockwork mechanism to rotate a pointer or type-wheel. These were the earliest telegraphs

Telegraph, Needle – the apparatus uses electricity to move the needles on one or more *electro-magnetic* galvanometers or "electricity-meters"; in *galvanic* telegraphy each needle moves left or right from the centre as the circuit polarity is changed by a single commutator worked by drop-handles or by a pair of press-keys ("tappers" in Britain between 1846 and 1870); in *magneto*-telegraphy each needle moves in a single direction at the instance of a local magneto-electric generator worked by a press-key or a handle. These instruments, by Cooke & Wheatstone or Highton, were commonly used in public messaging only in Britain

Telegraph, Printing – the apparatus used an *electro-magnetic* hammer to strike a rotating daisy-wheel on the 'petals' of which were alphabet type (Wheatstone's 1841 and 1862), an *electro-pneumatic* piston to drive a type-wheel (House's 1852) or an *electro-magnetic* print-wheel (Hughes' 1859). The signals were generated by a rotating commutator on a horizontal drum in the House or a vertical 'chariot' in Hughes, controlled by a lettered piano keyboard. These were mechanical telegraphs relying on external power to drive the type-printer, to move the paper in front of the type and to rotate the keyboard commutator

Telegraph, Private - electric communication directly connecting individuals. Private wires were offered on lease by all of the telegraph companies with or without the provision of operators. In the United Kingdom true private telegraphs used either Wheatstone's 1858 or Siemens 1859 dial magneto-apparatus. Very short distance or internal private circuits usually used Breguet's galvanic dial device

Telegraph, Public – electric communication accessible to the general public, whether offered by a telegraph, a cable or a railway company. *Exchange Telegraphs* providing a common message to private subscribers, are not dealt with here

Telegraph Stamps – adhesive labels sold by the companies, similar to postage stamps, used to pre-pay telegraphic messages by applying them to message forms or writing paper. These are different from the larger *Telegraph Labels*, used to seal the folded, addressed outgoing message forms instead of using envelopes in most countries other than Britain and the United States

Transcription – in telegraphy, the process where a message is received and written down by one clerk to pass to another clerk for sending on another instrument; replaced in the 1860s by *translation*, an electrical process using switching and an automatic relay

Underground or Subterranean telegraph – a resin-insulated wire or wires in an iron or earthenware pipe or metal-covered wooden trough buried in the ground

---

m.] **Love's Telegraph -** A comedy of 1846

In coincidence with the launch of the Electric Telegraph Company in the late summer of 1846 came the English premiere of the play, *Love's Telegraph*. Sadly, it must be said that the eponymous telegraph of the drama was not galvanic or even magnetic, but like the Company it was a success.

A comedy-drama in three acts, *Love's Telegraph* was first performed in English on September 9, 1846 at the Princess's Theatre, Oxford Street. It was translated from the French by James Planché at the instance of Mr J M Maddox, manager of the Princess's Theatre, probably on the advice of the popular French-speaking actor Charles James Mathews. The work was revived regularly there until 1859. It also played subsequently in the English provinces and in New York, at Laura Keane's Theatre, in June 1857 and for several seasons afterwards. Mathews was married to the famous actress and singer, Lucia Elizabeth Vestris, universally known on the stage as Madame Vestris.

"The new drama of *Love's Telegraph* has made a most decided hit, long continued plaudits follow each Act, it will therefore be repeated each evening."

"Princess Blanche is played by Madame Vestris; Alice by Mrs H Hughes; Marguerite, Miss E Stanley; Baron Pumpernickel, Mr Compton; Count Theodore, Mr J Vining; and Arthur de Solburg, Mr Charles [James] Mathews."

"It is an English adaptation of a French *comedietta*, and in a literary point of view presents no especial merit except that of general neatness. A lady and gentleman, courtiers at a Court of a Princess, invent a system of telegraph communication whereby they can make love to each other before the face of the princess herself. When the lady plays with her fan her conversation is directed to her lover, and when the gentleman gesticulates with his glove his compliments are intended for his inamoratas. It happens that the princess, notwithstanding the fact of her having a lover of her own, a prince too, falls in love with the gentleman in question, and of course appropriates all the fine compliments that are uttered over her head. She makes a written confession of her love, which the telegraphed individual, being high-minded, hands over to the princely suitor. This occasions some perplexity, but in the end all is set straight by the discovery of the flirtation that has been carried on by telegraph. The princess makes a sacrifice; marries the prince and allows the ingenious courtiers to unite their fortunes in life and matrimony."

---

n.] **Perceptions of the Telegraph Companies**

From 'Punch, or The London Charivari', September 20, 1862. There seems little difference in the art of customer service then as now...

"Electric Sparks"

An Imaginary Melodrama, constructed upon the complaints of Newspaper Correspondents

Dramatis Personæ

Some youthful Clerks. Enter to them Mr Morvays Hont, a mild gentleman who wishes to send a message.

Scene- An Electric Telegraph Office

Mr M H (*approaching the counter, and speaking in a low voice*): I believe you send electric messages to the town of Fortywinks?
1st Clerk (*loud*): Smith, where's Fortywinks?
2nd Clerk: Give it up.
1st Clerk: No, I say, it ain't a sell. This gent wants to send there. Where is it?
2nd Clerk: I don't know – isn't it out by Kent, or Wales, or that way. *(Opens a walnut)*
Mr M H *(meekly):* It is on your own list, sir.
1st Clerk: Is it? Why didn't you say so at first. The public give a great deal of unnecessary trouble.
Mr MH: But I rather wanted to know what would be your charge for a message there.
1st Clerk: 'Pends on length.
Mr M H: Yes, of course; yes, that is so. But I have written out the message I wish to send, and you can perhaps tell me the price before I fill up one of the forms.
1st Clerk *(takes the paper, and 2nd and 3rd Clerk come and look over their friend's shoulder)*: *He reads*: 'My dearest Maria-Jane' – that's four words, three if you like to call her *Mariar* only - 'I hope that your poor head is better' - (*aside to friend)* How about her poor feet? – twelve words. 'Be sure to use the *hoppledeaddog' (a burst from his friends)*.
Mr M H (*hurt*): Opodeldoc*, young gentleman. It is an application.
1st Clerk: Oh, ah! Well, you'd better say application; for I'm sure there'll be a mull with the Latin – eighteen words – 'and be careful about open winders'.
Mr M H: I have written "windows", I think.
1st Clerk: I said so, didn't I? – twenty-four words. 'I have sent the sugar candy' – not this way, I say, no such luck. Thirty words. Eight shillings – is the house near the telegraph station?
Mr M H: About three-quarters of a mile.
1st Clerk: Eighteen pence porterage – nine-and-six.
Mr M H: Dear me, that is more than I expected.
2nd Clerk (*a smart young fellow, up to business*): Well, you can cut out some of it, you know. See now. Cut out your dearest Mariah-Jane, if your name's to the letter she'll know it's you as sends, at least my Mariah-Jane would – that's four out. What's the use of hoping about her poor head? – stick to the message – say "Use the ophicliede" – what is it? – "keep out of draughts" – fifteen words out – there, Sir, we'll put that into the wire for you at a low figure, say four bob. Fill up a form – one of those before your nose.
Mr M H: Well, thank you, yes, that is shorter, certainly (*colouring*). But - you see – in fact there are circumstances, and that would read a little abrupt.
2nd Clerk: Well, it's your business, you know, not mine. (*Opens a walnut)*

Enter Small Boy, with much clatter.

3rd Clerk: Now then, you young scamp, where have you been all this while? You're in for it, you are, I can tell you.
Small Boy (*with much volubility*): Well, how's a fellow to go to Hislington and Chelsea and round by Brompting and the Minories and be back in five-and-twenty minutes you couldn't do it yourself and you've no call to put it on me to do it and what's more I won't and I can't and that's it.
3rd Clerk *(serenely)*: Better tell the Governor so.
S B: I *will* tell the Governor and I do tell the Governor so do you think I'm afraid to speak to the Governor he's not the man to see a poor lad put upon and bullied out of his life time if he happens to be hindered five minutes out of two hours because the road's up and the buss broke down and there was a fire and we couldn't get by. Come!
3rd Clerk: You'll see. Be off with this message to Hoxton. It's been waiting here three hours.
S B: Not till I've had my dinner if you know it and that's all about it.

(Exit)

2nd Clerk: Nice lad that. Nothing to say for himself, oh no!
1st Clerk: That ought to go off, you know.
2nd Clerk: I know nothing about it; except that it's been lying there since eleven o'clock, and that it is a thundering message to a doctor to be off by the next train.
1st Clerk: Well, I ask you is it my fault?
2nd Clerk: It's nobody's fault in particular, and everybody's in general, and we'll hope the doctor will be in time. Mind your customer.
1st Clerk: Well, Sir – cooked it?
Mr M H (*who has been fidgeting over his document and making faces, and showing much discomfort about it*): I – I think I have reduced it a little without making it quite so peremptory – how is it now?
1st Clerk: 'My dearest' – um – um.
2nd Clerk: You stick to the polite, Sir? *(Graciously)*
Mr M H: Ladies require to be addressed with consideration, you see. *(Apologetically)*
1st Clerk: Six shillings – seven-and-six in all.
Mr M H (*with a sigh*): Well, so it must be. But, oh yes, I beg your pardon, when will this be delivered?
1st Clerk: Oh, sometime to-night.
Mr M H: Ah, but that is very important! I would not send unless you could guarantee that it would be delivered by nine, or at the latest ten minutes past, as – as the lady retires at half-past nine, and I would not have her disturbed on any account.
1st Clerk: We guarantee nothing, but I dessay you'll hear that it's all right.
Mr M H: It is only three o'clock now. Surely the message could go away at once.
2nd Clerk: Of course it could go if the wire wasn't wanted for anything else, but we'll send it as soon as we can.
Mr M H: But you will assure me that it will go before five – surely, a distance of thirty-six miles –
2nd Clerk: You see it ain't all our line, there are two breaks, and we can't say what the other companies may do, but she'll have it tonight, and there's nothing very pressing in it.
Mr M H (*reddening*): That, allow me to say, is a matter on which I must be permitted to have my own opinion.
2nd Clerk: Have it by all means. *(Opens a walnut)*
Mr M H (*rising into wrath*): And I must add that to put Fortywinks on your list, and not be able to say that you

can send there in six hours is a little more than inconsistent.
2nd Clerk: Well, you can write to the papers and say so. And as the papers pay our salaries, of course we shall all get the sack.
Mr M H: The papers may not pay your salaries, but – ha! ha! (*with wild maliciousness*) they shall pay you out!
(*Rushes away on delivering this annihilating smasher, and hurries up the street*)
2nd Clerk: Not so bad of the old muff, that. But he's left his dearest 'Maria-Jane' paper behind him.
Re-enter Mr M H, very hot.
Mr M H: I left a paper here. I request its return.
2nd Clerk: Did you, Sir? No, I think not, Sir? I do not see it, Sir. Have you seen it, Brown?
1st Clerk: No, I haven't, Robinson.
3rd Clerk: I think you must be in Herror, Sir.
(They all gaze upon him with much politeness)
Mr M H: Then, I must have dropped it in the street.
2nd Clerk: Very likely, Sir. The public does those things occasionally. Perhaps the finder will bring it here and forward it at his own expense; if so, it shall receive every attention, Sir.
Mr M H: This telegraph system is ...
(Exit before completing his diagnosis)

(*Opodeldoc - "a well-known liniment, which is prepared by digesting three parts of soap in sixteen parts of the spirit of rosemary, till the former be dissolved; when one part of camphor should be incorporated with the whole. This unguent is of great service in bruises, rheumatic affections, and similar painful complaints": 'The Domestic Encyclopaedia', 1802)

---

o.] **Sources: Books & Major Articles**
There has been little recent writing or research on the telegraph in Britain; although there are several good reprints and on-line republications of old works. I have tried to use only sources contemporary with events.

- *Electric Telegraph, a Social and Economic History*; J L Kieve, David & Charles, Newton Abbot, 1973
- *Cooke and Wheatstone and the Invention of the Electric Telegraph*; Geoffrey Hubbard, Routledge and Kegan Paul, London, 1965
- *Telegraph Manual*; Taliaferro Preston Shaffner, Pudney & Russell, New York, USA, 1859
- *Abridgements of Specifications relating to Electricity and Magnetism, their generation and applications;* Bennett Woodcroft, Commissioners of Patents, London, 1859
- *Annals of British Legislation; being a classified and analysed summary of public bills, statutes, accounts and papers, reports of committees and of commissioners, and sessional papers generally, of the Houses of Lords and Commons;* Leone Levi, Smith, Elder & Co., London, 1861 et sec
- *Annales télégraphiques*; Dunod, éditeur, Libraire des Corps Impériaux des Ponts et Chaussées et des Mines, Paris, Tomes 1859 - 1864
- *On the Analogy between the Post Office, Telegraphs, and other systems of conveyance of the United Kingdom as regards government control*; W S Jevons, read at the Manchester Statistical Society, April 10th, 1867
- *American Telegraphy and Encyclopaedia of the Telegraph*; William Maver, Maver Publishing Co., New York, USA, 1912
- *Atmospheric Railways - a Victorian Venture in Silent Speed;* Charles Hadfield, David & Charles, Newton Abbot, 1967
- *Authorship of the Practical Electric Telegraph of Great Britain;* Thomas Fothergill Cooke, R E Beach, Bath, and Simkins, Marshall & Co., London, 1868
- *The Autobiography of James Graves*; transcribed from the manuscript and edited by Donard de Cogan, 2005
- *Before We Went Wireless - David Edward Hughes FRS, his life, inventions and discoveries*; Ivor Hughes & David Ellis Evans, Images from the Past, Bennington, Vermont, USA 2010
- *Bournemouth: 1810-1910, the history of a Modern Health and Pleasure Resort*; C H Mate & C Riddle, W Mate & Sons, Bournemouth, 1910
- *The British State Telegraphs*; Hugo Richard Meyer, Macmillan, New York and London, 1907
- *Catalogue of the Mechanical Engineering Collection in the Science Division of the Victoria & Albert Museum, Part II;* H M Stationery Office, London, 1908
- *Catalogue of the Special Loan Collection of Scientific Apparatus at the South Kensington Museum*; Committee of the Council on Education, H M Stationery Office, London, 1877
- *Catalogue of the Wheeler Gift of Books, Pamphlets and Periodicals in the Library of the American Institute of Electrical Engineers* (The Collection of Latimer Clark); Edited by W D Weaver, American Institute of Electrical Engineers, New York, USA, 1909
- *Chapters of Telegraph History, furnished by The American Telegraph Magazine;* John Brooke O'Rielly, New York, 1861 (Reprint of articles from 1852 and 1853)
- *Charles Wheatstone's Cryptograph and Pletts' Cipher Machine;* Donald W Davies, Cryptologia, London, April 1985
- *Classics of Communication;* Fons Vanden Berghen, Crédit Communal, Brussels, Belgium, 1999
- *Confidential Report to Robert Grimston;* Mark Huish, Electric & International Telegraph Company, London, October 1860
- *Die Copirtelegraphen, die Typendrucktelegraphen und die Doppeltelegraphie;* Karl Eduard Zetsche, B G Teubner, Leipzig, Saxony, 1865

- *Correspondence on the Subject of the Purchase of the Telegraphs 1873-4;* H M Treasury, London, 1875
- *Curiosities of Communication;* Anon., Charles Knight, London, 1851
- *Cyclopaedic Science Simplified*; John Henry Pepper, Frederick Warne & Co., London, 1869
- *The Danish Monopoly on Telegraph in Japan;* Eiichi Itoh, Keio Communication Review, No 29, 2007
- *Description of the Clock Trigger for the Time-Gun Signal in Edinburgh Castle*; F J Ritchie, Transactions of the Royal Scottish Society of Arts, Vol. VI, 1864
- *Description of an Electrical Telegraph*; Francis Ronalds, R Hunter, London, 1823
- *Digitale Kommunikation in der k.k. Monarchie - Die Errichtung der Elektrischen Telegraphie in Österreich um 1850*; Franz Pichler, Elektrotechnik und informationstechnik, Linz, Austria, 2003
- *Dingler's Polytechnisches Journal*; Johann Gottfried Dingler, J G Cotta, Stuttgart, Württemberg, 1838-1870
- *Discussion on the Electric Telegraph*; I K Brunel, E Clark, J L Clark, C W Siemens, F Whishaw and others, Proceedings of the Institution of Civil Engineers, London, March 2, 1852 (Also *The Electric Telegraph* and *On the Electric Telegraph*, same date)
- *The Domestic Telegraph;* Chambers's Journal of Popular Literature, Science and Arts, Edinburgh, Scotland, December 1863
- *Early Victorian telegraphs in London's topography, history and archaeology*; Francis Celoria, in 'Collectanea Londiniensia', London & Middlesex Archaeological Society, London, 1978
- *Economic Telegraph Company 1864 - 1875;* Letters and files, BT Archives, London
- *On the Electric Telegraph, and the principal improvements in its Construction*; Frederick Richard Windowy, Proceedings of the Institution of Civil Engineers, London, March 2, 1852 (Also *The Electric Telegraph* and *Discussion on the Electric Telegraph*, same date)
- *The Electric Telegraph* in *The Pictorial Handbook of London*; Anon., Henry G Bohn, London, 1854
- *The Electric Telegraph* in *The Quarterly Review;* Anon., John Murray, London, July, 1854
- *The Electric Telegraph, its History and Progress;* Edward Highton, John Weale, London, 1852
- *The Electric Telegraph Company, Chart of the Company's Telegraphic System in Great Britain*; The Electric Telegraph Company, London, 1852 (also published in 1853, 1859, 1860, 1866)
- *The Electric Telegraph Popularised*; Dionysius Lardner, Lockwood & Co., London, 1860 (Second edition, slightly updated from 1855)
- *The Electric Telegraph*; Dionysius Lardner and Edward Brailsford Bright, Lockwood & Co., London, 1867 (Third edition, updated and with Atlantic cables)
- *The Electric Telegraph in British India*; W B O'Shaughnessy, MD, FRS, The Hon East India Company, London, 1853
- *The Electric Telegraph; its History, Theory and Practical Application;* Charles Coles Adley, Proceedings of the Institution of Civil Engineers, London, March 2, 1852 (Also *On the Electric Telegraph* and *Discussion on the Electric Telegraph*, same date)
- *The Electric Telegraph; its Influence and Geographical Distribution;* Marshall Lefferts, American Geographical and Statistical Society, New York, USA, 1856
- *The Electric Telegraph; was it invented by Professor Wheatstone?* William Fothergill Cooke, privately printed in London, 1857
- *The Electricians' Directory with Handbook for 1885;* George Tucker, London 1885
- *Elektrisches Schreiben in die Ferne;* Prof Franz Pichler, Universitätsverlag Rudolf Trauner, Linz, Austria, 2007
- *Encyclopædia Britannica;* Eighth edition, Volume XXI, Article "Telegraph , Electric", William Thomson, Adam & Charles Black, Edinburgh, Scotland, 1860
- *Encyklopädie der Physik*; Ed. Gustav Karsten; XX Band, Angewandte Electricitätslehre, C Kuhn; Leopold Voss, Leipzig, Saxony, 1861-65
- *Facts bearing on the Progress of the Railway System*; Wyndham Harding, Journal of the Statistical Society of London, Vol XI, J W Parker, London, November 1848
- *A Family Chronicle derived from notes and letters selected by Barbarina, Lady Grey;* Gertrude Lyster, editrix, John Murray, London, 1908 (containing the Journal of Gertrude Sullivan)
- *Faster than the Wind – A History of and Guide to the Liverpool to Holyhead Telegraph*; Frank Large, Avid Publications, Wirral, Cheshire, 1998
- *The First Cable Cruises of the Old 'Monarch'*; Frederick Charles Webb, in 'The Electrician', May 31, 1884, online at atlantic-cable.com
- *Forty Years at the Post Office - A Personal Narrative*; Frederick Ebenezer Baines, Richard Bentley & Son, London, 1895
- *From Elektron to E-commerce*; Stewart Ash, Submarine Telecoms Forum, Issues 14, 15 and 17, WFN Strategies, Potomac Falls, Virginia, USA, 2004
- *From Rattle to Radio*; John Bunker, K A F Brewin Books, Studley, Warwick, 1988
- *The Gilbart Prize Essay on the adaptation of recent discoveries and inventions in science and art to the pur-*

poses of practical banking; Granville Sharp, Groombridge & Sons, London, 1854

- *Government and The Telegraphs, Statement of the Case of the Electric & International Telegraph Company against the government Bill for Acquiring the Telegraphs*; Robert Grimston, Effingham Wilson, London, 1868
- *A Handbook of Practical Telegraphy*; Richard Spelman Culley, Longman, Green, London, 1863
- *The Handbook of the Telegraph*; R Bond, Virtue Brothers, London, 1862
- *Handbook to the Electric Telegraph*; Staff of the Electric Telegraph Company, W Scales and W M Clark, London, Third Edition, 1849
- *Heroes of the Telegraph*; J Munro, Religious Tract Society, London, 1891
- *Het Internet van der 19e Eeuw*; Fons Vanden Berghen, privately published, 2012
- *A History of Electric Telegraphy, to the Year 1837*; John Joseph Fahie, E & F N Spon, London, 1884
- *History of the Great Western Railway;* E T MacDermot and C R Clinker, Ian Allan, Shepperton, 1964
- *History, Theory & Practice of the Electric Telegraph*; Geo. Prescott, Boston, USA, 1866
- *A History of the Telegraph in Jersey 1858 - 1940*; Graeme Marett, www.marett.org/telecom/ telegraph.pdf, 2009
- *History of Telegraphy*; Ken Beauchamp, Institution of Electrical Engineers, London, 2002
- *History & Progress of the Electric Telegraph;* Robert Sabine, Lockwood & Co., London, 1872
- *History of the Corps of Royal Sappers & Miners*; T W J Connolly, Longmans, Brown, Green, Longmans & Roberts, London, 1855
- *A History of Wireless Telegraphy;* John Joseph Fahie, William Blackwood & Sons, Edinburgh, Scotland, 1899
- *Historical Account of the Introduction of the Galvanic and Electro-Magnetic Telegraph*; Dr Josif Kristianovich Hamel, Journal of the Royal Society of Arts, London, July 22 and 29, 1859
- *Historical Sketch of the Electric Telegraph*; Alexander Jones, Putnam, New York, USA, 1852
- *An Illustrated Handbook to the Electric Telegraph;* Robert Dodwell, T T Lemare, London, and John Heywood, Manchester, 1861
- *Die indo-europäische Telegraphenlinie in Originaldokumenten*; Fritz Jörn, 2004, www.joern.de/ indolinie.htm.
- *International Telegraph Company 1854 - 1858;* Letters and files, BT Archives, London
- *The Introduction of the Electric Telegraph in Britain, a Reappraisal of the Work of Cooke and Wheatstone*; John Liffen, International Journal for the History of Engineering & Technology, Vol 80 No 2, July 2010
- *Lands of the Slave and the Free;* Henry A Murray, George Routledge, London, 1855
- *Law Reports of the Chancery and Exchequer Courts of England;* London, 1838 to 1870
- *Lectures on the Electro-Magnetic Telegraph*; Laurence Turnbull, Philadelphia, USA, 1852
- *The Life of Samuel F B Morse*; Samuel Irenæus Prime, D Appleton & Company, New York, USA, 1875
- *London District Telegraph Company 1860 - 1868;* Letters and files, BT Archives, London
- *Memoir of Henry Wilde;* W W Haldane Gee, Memoirs and Proceedings of the Manchester Literary & Philosophical Society, Vol LXIII (1918-19), Manchester, 1920
- *Military Telegraphy and Signalling;* Captain R H Stodherd RE, Journal of the Royal United Service Institution, London, Vol XIV, May 13, 1870
- *Les Merveilles de la Science*; Louis Figuier, Furre, Jouvet et Cie., Paris, 1868
- *The Nervous System of the Metropolis,* in *Our Social Bees*; Andrew Wynter MD, Robert Hardwick, London, 1861
- *Ocean Telegraph Company;* C W & J J Harrison, privately published, Richmond (Surrey), 1852
- *Old Bailey Proceedings*, Central Criminal Court, Regina v Evans and Thorn, October 26, 1857
- *On Railway Telegraphs and the Application of Electricity to the Signalling and Working of Trains;* William Henry Preece, AICE, Proceedings of the Institution of Civil Engineers, London, January 13, 1863
- *On the Electric Telegraph between England and India*; E C Cracknell, Royal Society of New South Wales, Sydney, Australia, 1869
- *The Old Telegraphs*; Geoffrey Wilson, Phillimore, London, 1976
- *Overhouse Telegraphs*; Sydney Waterlow, Journal of the Society of Arts, London, August 13, 1858
- *Papers on subjects connected with the duties of the Corps of Royal Engineers*; Volume III, W P Jackson, Woolwich, 1859
- *Paris Universal Exposition - Telegraphic Apparatus*; S F B Morse, Washington, USA, 1868
- *The Penny Cyclopaedia of the Society for the Diffusion of Useful Knowledge*; Vol XXIV, various authors, Charles Knight & Co., London, 1842
- *Pictorial History of the Russian War 1854-5-6*; G Dodd, W & R Chambers, Edinburgh, Scotland, 1856

- *The Post Office Telegraphs and their Financial Results*; W S Jevons, Fortnightly Review, London, December, 1875
- *The Postage and Telegraph Stamps of Great Britain*; F A Philbrick & W A S Westoby, Sampson Low, Marston, Searle & Rivington, London, 1881
- *Private Telegraph Companies of Great Britain and their Stamps*; Raymond Lister, Golden Head Press, Cambridge, 1961
- *The Railway Clearing House in the British Economy 1841-1922*; Philip Bagwell, George Allen & Unwin, London, 1968
- *Report by the Registrar of Joint Stock Companies to the Committee of the Privy Council for Trade for the Year 1845*; HM government, London, 1846
- *Report from the Select Committee on Accidents on Railways*; HM government, London, 1858
- *Report from the Select Committee on East India Communications*; HM government, London, 1866
- *Report of the Joint Committee to inquire into the Construction of Submarine Telegraph Cables*; HM government, London, 1861
- *Report from the Select Committee on the Electric Telegraph*; New South Wales - Votes and Proceed-ings of the Legislative Assembly, Session 1856-57, Vol III, William Hanson, Sydney, New South Wales, 1857
- *Report on the Reorganization of the Telegraph System of the United Kingdom;* HM government, London, 1871
- *Reports from the Committees 1867-8, Volume 6, Electric Telegraph Bill;* HM government, London, 1868
- *Reuters' Century 1851-1951;* Graham Storey, London, 1951
- *The Rise & Fall of Government Telegraphy in Britain;* C R Perry, Business & Economic History, London, 1997
- *The Rise & Progress of the Telegraphs;* Maria Susan Rye, London, 1859
- *The Royal Engineer;* Sir F B Head Bt, The Quarterly Review, London, July 1868
- *The Royal Engineer;* Sir F B Head, Bt, John Murray, London, 1869 (enlargement of the above)
- *Royal Household Mail;* Glen H Morgan, British Philatelic Trust, London, 1992
- *Royal Meteorological Society;* Papers and Membership lists, 1851 to 1868, on-line
- *Ruff's Guide to the Turf or Pocket Racing Companion;* Ed. William Ruff then W H Langley, London, Annually from 1842
- *Shaffner's Telegraph Companion, devoted to the science and art of the Morse American telegraph;* Tal P Shaffner, Pudney & Russell, New York, USA, 1854
- *A Short History of the Electric Clocks;* Alexander Bain, Chapman & Hall, London, 1852
- *The Spanish Campaign in Morocco*; Frederick Hardman, William Blackwood & Sons, London, 1860
- *State or Tynwald Laws of the Isle of Man*
- *Statement of Facts on the Subject of the Electric Telegraph;* Douglas Pitt Gamble, D P Gamble, London 1847
- *Stokers and Pokers*; F B Head, John Murray, London, 1849
- *The Story of My Life by the Submarine Telegraph* (sic); Charles West, London, 1859
- *On Submarine Telegraphs;* Frederick Richard Window, Proceedings of the Institution of Civil Engineers, London, January 13, 1857
- *The Suction Post,* in *Our Social Bees*; Andrew Wynter MD, Robert Hardwick, London, 1861
- *Tallis's London Street Views;* John Tallis, J & F Tallis, London, 1840 and 1847
- *Der Telegraph als Verkehrsmittel;* Karl Knies, H Laupp, Tübingen, Württemberg, 1857
- *De Telegraphie in hare Rechtsgevolgen;* Carel Asser, Gebroeders van Cleef, Den Haag, Holland, 1866
- *Telegraphic Railways; or The Single Way*; William Fothergill Cooke, Simkin, Marshall & Co., London, 1842
- *The Telegraphs of Europe* (a map); The Electric & International Telegraph Company, London, 1856 and 1861 (also published 1854, 1855, 1859, 1861, 1863, 1865)
- *The Telegraph*; Sir William Preece and J Sivewright, London, 1876
- *Telegraphs in Victorian London*; John Durham, Golden Head Press, Cambridge, 1959
- *Telegraph Manipulation*; C V Walker, George Knight & Sons, London, 1850
- *Telegraph & Telephone Stamps of the World*; S Hiscocks, Woking, 1982
- *Telegraph and Travel;* Colonel Sir Frederic John Goldsmid, CB, KCSI, Macmillan & Company, London, 1874
- *The Telegraph, A History of Morse's Invention*; Lewis Coe, McFarland, Jefferson, North Carolina, USA, 1993
- *Telegraphen-Apparate, Geschichte der elektrischen Telegraphie;* Prof Franz Pichler, Universitätsverlag Rudolf Trauner, Linz, Austria, 2012
- *Thirty-Six Years in the Telegraphic Service*; James Graves, transcribed from the manuscript by Dominic de Cogan and edited by Donard de Cogan, 2008

- *The Timely Story of Loughton's First Public Clock* – Ian Strugnell, Chigwell & Loughton History Society, Newsletter 131, March 1996
- *Town Telegraphs* in *Subtle Brains and Lissom Fingers*; Andrew Wynter MD, Robert Hardwick, London, 1863
- *Then and Now, or Fifty Years of Newspaper Work;* William Hunt, Hamilton, Adams & Co., London, 1887
- *Universal Private Telegraph Company 1861 - 1870;* Letter Books and files, BT Archives, London
- *Universal Private Telegraph Company Limited;* Prospectus, Glasgow, 1860
- *Universal Private Telegraph Company, Report to the General Post Office on the condition of its works*; E G Bartholomew, London, November 1868
- *Universal- und Privat-Telegraphie in London*; Magazin für die Literatur des Auslandes, herausgegeben von Joseph Lehmann, Beit & Comp., Leipzig, Saxony, September 1861
- *The Varley Family*: *Engineers and artists*: John Varley Jeffery, Royal Society of Arts & Sciences, London, 1997
- *Memoir of Henry Wilde;* Prof W W Haldane Gee, Memoirs and Proceedings of the Manchester Literary & Philosophical Society, Vol LXIII (1918-19), Manchester, 1920
- *The Working Women of England*; Joseph Foulkes Winks, The Christian Pioneer, Leicester, 1859
- *Zeitschrift des deutsch-österreichischen Telegraphen-Vereins*; Dr Wilhelm Brix, Berlin, Jahrgang 1 - 16, 1854 to 1869
- *Bradshaw's Railway Manual, Shareholders' Guide & Official Directory;* (an annual detailing railway and associated companies), London, 1848 to 1921

Regarding the Electric Telegraph Company, according to one source, "When the transfer of the undertaking of this Company to the Postmaster-General took place, the whole of the papers of the Company were destroyed by order of the directors." (Philbrick & Westoby 1881)

The surviving records of the London District Telegraph Company comprise just 56 pages.

Kieve's work is a fine piece of original research on the economy of the telegraph, particularly the final years of the companies – I have tried not to replicate his efforts so have used other sources from the period.

Beauchamp's more recent work, published, and presumably edited, after his death, sadly has several commercial and technical inaccuracies.

Geoffrey Wilson's splendid early work on "The Old Telegraphs", pre-electricity, is a model for historical writers on technology.

Ivor Hughes' biography of David Hughes, "Before We Went Wireless", describing his revolutionary contributions to telegraphy, the telephone and radio, is thoroughly recommended for its context-setting, breadth and clear descriptive nature.

John Liffen of the Science Museum in his recently published paper detailing in formidable detail the earliest work of Cooke and Wheatstone shows that virtually all current history on that subject requires rewriting. My particular thanks go to him for sharing this important research.

The best composite *period* source is Tal Shaffner, but like everyone else he got nowhere with prying information out of the Electric Telegraph Company. Dionysius Lardner, the great scientific populariser, is also to be recommended, in this and many other subjects.

Morse's work for the Paris Exposition is an embarrassing self-justification but he used his name to acquire a large amount of data through the US Embassies abroad; the Electric Telegraph Company refused, as usual, to co-operate. It will come as a surprise to most people interested in the subject to learn from this that needle instruments are not "telegraphs" at all but are really "semaphores".

Several extracts have been included from Morse's correspondence in the 1840s as recorded in Prime's biography. There is a suspicion that these letters and, in particular, the accompanying memoranda were edited or even written well after the events described.

To any Americans who might take offence at this view of Morse; the *Electric Telegraph* by W F Cooke cited above is even worse in its self-serving grind.

Researchers are very specifically warned against the value of the statistics published by the Post Office in regard to the final years of the telegraph companies. They bear little or no relationship to the companies' official returns made to the Board of Trade before 1870.

For a period view of the state of the British telegraphs in government hands subsequently in the 1870s Stanley Jevons analytical article in the *Fortnightly Review* is the best source.

Finally, Meyer's much later *British State Telegraphs* is thoroughly recommended as it gives the political context to the appropriation of the telegraphs in 1868, describing the subsequent regime and the failure of bureaucracy. Meyer scrupulously corrects the statistics given by the Post Office for the era of the Companies.

Sources: Technical

- United States Patent Office
- The Patent Office (UK)
- L'Institut National de la Propriété Industrielle

The immense USPO archives are available on-line, partially indexed by Google. The UKPO, now called the Intellectual Property Office, is paper-based and relies on a privately-produced index. INPI, the French organisation concerned with patents, now has its earliest records available on-line and easily searchable.

Sources: Journals

The period between 1836 and 1860 saw a huge increase in business and technical journalism in Britain; these journals – dealing primarily with the railway interest – published a large amount of government statistics, semi-scientific information and, what were basically, company press releases. W F Cooke was particularly active in placing articles in the business press in England; but apart from in the earliest period the companies were not.

- *The Builder, The Railway Times, The Railway Chronicle, The Railway Record, Mining Gazette, Shareholders' Guardian, The Electrician (1861-3), The Telegraphic Journal (1864), The Telegraphic Journal (started in 1870 it printed memoirs and retrospective information), The Daily News, The Glasgow Herald, The Illustrated London News, The London Gazette, The Manchester Guardian, The Mechanics' Magazine, The Morning Advertiser, The Morning Chronicle, Punch, The Times, The Scientific American, The Living Age, Once-a-Week and, more recently, Telektronikk (Norway)*
- *Post Office Directories* for London, Manchester and Glasgow between 1845 and 1868

Sources: Internet
Unless one is a collector of 'telegraphiana' there is little original relating to telegraphy on the internet, the impressive exceptions are:

- Bill Burns' fine work on the history of underwater telegraph cables at *www. atlantic-cable.com*
- James B Calvert, *The Telegraph*, a History of the Electromagnetic Telegraph, at *www.du.edu/~jcalvert /tel/telhom.htm*
- Fons Vanden Berghen's wonderful, ever expanding, telegraphic picture library, an adjunct to his book *Classics of Communication* (q.v.) at *www.telegraphsofeurope.net*
- Fons Vanden Berghen's more personal site that records his many historical articles and his exhibitions, with videos of Cooke & Wheatstone instruments, American telegraphs and Hughes printers in action at *www.telegraphy.eu*
- John Jenkins' *Spark Museum* of Vintage Radio and Scientific Apparatus at *www.sparkmuseum.com*
- J E Bosschieter's *History of the Evolution of the Electric Clock,* with excellent technical explanations and animations, at *www.electric-clocks.nl*
- Steve Panting's *Telegraph Stamps of Great Britain*, a new compendious site for this neglected subject, at *gb-precancels.org/Telegraphs/index.html*
- The Lords of Lightning site offers new researchers into telegraphy an excellent list of web sources at *lordsoflightning.com*

Sources: Genealogy
Many of the details for the biographies of telegraphic individuals found in the Appendix here have been discovered through the on-line resources, the Census and City Directories, available on subscription at:

- The Genealogist - *www.thegenealogist.co.uk*

The Wheeler Gift:
The history of electric telegraphy, indeed of all things connected with electricity and magnetism, would be much easier if the gift of *Schuyler Skaats Wheeler* to the Library of the American Institute of Electrical Engineers of May 17, 1901 had been properly honoured.

Mr Wheeler, one of nature's modest philanthropists, had purchased the immense collection of 6,000 books, pamphlets and periodicals relating to electricity, dating from earliest times, collected by the telegraph engineer, Latimer Clark in London. With the equally generous support of Andrew Carnegie, a perpetual bequest of money was made to house, catalogue and complete Latimer Clark's library at the American Institute of Electrical Engineers.

Sadly the gift and bequest were dishonoured and in the 1990s the Wheeler Gift was dispersed, destroying an almost perfect archive of publications relating to electricity. Many of the works ended up with the New York Public Library, who have compounded the dishonour by failing to catalogue its acquisitions, leading to losses and thefts. Much of the Gift, even Clark's personal correspondence, is now being peddled on the internet.

All that effectively remains is the two volume catalogue of 1909 that reveals the true value of Schuyler Skaats Wheeler's gift and Latimer Clark's perseverance. This, at least, offers historians a wish list of works that they need to access for a complete view of electrical communication through the ages.

On Sources:
This work has been a collation of small pieces acquired over a long time. The use of original printed sources from the nineteenth century has the defect of being unverifiable; although checks have been made, all manner of authorial and compositors' errors might have crept in, let alone the writer's own contributions; corrections and comments are therefore welcome. This has not been written for academic use so the massive irritation to readers of reference notes has been, rightly or wrongly, forsaken.

Website:
Distant Writing is added-to and corrected regularly; the latest text is available on-line, before a revised PDF is prepared, at the website - *distantwriting.co.uk*

Illustrations of most of the instruments mentioned have been captured from period sources and are included on the website in the 'Instrument Gallery'.

p.] **INSTRUMENT GALLERY**
Illustrations featured on the *Distant Writing* website:

1. Bain Writer
2. Bain's first I & V Telegraph
3. Bain's I & V Telegraph
4. Bakewell's Copying Telegraph
5. Bonelli's Typo-Telegraph
6. Breguet's Dial Telegraph – receiver
7. Breguet's Dial Telegraph – sender
8. Breguet's Portable Telegraph
9. Brett & Little's Electro-Telegraphic Converser

10. Brett's Electric Type-Printing Telegraph
11. Bright's Bell Telegraph
12. Cooke & Wheatstone's Five-Needle Telegraph
13. Cooke & Wheatstone's Two-Needle Telegraph
14. Cooke & Wheatstone's One-Needle Telegraph 1843 and 1868
15. Cooke's Detector
16. Cooke's Dial Telegraph
17. Clark's Perforator for the Bain printer
18. Culley's Pneumatic Perforator
19. Dering's Telegraph
20. Digney's American Telegraph
21. Electric Telegraph Company's *Paratonnerre*
22. Foy & Breguet's Telegraph
23. Froment's Alphabetical Telegraph
24. Hatcher's Single and Double Index Telegraph
25. Henley's Magneto-Telegraph
26. Henley's Single Needle Magneto-Telegraph
27. Henley's Magneto Dial Telegraph
28. Henley's Military Telegraph
29. Highton's first One-Needle Telegraph
30. Highton's improved One-Needle Telegraph
31. Highton's final One-Needle Telegraph
32. Highton's Tappers
33. House's Type-Printing Telegraph
34. Hughes' Type-Printing Telegraph
35. Insulator - Cooke's Disc
36. Insulator - Cooke's Barrel
37. Insulator - Bain's
38. Insulator - Ricardo's
39. Insulator – Edwin Clark's
40. Insulator - Edwin Clark's Ceramic
41. Insulator - Walker's
42. Insulator - Highton's Gutta-Percha
43. Insulator - Bright's
44. Insulator – Latimer Clark's
45. Insulator - Varley's Double Shed
46. Insulator – Andrews'
47. Insulators - Henley's
48. Insulator - Siemens
49. Little's Telegraph
50. Moore's Galvanometer
51. Nott & Gamble's Telegraph
52. Nottebohm's *Umschalter* or Switchboard
53. O'Shaughnessy's Indian "Reverser" or sender
54. O'Shaughnessy's Indian "Telegraph" or receiver
55. Pipes - Electric Telegraph Company
56. Pipes - Reid's
57. Pipes - Henley's
58. Rutter's Fire and Burglar Alarm
59. Shepherd's Electric Time Transmitter
60. Siemens & Halske's Galvanic Dial Telegraph
61. Siemens & Halske's American Telegraph
62. Siemens & Halske's Magneto Dial Telegraph
63. Siemens & Halske's Rotary Sender
64. Siemens & Halske's "Sounder"
65. Statham's Fuze
66. Theiler's Direct Printing Telegraph
67. Thomson's Mirror Galvanometer
68. Troughs - Cooke's Batten
69. Troughs - Reid's
70. Troughs - Reid's Improved
71. Troughs - Henley's
72. Troughs - Henley's Improved
73. Troughs - Electric Telegraph Company
74. Varley's Submarine Key
75. Varley's Relay
76. Wilde's Globe Telegraph
77. Whishaw's Telekouphonon
78. Wheatstone's Automatic Telegraph
79. Wheatstone's Magnetic Exploder and Abel's Magnet Fuze
80. Wheatstone's Magnet & Bell
81. Wheatstone's galvanic Dial Telegraph - sender
82. Wheatstone's Dial Telegraph – sender
83. Wheatstone's Dial Telegraph – receiver
84. Wheatstone's Universal Telegraph
85. Wheatstone's Universal Type Printer
86. Wheatstone's Magnetic Clock

There are also many rare illustrations of instruments, ephemera, premises and equipment published within the online chapters:-

Introduction: 1] An Electric Telegraph Office in London 1852

1. Cooke & Wheatstone: 1] Cook & Wheatstone's Five Needle Telegraph; 2] Cooke & Wheatstone's Patent of June 10, 1837; 3] Francis Ronalds' electric telegraph 1816; 4] The London & Birmingham Railway's Euston Square Station 1838; 5] The first Electric Telegraph of 1837; 6] Wheatstone's Original Five-Needle Telegraph 1837; 7] The Great Western Railway's Paddington station, London; 8] Cooke's four-needle electric telegraph 1837; 9] Minories terminus of the London & Blackwall Railway 1840; 10] Telegraph Conduits on the Blackwall Railway 1843; 11] The Brunswick Steam Packet Wharf, Blackwall 1840; 12] Cooke & Wheatstone's single-needle electric telegraph 1840; 13] Cooke & Wheatstone's five-dial telegraph 1840; 14] Circuit testing 1841; 15] Cooke & Wheatstone's five-dial railway telegraph 1844; 16] Cooke's dial telegraph 1840; 17] Wheatstone's Cross-Channel Cable 1840; 18] Wheatstone demonstrating his dial telegraph to Prince Albert, 1843; 19] Cooke & Wheatstone's first two-needle telegraph instrument; 20] Paddington terminus of the Great Western Railway in 1842; 21] The "Telegraph Cottage", Slough, on the Great Western Railway 1843; 22] Cooke & Wheatstone's two-needle telegraph, Great Western railway 1843; 23] Wheatstone's patent type-printing telegraph 1841; 24] The First Long Line in Britain; 25] Wheatstone's Electro-Magnetic Dial Telegraph 1843; 26] Cooke & Wheatstone's two-needle telegraph, London & Croydon Railway, 1846; 27] Mr Punch's Railway; 28] The South-Eastern Railway's Harbour at Folkestone; 29] Great Western Railway telegraph posters 1843

2. The Electric Telegraph Company: 1] The Electric Telegraph Company Central Station, Founders' Court, Lothbury, London; 2] The monogram of the Electric Telegraph Company; 3] The Electric Telegraph Company's Admiralty instruments 1847; 4] The Electric Telegraph Office 1846 No 345 Strand; 5] The Electric Telegraph Company's Subscription Room 1847 No 142

Strand; 6] Cooke & Wheatstone' double-needle telegraph; 7] The launch advertisement for the Electric Telegraph Company, September 1, 1847; 8] The Great Western Railway Telegraph 1849; 9] The Public Hall of the Central Telegraph Station 1848; 10] The Electric Telegraph Company's Secretary's Office, No 64 Moorgate Street; 11] Map of the location of the Electric Telegraph Company's Central Telegraph Station, Secretary's Office and its General Offices in Telegraph Street; 12] The Telegraph on the South Devon Railway at Dawlish, 1848; 13] The Electric Telegraph Company's West-End Office 1849, No 448 West Strand, Charing Cross; 14] Euston Square Station of the London & North Western Railway Company 1851; 15] The Telegraph Station at Tonbridge 1850; 16] William Reid's Single Needle Telegraph, 1851; 17] The Great Exhibition Season Ticket of Jacob Brett; 18] The Electric Telegraph arrives in Parliament; 19] The Holyhead Howth Cable 1852; 20] The Telegraph Station at Charing Cross in 1852; 21] The "Public Face" of Charles Shepherd's electric clock at Greenwich 1870; 22] The Edinburgh Time-Ball; 22] Electric Telegraph Company's Parliamentary Bulletin; 24] Bookplate from J Lewis Ricardo's Library 1858; 25] The telegraph alongside of the railway in 1850; 26] The Great Northern Railway telegraph 1852; 27] The Instrument Room at Charing Cross; 28] The Electric Telegraph Company's steamer Monarch 1853; 29] The Electric Telegraph Company's London - Liverpool - Manchester Circuits 1861; 30] The Telegraph Gallery, Telegraph Street 1859; 31] A Plan of the Instrument Gallery of the Electric Telegraph Company's General Offices, Telegraph Street 1868; 32] The Company's Factory, Camden Town; 33] Connections & Tariffs Leaflet 1860, 34] The German-Austrian Telegraph Union; 35] The Electric Telegraph Company's coast station, Dunwich, 1858; 36] The Official Seal of the Electric Telegraph Company

3. Competitors & Allies: 1] Northampton & Peterborough telegraph 1845; 2] The British Electric Telegraph Company's Chief Office 1852; 3] The British Electric Telegraph Company's Chief Office 1855; 4] The steam-tug 'Goliath'; 5] Landing the Submarine Telegraph Company's Belgian cable 1854; 6] The Submarine & European Telegraph Companies' City Office, No 30 Cornhill, London; 7] The Submarine Telegraph Company's office, 58 Threadneedle Street, London; 8] The Seal of the Electric Telegraph Company of Ireland; 9] Royal Exchange Buildings, London 1845; 10] The British & Irish Magnetic Telegraph Company's Central Station, Threadneedle Street, City, 1859; 11] The Edinburgh Time-Gun 1861; 12] Tyer's telegraph 1861; 13] Ordering Wine On-line 1862; 14] Mr Punch on the District Telegraph; 15] Hughes' type-printing telegraph 1863; 16] The Croll Testimonial, 1871; 17] Bonelli's Typo-telegraph 1863; 18] A Bonelli telegram 1863; 19] Breguet galvanic dial telegraph 1868; 20] The Indo-European Telegraph Company in 1870; 21] Siemens Indo-European Pole and Insulator 1965; 22] The South Eastern Railway Company's *Princess Clementine* cable steamer 1849; 23] Landing the South Eastern Railway's cable at Folkestone 1849; 24] South Eastern Railway Telegraphs in 1850; 25] South Eastern Railway London Bridge Telegraph Office 1849; 26] Roche's Point Telegraph, Cork, 1862; 27] The Telegraph from a book-title of 1850

4. The Universal Telegraph: 1] Charles Wheatstone's Universal Telegraph 1863; 2] Wheatstone's Galvanic Dial Telegraph 1840; 3] Wheatstone's Magneto-Electric Dial telegraph 1840; 4] Wheatstone's galvanic dial telegraph 1855; 5] The Electric Telegraph Room at the Houses of Parliament 1859; 6] The original Indicator of the Universal Telegraph in 1859; 7] The Volunteer Sham Fight, Bromley, Kent 1860; 8] The original Communicator of the Universal Telegraph in 1859; 9] The Universal Private Telegraph Company's Plan for London 1860; 10] Reuter's West End Office, 9 Waterloo Place, Pall Mall 1861; 11] Wheatstone's Universal telegraph instrument of 1863; 12] Pneumatic Despatch Company's Tube Railway 1863; 13] Edinburgh Electric Time Gun 1861; 14] Holmes' Electrical Torpedo 1866; 15] Wheatstone's Large Dial Indicator 1868; 16] "Captured by the Telegraph"; 17] Scotland Yard 1860; 18] Wheatstone's Magnetic Recording Instrument or Counter 1862; 19] Wheatstone's Magnetic Counter 1872; 20] Wheatstone's Cryptograph 1860; 21] Wheatstone's Universal Telegraph communicator 1859; 22] Wheatstone's Universal Telegraph indicator 1859; 23] Wheatstone's Universal Telegraph 1863; 24] Wheatstone's Universal Type Printer 1863; 25] Wheatstone's Portable or Military Universal Telegraph 1867; 26] Aerial Cables of the Universal Private Telegraph Company; 27] Pole and Wire Suspension System of the Universal Private Telegraph Company 1863; 28] A Connecting Box of the Universal Private Telegraph Company 1863; 29] Wheatstone's Magnetic Exploder 1867; 30] Breguet Dial Telegraph Apparatus 1867; 31] Siemens Magneto Dial Telegraph 1859; 32] Chandos Street Fire Engine Station; 33] Henley's Magneto Dial Telegraph 1861; 34] Wilde's Globe Telegraph 1861; 35] Alice looks into the future; 36] Albion Telegraph 1870; 37] "Albert, We have mail"

5. Bain: 1] Bain Clock 1848; 2] Bain Pendulum 1848; 3] Bain Clockwork 1848; 4] Bain Companion Clock 1848; 5] Bain type-printing telegraph 1841; 6] Bain Railway Controller 1841, 7] Bain & Gauci Inkstands 1841; 8] Chemical Telegraph 1843; 9] Bain improved I & V Telegraph 1845; 10] Bain I & V Code 1850; 11] Bain Copying Telegraph 1850 front; 12] Bain Copying Telegraph 1850 side; 13] Bain electric motor; 14] Bain Electric Printing Telegraph 1844; 15] Control Dial of Bain's Electric Printing Telegraph 1844; 16] Print head and printing cylinder of the electric printing telegraph 1844; 17] Bain Chemical Printer, Electric Telegraph Company, 1855; 18] Bain Alphabet 1848; 19] Austrian Bain I & V Telegraph 1846; 20] Bain late model Chemical printer 1855; 21] Bain US Chemical Telegraph 1848; 22] Bain "band" telegraph 1851; 23] Bain "finger pedal" or key; 24] Bain Electro-Chemical Telegraph, rotary sender and receiver 1850; 25] Bain electric clocks 1852; 26] Bain Shop Advert May 1852; 27] Bain electric companion clocks 1852; 28] Bain Dial Telegraph 1863

6. Non-Competitors: 1] The General Telegraph Association's Southwark station 1843; 2] Admiralty Shutter Telegraph, Deptford, London 1825; 3] Liverpool & Holyhead Marine Telegraph, Llandudno 1856; 4] Watson's Code of Signals for Shipping 1838; 5] General Telegraph Association Sydenham signal station 1842; 6] Davy's Recorder 1838; 7] Alexander's telegraph 1837; 8] Crosley's Pneumatic Telegraph 1839; 9] Jowett's Hydraulic Telegraph 1847; 10] Highton's gold-leaf telegraph 1846; 11] Nott & Gamble's dial telegraph 1845; 12] Whishaw's Velocentimeter 1846, 13] Whishaw's Telekouphonon 1852; 14] & 15] Whishaw's Telekouphonon 1865; 16] Siemens galvanic index or dial telegraph 1847; 17] Kramer's galvanic dial telegraph 1848; 18] Wilde's Globe telegraph 1863; 19] Telegraph Ship *Brisk* 1870

7. How the Companies Worked: 1] "The Telegram"; 2] The Telegraph Office at the Dublin Exhibition 1862; 3] The Telegraph Office at Nine Elms 1844; 4] Message Receipt Form, Electric Telegraph Company, 1868; 5] Telegram Receipt, London & Provincial Telegraph Company 1869; 6] Electric Telegraph Company Delivery Form 1853; 7] A Messenger of the Electric Telegraph Company 1868; 8] British & Irish Magnetic Telegraph Company Delivery Form; 9] Normanton station 1845; 10] The Ladies of the Instrument Gallery; 11] The Telegraph Song; 12] Electric Telegraph Company Stamped Message Paper 1852; 13] The first Telegraph Stamp 1854; 14] The English & Irish Magnetic Telegraph Company's Frank Stamp 1854; 15] The Electric Telegraph Company's Telegraph Stamp 1861; 16] The first electric advertiser 1864; 17] The monogram of the Electric Telegraph Company; 18] The Otherside of New Technology; 19] Messengers' Kitchen, Telegraph Street 1870; 20] Electric Telegraph Company Message Receipt 1853; 21] The British Telegraph Company's Frank Stamp 1855; 22] Electric Telegraph Company "Mercury" 1855

8. What the Companies Charged: 1] "Social Messaging" 1862

9. The Companies and the News: 1] The Telegraph Hass; 2] Telegraph Company Press Pass; 3] Reuter arrives in London! 1851; 4] Reuter's Telegram No 1

10. The Companies and the Weather: 1] Sample and Explanation of the Weather Cypher Messages 1865; 2] The Daily Weather Map 1861

11. The Companies Abroad: 1] The first message received by the Submarine Telegraph Company; 2] East India Company telegraph 1854; 3] Siamese Twins - England and France 1851; 4] SS Great Eastern 1866

12. The Companies' Foreign Operations: 1] "Monarch", the first dedicated cable-laying steamer 1853 – 1870; 2] The European Alphabet 1853

13. Railway Signal Telegraphy 1838 – 1868: 1] Cooke's Railway Signal Telegraph 1844; 2] Cooke's "engine warner" 1841; 3] Cooke & Wheatstone's Railway Signal Telegraph 1850; 4] Wheatstone's Magnet-and-Bell 1846; 5] Clark's Railway Signal Telegraph 1854; 6] Tyer's Patent Train Signalling Telegraph 1868; 7] C V Walker's Miniature Semaphore 1854; 8] C V Walker's Bell 1852; 9] South-Eastern Railway Signal Box at London bridge 1866; 10] Bartholomew's Railway Signal Telegraph 1855; 11] Rudall's Railway Bell Signal 1863; 12] A Signal Box on the South-Eastern Railway in 1865

14. Telegraph at War 1854 – 1868: 1] The Siege of Sebastopol; 2] The Electric Telegraph Company's War Wagon 1854; 3] Cadogan's patent army telegraph carriage 1853; 4] Latimer Clark's Cable-laying Plough 1855; 5] Monastery telegraph station, Balaklava 1855; 6] Henley's Portable Military Telegraph; 7] Leseurre's Solar Telegraph 1855; 8] Bolton's Portable Field Telegraph 1863; 9] Wheatstone's Universal military telegraph 1868; 10] Mobile Military Telegraph Office 1868; 11] Military Wire and Stores Waggon 1868; 12] Bolton's Cipher Wheel 1868; 13] The Field Electric Telegraph Train 1868; 14] The Field Electric Telegraph on exercise at Dover 1869; 15] The Field Electric Telegraph practising at Dover 1869; 16] Laying a Field Telegraph 1870; 17] Zula in Abyssinia 1868; 18] To wind up the story...

15. Technical Detail: 1] The Electric Telegraph, then and now, 1859; 2] British Telegraph Codes 1868; 3] Charles Wheatstone's Five-Needle telegraph 1837; 4] A segment cut from W F Cooke's first electric telegraph circuit; 5] W F Cooke's Four-Needle telegraph 1839; 6] Cooke's "butterfly" key or rotating switch 1837; 7] Cooke & Wheatstone's original Single-Needle and Two-Needle telegraphs 1841; 8] Morse's first receiver 1838; 9] Morse's first relay 1838; 10] Morse's first sender; 11] The American Telegraph 1850; 12] Turnplates 1855; 13] Cooke's Detector and sand battery 1847; 14] Cooke & Wheatstone's *Paratonnerre* 1847; 15] Cooke & Wheatstone's Alarum, 1847; 16] Cooke & Wheatstone's Tunnel Bell 1847; 17] William Reid's Cooke & Wheatstone Two-Needle telegraph 1851; 18] Cooke & Wheatstone's Two-Needle telegraph 1848; 19] Cooke & Wheatstone's Portable Two-Needle telegraph 1850; 20] Cooke & Wheatstone's Single-Needle telegraph; 21] Cooke & Wheatstone's Two-Needle Code 1843; 22] Cooke & Wheatstone's New Two-Needle Code 1860; 23] Cooke & Wheatstone's Single-Needle Code 1841; 24] Cooke's Original Telegraph Poles 1843; 25] Electric Telegraph Company's Screw Pile for securing Poles 1860; 26] Electric Telegraph Company's Wire Stretcher 1860; 27] Edwin Clark's Insulators 1852; 28] Electric Telegraph Company's Proving Box 1848; 29] Electric telegraph Company's Underground Pipe 1848; 30] The Test Box 1848; 31] Bain Chemical Telegraph 1848; 32] Clark's Perforator for the Bain printer 1850; 33] W H Hatcher's Double Index Telegraph 1848; 34] Siemens & Halske's earliest American Telegraph 1855; 35] Bakewell's Copying Telegraph 1851; 36] Images from Bakewell's Copying Telegraph in November 1850; 37] Varley's double-current key 1853; 38] Wheatstone's Automatic telegraph 1868; 39] Electric Telegraph Company "Umschalter" 1860; 40] The Chronopher; 41] Haworth's Wireless Telegraph Apparatus 1862; 42] Latimer Clark's Patent Air and Vacuum Message Tube 1853; 43] Varley's Pneumatic Tube 1870; 44] Varley's Interior Pneumatic Tube 1870; 45] Cooke & Wheatstone's two-needle telegraph; 46] Highton's single-needle telegraph 1852; 47]

Highton's Insulators 1852; 48] Henley's Magneto-Electric Telegraph 1851, external view and internal arrangements; 49] Henley's large magneto telegraph 1851; 50] Bright's Improved Magneto Telegraph; 51] Henley's Split Pipe 1853; 52] Jacob Brett's Printing Electric Telegraph 1852; 53] Jacob Brett's Type Printer 1851; 54] Jacob Brett's Rotary Transmitter 1851; 55] Jacob Brett's "Portable Telegraphic Communicator for Railway Guards, &c."; 56] Cooke & Wheatstone's Two-Needle Telegraph used by the Submarine Telegraph Company; 57] Bright's Bell Telegraph 1856; 58] Highton's key or tappers; 59] Henley's magneto-dial telegraph 1861; 60] Charles Bright's Patent Insulator 1858; 61] Tyer's Single Needle Telegraph 1859; 62] The Hughes Type-printing Telegraph 1863; 63] A sample message from Hughes's type-printing telegraph 1864; 64] Rutter's Electric-Indicator 1847; 65] Shelves of Cruikshank batteries 1848; 66] A Cooke 24 cell "sand" battery 1846 – 1824; 67] A Daniell Cell 1855; 68] A Battery of Daniell cells 1855; 69] A Muirhead Battery 1857; 70] Thomson's Mirror Galvanometer 1858; 71] The Battery Room; 72] Queen's Telegraph 1851 - 1880

The Rest of the World: 1] The Telegraph in Europe map 1854; 2] The first American telegraph used in Europe 1848; 3] The German-Austrian Telegraph Union map 1852; 4] The Telegraph Stations of America 1853; 5] American Telegraphs and Cells c 1855; 6] The American telegraph; 7] The House Type Printer; 8] The Hughes Type Printer; 9] The American District Telegraph; 10] Wiener Privat-Telegraphen-Gesellschaft Stamp and Receipt 1870

Telegraph Maps: 1] Great Britain 1852; 2] Europe 1856; 3] Europe 1860; 4] The East 1865; 5] London 1866; 6] City Telegraphs 1868, Plans of Birmingham, Edinburgh, Glasgow, Leeds, Liverpool and Manchester
Appendices: 1] Mr Punch at the Electric Telegraph

SPECIAL THANKS
My special appreciation goes to Bill Burns of Atlantic Cable for sharing his knowledge of telegraphy, and for generously and patiently managing the constant additions and corrections to the original online version of *Distant Writing* on his website, as well as for his continued advice and support.

My thanks also go to Ivor Hughes for information on Prof D E Hughes and his connection with the United Kingdom Electric Telegraph Company, to Fons Vanden Berghen for putting me right regarding Cooke & Wheatstone in Belgium and the Netherlands, and to Cor Scholten for details on the *Rijkstelegraaf*.

I am deeply obliged to Donard de Cogan for permission to quote from 'The Autobiography of James Graves' and 'Thirty-Six Years in the Telegraphic Service'. These contain detailed experiences of his wife's kinsman, James Graves, with telegraph and cable companies.

Ann Galliard has also provided all manner of detail on the launch of the West Highland Telegraph in her native Scotland, for which I thank her. All the more appreciated because it involves the writer's favourite concern, the Universal Private Telegraph Company.

Thanks too, to Brian P Willmot for his background details on C V Boys, George Saward and Henry Weaver, discovered in his researches into his ancestor Joseph William Willmot, an apprentice with the Electric Telegraph Company – who went on to greater things.

Appreciation is offered to Paul Hellier for discovering and sharing many interesting documents relating to the telegraphs of the East India Company.

I must also thank H R Bristow of the Scientific Instrument Society for his excellent histories of Watkins & Hill and M W Theiler & Sons, two of the earliest specialist makers of telegraph apparatus in Britain.

John Liffen, curator of communications at the Science Museum in London, was most generous in sharing his original research into Cooke & Wheatstone's first steps in telegraphy. He is to be heartily thanked for his new discoveries, and for the preservation of so much telegraph heritage.

Neil Mackay of the North Eastern Railway Association has generously sent me details of his research into Alexander Bain's I & V telegraph used on the Shildon Tunnel of the Stockton & Darlington Railway. He and his colleagues are preparing a history of railway signalling on the North Eastern Railway.

John Bunker took the trouble to introduce me to his fine book 'From Rattle to Radio' describing the development of communications in the Metropolitan Police. It is a truly excellent, and sadly neglected, source. For which many thanks.

Fons Vanden Berghen has generously sent me a copy of his latest, splendidly illustrated book, *Het Internet van der 19e Eeuw*; a long-needed, comprehensive history of early telecommunications in Europe.

DEDICATION
To Maria Elkington, who appealed in the 'Telegraphic Journal' on behalf of her sisters for a half-day off on December 24, 1864 for "the pleasure of helping to make, as well as to eat our Christmas pudding".

Maria Elkington was born in 1843 in St Pancras, London, where her father was parish clerk. She trained to be a teacher of children but by 1864, when age 21, like over three hundred and fifty other young ladies in London, she was at work on the electric telegraph.

Issue: December 4, 2012