

Greenwich and Woolwich and the start of the international telecoms revolution

From the 1850s for a century and a half, the Thames in Greenwich and downstream was home to the development of international communications technology, from the electric telegraph to today's internet. **Alan Burkitt-Gray** looks at the importance of the sites and their implications

Industrial archaeologists – including those in GLIAS – do not just talk about the tremendous technological changes of the past three centuries or so, but also about their wider effects on society: mining and steel-making; docks, roads, canals and railways; brewing and food-making; water, gas and electricity. And so on.

But, even though developments in the electric telegraph and telecommunications industries have run through 175 years of history since their invention through to the present day, it is rare that industrial archaeologists pay due attention either to those technologies themselves or to their enormous political, economic or societal effects.

Yet, as the recent pandemic years show, we owe a lot to telecommunications technology. This very article is based on research that started out for a presentation I did during lockdown in October 2020 for a talk – delivered via Zoom – to the Greenwich Industrial History Society (GIHS).

Without the advances of the past five years – built on the technological developments of the previous 175 years or so – much of our family and economic life would have come to a halt when the COVID pandemic took hold in early 2020. Either that or we would have been forced to ignore the risks and the death toll would have been more than the 7 million recorded so far. Telecommunications has helped to keep the world connected.

Let us compare and contrast the world before telecommunications and the world after 1851, when the first subsea cable across the English Channel went into service, linking the British telegraph networks, already extensive, with the emerging networks in mainland Europe and beyond. Let's start at the beginning, with the correspondence between Pliny the Younger and Trajan, the Roman Emperor. Pliny (or Plinius in Latin) was Trajan's governor of Bithynia and Pontus, now in modern Turkey, 1,600km from Rome as the crow flies. But the crow didn't fly: Pliny's letters – many of which are still in existence – had to go by sea via the Black Sea, the



Enderby House, formerly the headquarters of Telcon and subsequently of STC's submarine cable business, derelict and unprotected in 2014

Aegean and the Tyrrhenian Sea along the west coast of Italy to Ostia, the port of Rome, a total distance of 2,300km or so.

Speed would be anything from 6 to 12 km/h, depending on wind conditions. Sometimes ships were becalmed. Even with an efficient postal service, in the best case Pliny's letters could take a week to reach Trajan; and there'd be a week for the emperor's reply.

We have more recent evidence of the consequences of delay. In the American War of Independence, lives were lost because the rival armies – that of Britain and that of the newly formed United States – did not know that their political leaders had signed a peace treaty in Paris on 3 September 1783. Congress ratified the decision on 14 January 1784 and the signed treaty didn't reach Paris, putting it into legal effect, until March. Six months.

In the early years of the nineteenth century, the battle of Trafalgar between the British and French navies took place on 21 October 1805, off the south-west coast of Spain. The Admiralty didn't get to hear about either the battle or Horatio Nelson's death until 6 November, two and a half weeks later.

Nearly ten years later, on 18 June 1815, the French faced the British and the Prussian armies at Waterloo, about 25km south of Brussels, and Napoleon's army lost – bring to an end 25 years of war in Europe. The news reached the minister of war in London in the evening of 21 June. It was reported in the press the following day.

And that was just carrying the news to London in the early 1800s. Consider the time it took to carry the news to the rest of the country. For all of human history and prehistory, the fastest way of delivering news and information was via a rider on a horse.

According to research by Dan Bogart, an associate professor of economics at the University of California, Irvine, the travel time between London and Manchester was around 90 hours in 1700. By 1787 it had fallen to 24 hours. The biggest improvement to the speed of information was the development of the turnpike roads, well surfaced roads on which horses and carriages, or stage-coaches, could travel fast. But the horse was still the limiting factor.

The French revolution brought about the first significant improvement in the speed of information flow. Claude Chappe built a semaphore network for Napoleon, sending messages from hilltop to hilltop, by line of sight, using hill stations with a set of rotating arms to show successive letters and numbers. The network covered the country, radiating out from Paris.

A British naval officer, investigating after the battle of Waterloo, found it was possible to send a message from Paris to Strasbourg in fifteen minutes. Those cities are 400km apart, so that means the signal travelled at an average speed of 1,600km/h – a lot faster than a dispatch rider on a horse. It's also, incidentally, faster than the speed of sound, which is about 1,200km/h.



36 West Square, close to Elephant and Castle, the building that housed the Admiralty's semaphore telegraph station on the route to Deal

However, there were no time zones or co-ordinated clocks in the early 1800s. Paris and Strasbourg would both have used their own solar time. The only way to test the speed would have been to send a message out to Strasbourg and wait for an answer – what in the telecoms and internet industries is called round-trip time.

The Admiralty's first telegraph

In the 1790s, as the war against France was building up, the UK's Admiralty built its own telegraph networks, including one from London to Portsmouth and one to Deal on the Kent coast. The Admiralty used shutters rather than arms, so they were harder to read through a telescope. The shutters encoded letters, numbers and a few words – words that were important to the British Royal Navy, such as "French", "admiral", "Dutch" and "fog".

Both lines of communication started at the Admiralty in Horseguards Parade just off Whitehall in central London, approximately on the site of the World War 2 bunker. The Deal line had 10 intermediate stations. The first after the Admiralty building was at 36 West Square near the Elephant and Castle, a building that still exists, though the tower carrying the semaphore equipment has

long since been removed from the roof. The building was also the home of the Admiralty's superintendent of telegraphs and it was sold for £2.85 million in 2018. The next telegraph station was at Plow Garlic Hill in Nunhead, where today there is a tennis court in what's now called Telegraph Hill Park. After that, the line went to the top of Shooters Hill in Woolwich, still used for telecoms, and so on eastwards into Kent.

However, the fundamental problem with semaphore telegraphs is that they did not work successfully at night or – especially a problem in London in the nineteenth century – when there was fog.

Experiments in electricity

But London was the pioneer in developing a resilient alternative, the electric telegraph. Why did it all happen in London? Largely because of a combination of people in the Royal Institution in Albemarle Street and in King's College London in the Strand, and the presence of entrepreneurs in London. The Royal Institution and King's College were the places where the fundamentals of electromagnetism were developed: the science and technology that were used in the electric telegraph, and later in electric motors and in telephones. The main people were Humphry Davy, Michael Faraday, Charles Wheatstone and William Fothergill Cooke, who all contributed to London's pre-eminence as the centre for the development of telecommunications.

Davy was born in Penzance in Cornwall in 1778, a place that led the world in the development of steam engines to pump out tin mines. He became a laboratory superintendent in Bristol and by 1801 was at the newly founded Royal Institution, experimenting on galvanism. He was a Fellow of the Royal Society at 26. That was just over half the average age when scientists, all men in those days, were elected to the Royal Society. Michael Faraday FRS, born in 1791 in Newington Butts near the Elephant and Castle, started as Davy's lab assistant at the RI after attending his lectures. He built a battery, then called a voltaic pile, in 1812 – and went on to discover and describe the fundamentals of electricity and magnetism.

Charles Wheatstone FRS, born in 1802 in Gloucestershire, was apprenticed to his uncle, a musical instrument maker, at 436 Strand, now the site of a Three mobile phone shop. In 1834 he became professor of experimental physics at King's College London, just along the Strand from his uncle's shop – that's where he invented the Wheatstone bridge, beloved of physics A-level students. The following year he started developing work by a German scientist, Pavel Schilling, leading to the pioneering electric telegraph. William Fothergill Cooke was not a scientist, but he was the son of a surgeon and served in the private army of the East India Company. On his departure from the army he became interested in telegraphy in 1837, and went into partnership with Wheatstone – an entrepreneur and a scientist.

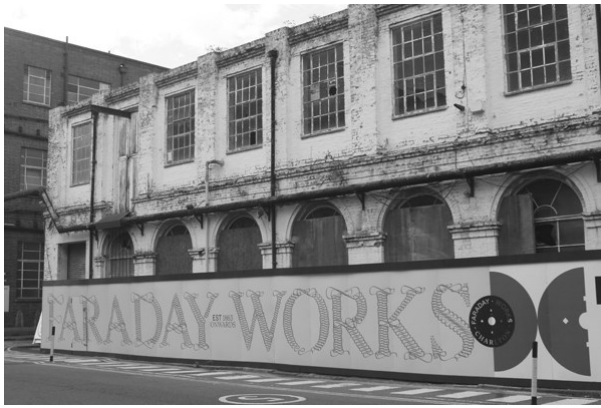
First task, as any entrepreneur will know, is identify your customer. Who needed the electric telegraph in 1837? There was one obvious candidate – the railways. Cooke and Wheatstone found customers with the London and Blackwall Railway, which built the route that is today covered by the Docklands Light Railway from the City to the Isle of Dogs; as well as with the London and Birmingham Railway, north from Euston, and the Great Western Railway from Paddington. When the London and Birmingham completed the last stretch of its line into Euston in 1837, working from north to south, unlike today's HS2 line, it needed a signalling system, because departing trains were pulled out of Euston uphill by cable to Camden by a stationary engine. Cooke and Wheatstone used their telegraph as a way of alerting the engineer in Camden to haul away.

The GWR opened from Paddington to Maidenhead in 1838, and, as a high-speed line it needed reliable signalling. The electric telegraph was ideal, and the GWR also offered services to the public. The world's first commercial electric telegraph opened from Paddington to West Drayton on 9 April 1839, 181 years ago. This was a full five years before Samuel Morse, who sent his famous first message, "What hath God wrought", without the question mark, on 24 May 1844. That was also along a railway line, from Washington to Baltimore.

However, Morse had a huge advantage. He invented the Morse code, as we call it today, by which messages could be sent on a single wire, with an earth connection as the return. Cooke and Wheatstone's five-needle telegraph needed five wires plus earth. The wires weren't very well insulated and didn't work well.

The London and Blackwall, opened in 1840, ran along a brick viaduct, which still exists, to what we know as Island Gardens, but then was called North Greenwich. For a time it used cable haulage, and the Cooke and Wheatstone telegraph coordinated the trains.

This all means that it was just a few years between Wheatstone starting work on telegraphy at King's College in the Strand and the first commercial applications. By any standards, that is fast development. And there was more to come. In 1846 Cooke, the entrepreneur, set up the Electric Telegraph Company: as the GWR had shown, this technology wasn't just for railways. It allowed companies, governments and individuals to send commercial and



Siemens Brothers' factory in Charlton/Woolwich, now being adapted for offices, studios and flats

for hose pipes, and speaking tubes that people could use to talk confidentially on trains – railway conversation tubes, they were called.

There was even an invention called the medical man's midnight friend, a speaking tube from the front door to a doctor's bedside, through which he could ask a patient – or a patient's relative – for details of why he was being called out. The Duke of Devonshire had a speaking tube installed in Lismore Cathedral in County Waterford in Ireland so he could hear the sermons. And 800 boys at Greenwich Hospital were kitted out with shoes soled with gutta percha.

The Gutta Percha Company had a showroom at 98 New Bond Street, a building that is today a clothes shop. The two places for production of gutta percha goods were in Silvertown in east London, and in Wharf Road, between two canal basins on the Regent's Canal.

The Electric Telegraph Company was set up by John Lewis Ricardo, a Liberal MP and chairman of the North Staffordshire Railway Company, who bought out Cooke and Wheatstone's patents, though retained Cooke. The

Clock at Greenwich Observatory, which provided the first national time signals via telegraph lines



company's first project was to connect London with Birmingham, Manchester and Liverpool. Mostly their wires were suspended from poles but sometimes they needed insulation. Tar, wax and pitch didn't work, and Michael Faraday suggested gutta percha. The first person to actually use gutta percha seems to have been Werner von Siemens, one of the formidable trio of Siemens brothers. One of his brothers, Wilhelm, or William, and later Sir William, came to London to set up a factory for the company in Charlton. Another brother, Karl Heinrich, set up the Russian operation in St Petersburg. Their Charlton factory, though they called it Woolwich, was just to the west of Woolwich Dockyard. The oldest buildings date to 1863, and development continued until the 1950s

But they encountered problems with water.

Fortunately they found a solution with the gutta percha tree, related to the rubber tree and grown in Malaysia. Like rubber, it produces a sap, but, unlike rubber, it crystallises into a hard material. Malaysians had used it as a material from ancient times, but John Tradescant brought it to Europe in 1656. It softens when immersed in hot water, and then hardens again. It's waterproof and also, handily, it's an electrical insulator. Before telegraphy, gutta percha was used

for hose pipes, and speaking tubes that people could use to talk confidentially on trains – railway conversation tubes, they were called.

Channel communications

On 10 January 1849 the UK operation of Siemens Brothers worked with the South Eastern Railway to lay two miles of gutta percha-insulated telegraph wire from a ship, the Princess Clementine, in the Channel – and they successfully sent messages to London. This led to the world's first working subsea cable, in 1850, across the Channel to Calais. But it survived only a few hours before the insulation gave way and messages became garbled and then non-existent.

The second attempt was better, with cable made initially at Wilkinson and Weatherley in Wapping High Street,

then – after a patent dispute – in Gateshead at Newall and Company and at Küper and Company on the Surrey Canal (I've been unable to identify the exact location). By 13 November 1851 Dover and Calais were connected by telegraph, as they have been, apart from in times of war, ever since. The Gutta Percha Company's insulation was vital and within the first two years the company had supplied 1,300 nautical miles; that's 2,400km.

The South Eastern Railway had another historic role in telegraphy, in Lewisham, an unintended consequence of the development of electric telegraphy. In 1849 the SER – the original company, not the brand that operates trains today – came to an agreement with the Astronomer Royal, George Airy, to carry time signals from the Royal Observatory along its tracks from Lewisham, first to London Bridge station and then via the Electric Telegraph Company to Founder's Court, Lothbury, in the City of London, so all the clocks and particularly the different railway companies' clocks could coordinate on Greenwich Mean Time, or Railway Time as many called it. Within weeks the SER was distributing Greenwich time to stations across its network, including Ashford, Blackheath, Dover, Erith, Folkestone, Gravesend, Redhill, Strood and Woolwich. This was three decades ahead of Parliament's declaring that Greenwich Mean Time was the legal standard time for the UK. The International Meridian Conference, held in Washington DC in October 1884, made GMT the basis of standard time worldwide. US railroads had already adopted GMT as the basis of their timetables. Without telegraphy from Greenwich, across the Atlantic via subsea cables built in Greenwich, that wouldn't have been possible.

In 1853 the Wharf Road gutta percha factory burned down. Though it was rebuilt on the same site, in 1854 much of the operation moved to Morden Wharf in Greenwich. One of the Gutta Percha Company's neighbours on the west side of the Greenwich Peninsula was another cable maker, W T Henley, which later moved to North Woolwich, where there is still a Henley Road, surrounded by dereliction. A series of mergers saw the creation of Glass Elliot in Greenwich, at Enderby House, alongside the Gutta Percha company in Morden Wharf. The house is named after the Enderby family, who were whalers: there is an Enderby Land in Antarctica.



Cyrus Field Street, Greenwich, named after the main financier behind the original Atlantic cables, after a suggestion from the Enderby Group

Across to the Americas

With land-based telegraph cables covering much of Europe and North America, and linking Britain to the mainland of Europe, the next big project was to cross the Atlantic. The financier behind the project was Cyrus Field, an American, now commemorated in a rather short street in the new housing development behind Enderby House. This pioneering cable, 2,500 nautical miles or 4,600km, was built by Glass Elliott in Greenwich and Newalls in Birkenhead. The Greenwich cable was put aboard HMS Agamemnon, an ageing British ship, while an American ship, the USS Niagara, took the Birkenhead portion.

They started in 1857 but the cable snapped. They started again in 1858, the ships meeting in mid-Atlantic. There were a few more breakages, but by August the American ship had reached Trinity Bay in Newfoundland, a British colony, and the Royal Navy ship had reached Valentia in western Ireland, still part of the UK. Trinity Bay was connected by a short stretch of submarine cable to the North American mainland, through Canada and the US. Queen Victoria sent a message to President James Buchanan, the fifteenth president, calling the cable “an additional link between the nations whose friendship is founded on their common interest and reciprocal esteem”. Buchanan said: “It is a triumph more glorious, because far more useful to mankind, than was ever won by conqueror on the field of battle. May the Atlantic telegraph, under the blessing of heaven, prove to be a bond of perpetual peace and friendship between the kindred nations, and an instrument destined by Divine Providence to diffuse religion, civilization, liberty, and law throughout the world.” But scientists and engineers still didn't understand the complexities of electricity, nor insulation. They ran the cable at 2,000V, because they thought that was needed to get a signal from one end to the other. In spite of this, the cable worked slowly, just three words a minute, but the gutta percha insulation broke down within a month. Field sold off spare bits of the cable via Tiffany's in New York, complete with certificate, and it is occasionally possible to pick them up on eBay.

In 16 years following, despite the American Civil War, the London factories produced 14,000 nautical miles,



Launch site of the Great Eastern on the Isle of Dogs: designed as a passenger liner, Brunel's ship was used for the first two successful Atlantic cables in 1866 and the first Britain-India cable in 1870

26,000km, of cables that were used in the North Sea, the English Channel, the Aegean, the Mediterranean, the Gulf, and the Bay of Bengal.

Meanwhile, in 1864, Glass Elliott merged with the Gutta Percha company to create the Telegraph Construction and Maintenance Company, a name that lasted until the 1950s. It was usually abbreviated to Telcon, and Enderby House was its headquarters. Top of its agenda was a new attempt at an Atlantic cable. Cyrus Field was back in the business, but Telcon needed money, and an imaginative way to lay four and a half thousand kilometres of newly designed cable. This is where the network of business people came to the rescue. Just across the river from Deptford and Greenwich, at Millwall Iron Works on the Isle of Dogs, Isambard Kingdom Brunel designed and built the Great Eastern. It was intended to carry passengers to Australia. It was launched with great difficulty into the river in 1858.

It is still possible to see the launch site of the Great Eastern, a short walk along the river westwards from Island Gardens DLR station. The chains, now part of a scheduled ancient monument, that are laid out on the site closely resemble those in front of which Brunel is standing in the famous photograph by Robert Howlett, taken in 1857. The Great Eastern, which would be the largest ship to be built for the next 40 years, was a failure. Brunel was most famous for the Great Western Railway. His chief engineer, Daniel Gooch, formed a company to buy the Great Eastern from its near-bankrupt owners in Liverpool for just £25,000. It was refitted in Sheerness to carry cable, and the Great Eastern started its life as a cable-laying ship.

The new cable

Work started on a new Atlantic cable on 23 July 1865 from the west of Ireland – but the project lasted barely a week before the cable broke and fell to the bottom – 2,000 fathoms, more than three and a half kilometres deep.

The Great Eastern went home, to start again a year later, on 13 July 1866. This time a complete cable was landed in Heart's Content, Newfoundland, after a journey of only 14 days. The cable was connected and then the ship went back to grapple up the cable lost the previous year. It was spliced to a new cable and the Great Eastern continued back to Newfoundland with a second complete connection. That meant the world went from no cable to two cables across the Atlantic in just a few weeks. Since then, North America and Europe have been connected by the electric telegraph without a break, and then by phone, and now the internet.

In 1870 the Great Eastern laid much of the first submarine cable from Britain to India. This was built by

Telcon, and was laid in several stages, calling on the way at Suez in Egypt, the British base in Aden, now in Yemen, and across the Indian Ocean to Bombay, now Mumbai.

Let's now go back down the River Thames to Siemens Brothers. The British arm of the company was German-owned, but on 4 August 1914, World War One broke out. For such a huge operation it took more than a year for the legal situation to be sorted out – the company was enemy property, and was finally put in British hands in January 1916. Meanwhile, within hours of the declaration of war, in the early morning of 5 August 1914, the UK's General Post Office had sent out a cable-laying ship to cut Germany's cables to Spain and the US.

After the Armistice in 1918 the Woolwich operation of Siemens remained a British company. It sold its operations in Stafford to English Electric and Siemens Brothers re-formed an association with Siemens of Germany. It bought a new cable-laying ship, called the Faraday. But times were tough and in 1935 it merged its cable business with Telcon's just up the river in Greenwich. The new company was called Submarine Cables Ltd, but the Telcon name survived in general use. And then, of course, in 1939 war started again. Siemens Brothers again was enemy property. A fascinating picture was taken by the Luftwaffe, the German air force, showed the Siemens Brothers factories as targets for German bombers.

Later it became AEI, Associated Electrical Industries, and then in the late 1960s AEI was taken over by the General Electric Company, a UK operation led by businessman Arnold Weinstock, not connected to General Electric of the US. GEC also merged with English Electric. Much of their computing interests – including LEO, the pioneering commercial computing company set up in the 1950s by J Lyons & Co – were separated into a distinct company, International Computers Ltd, ICL. The telecoms business was centred on GEC Telecommunications in Coventry, competing in a gentlemanly way with Plessey in Ilford, Liverpool and Nottingham, and with Standard Telephone and Cables (STC), with offices in the Strand and a factory at New Southgate, north London. STC was part of the giant US operation ITT, and it owned the former Telcon site at Enderby Wharf in Greenwich and other sites in North Woolwich, with a research centre – one of the best in the world – in Harlow. This was Standard Telecommunication (without the S) Laboratories (STL). After the GEC-AEI-English Electric merger there was a huge amount of rationalisation and closure and bloodletting. The Woolwich factory, which had been the biggest employer in the area after the Arsenal, was shut down.

The final chapter, optical fibres

Enter Charles Kao, born in Shanghai in 1933. He moved to British-ruled Hong Kong as a teenager in 1948. He then came to Woolwich Polytechnic to take his A levels and study for a degree in electrical engineering. He travelled by boat to Southampton with a group of other Hong Kong students coming to study in Britain. It still happens: I remember flying back from Hong Kong after a conference a few years ago. Because it was just before the start of term, the plane was full of Hong Kong students returning to their studies. Kao, though, travelled on the SS Canton to Southampton. He lived at 14 Wrotesley Road in Plumstead, having caught the 53 bus from central London, and he travelled every day on the same bus route back into Woolwich Polytechnic, which later became Thames Polytechnic and today is the University of Greenwich.

Kao then joined STC, while he was doing a PhD at University College London as an external student. As well as its subsea cable factory at Enderby Wharf, STC also had a factory in North Woolwich, just through the foot tunnel from Woolwich Poly. It's no longer there of course, but there is the Standard Trading Estate on the site.

Meanwhile Kao had married Gwen, a British-born engineer with STC. By then they were living in Blackheath, and they were married in 1959 at the local St John's church – having previously been turned away from another Anglican church in Blackheath – his autobiography does not say which – when



Alcatel Submarine Cables, Greenwich, on the site of the 1850s Telcon cable factory. Nokia, the owner, plans to sell it to the French state

the vicar told them he didn't marry foreigners. Gwen was British, of course, and Charles was from Hong Kong, a British colony. The couple then moved out of London, to Harlow, to join STL, one of the world's leading telecoms labs. At STL, Kao and his colleague George Hockham invented optical fibres, the technique of carrying digital signals as beams of laser light down thin strands of glass. Kao, but not Hockham, got the 2009 Nobel prize for physics, and he was knighted the following year. Sadly, he didn't deliver his Nobel speech, as he already had advanced Alzheimer's disease: Gwen spoke for him. He died in 2018, in California, where he'd moved with Gwen to be close to their children. Gwen still chairs the Hong Kong based Charles K Kao Foundation for Alzheimer's Disease.

Meanwhile, what's happened to Enderby Wharf? There is still a factory on part of the site – it makes optical fibre repeaters, which amplify the light signals on long-haul routes. After Telcon had become STC, it was bought by Alcatel, a French company, which in 2016 became Alcatel-Lucent and then got bought by Nokia for €15.6 billion. It's still owned by Nokia – it has tried, unsuccessfully, to sell the submarine cable business, which is now called Alcatel Submarine Networks.

Cable manufacture moved first to Southampton and then to Calais, and so the company sold most of the space to property developers, the part closest to the river, and there are now flats on the site. Enderby House is still there, listed grade II. That was after in

2014 when a group of us – including Dan Hayton of GLIAS, Dr Mary Mills of the Greenwich Industrial History Society (GIHS), Bill Burns of the Atlantic Cable website, a cable consultant, Stewart Ash, who had worked at STC, with myself and others – were concerned about its state, and about the fact that it had no security, no hoardings (see the picture at the head of this article). It would have been easy for an arsonist, say, to break in on a weekend and set fire to the place.



Enderby House, now a riverside pub, on Telegraph Avenue. The building behind the sign is the same as the building on the first page of this report.

The Enderby Group, which is now incorporated into GIHS, created a stink, published pictures of the endangered building, and told of its importance to industrial and national history. The developers decided to save the building. It is now a thriving pub.

And as the work on the flats was starting we suggested to the developers that they might pay tribute to the site's history with some street names and building names. Now we have Telcon Way, Morse Lodge, Cable Walk, Cyrus Field Street, and Telegraph Avenue, all built where the men and women of south-east London used to make high-technology telecoms cables and equipment from 1850 onwards. So if you head down to the Enderby House pub by the river, it's there because a group of us locals quietly campaigned for its survival. And the fact that it's in Telegraph Avenue is also because we planted the idea in the developers' minds.

Postscript: In January 2024 I submitted a proposal to Historic England that it should list the winding gear, used in the 1950s to load the first transatlantic telephone (as opposed to purely telegraph) cable onto cable-laying ships. HE is now considering this and if it accepts the proposal it will submit a recommendation to the Secretary of State for Culture, Media and Sport.

And in June 2024 Nokia agreed to sell Alcatel Submarine Networks, including the Greenwich factory, to the French state for €300 million. No official statement has been made about the Greenwich site.

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