The transatlantic telegraph cable of 1858 and other aspects of early telegraphy

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From the very beginning, *Telektronikk* has made room for historical articles on inventions and major events in telecommunications. The first transatlantic telegraph cable was laid in 1858 and a comprehensive article on 'Cable telegraphy' from 1907 describes the project. It also describes other sub sea cable projects from the time of the early telegraph in the 1850s until 1907. Cables and cable technology was of major concern for the Norwegian Telegraph Administration for many years, because most of the investment cost in establishing the telegraph and telephone networks lay here.

Introduction

Both manufacturing and deploying a sub sea cable of approximately 3,000 km length was a risky and expensive project in the 1850s. There were a lot of unknowns and the first cable, which cost a total of £ 465,000, only worked for less than a month. This article contains a summary of the original article from *Technical Information* (*Telektronikk*, see [1]) in 1907. Additional information has also been gathered. A book from 2003, *'The Cable – The Wire that changed the World'* by Gillian Cookson [2] tells the full story of this daring project. However, we will start with some introductory notes on Samuel F.B. Morse and his 'electric' telegraph as well as the introduction of the telegraph in Norway.

The Morse telegraph

Samuel Finley Breeze Morse (1791 – 1872) is recognized as the inventor of the electric telegraph. Morse was an American artist, educated in England, but before that he had studied at Yale College, and was excited by lectures of the then newly-developing subject of electricity.

In 1832 Morse was on his way home from Europe on the ship *Sully*. Conversations with Charles T. Jackson, Professor in Physics at the University of Boston, gave Morse an idea. Jackson had been to Paris and heard the latest news on research in electricity. During the trip across the Atlantic Morse had developed and sketched the main concept for a *telegraph apparatus* based on electrical pulses.

It is believed that he had his first telegraph model working in 1835 in the New York University building where he taught art. In his model he used crude materials: an old artist's canvas stretcher to hold it, a home-made battery and an old clockwork to move the paper on which dots and dashes were to be recorded. With the aid of new partners, Morse applied for a patent for his new telegraph in 1837. Morse was discouraged from his art career and was devoting nearly all his time to the telegraph.

His telegraph was exhibited in New York in 1838, and there Morse transmitted ten words per minute. Instead of using the number-word dictionary (see frame about the Morse alphabet), he used dot-dash code directly for letters. The Morse code that was to become standard throughout the world had essentially been introduced [3].

The Morse code was dominant until the 1930s, but already in 1902, *Charles L. Krum*, a mechanical engineer and vice president of the Western Cold Storage Company, had started to develop the teletypewriter machine. This differed in many ways from the current interest of the telegraph engineers, which was to further develop the Morse telegraph. Krum equipped his *teletypewriter* with a keyboard similar to an ordinary typewriter. Speed telegraphs, like the Wheatstone – Creed Morse telegraph relied on special trained people and had problems with the synchronisation between the transmitter and receiver. The synchronisation problem was avoided by introducing start and stop signals for each combination of impulses (char-

In 1844, Morse demonstrated to the US Congress the practicality of the telegraph by transmitting the famous message "What hath God wrought" over a wire from Washington to Baltimore. The picture shows Morse's telegraph receiver, which he used at the demonstration in 1844 (Smithsonian National Museum of American History)

The Morse alphabet (1832 – 1999)

The original Morse code from 1832 was a translation system consisting of two essential parts:

- A two-way code book or dictionary in which each English word was assigned a number (and in order to spell out proper names, unusual words, initials, etc., when necessary, each letter of the alphabet was also assigned a number), and
- A code symbol for each digit from 0 – 9 to represent that number.

The sender would convert each word to a number, send that number and the receiver would then convert it back again to the English word with a reverse dictionary.

Later, the dot-dash code was invented and was eventually named the *International Morse Alphabet* and adopted by the ITU.

The International Morse Alphabet has later gone through smaller changes and amendments. As an example, the international distress signal 'SOS' (as one sign) was made in 1906, when radiotelegraphy appeared. As late as in the 1960s special signs were introduced for e.g. first and last parenthesis.

Morse's system was practically supreme in transferring text from the start in the 1840s until 1910–20 when the telex arrived.

Also in Norway, when the State Telegraph was established in 1855, Morse's system was used. In the mid 1950s the use of Morse coding was completely left in the Norwegian network. On the wireless, the last fixed communication links were migrated to telex lines during the 1960s.

31 January 1999 was the last day that the International Telecommunications Convention demanded knowledge competence in Morse telegraphy aboard ships over a certain size.

acters). A new code was introduced, using five impulses per character. It was originally invented by *Émile Baudot* around 1874 and adopted by the CCIT as the 'International Alphabet No 1' (IA1). Later, it was improved by Donald Murray by adding extra characters and 'shift' codes. The code is still known as the 'Baudot code' also known as the 'International Alphabet No 2' (IA2). The code was used as long as the teleprinter service was operational. The term "baud" (a measure of symbols transmitted per second) is named after Baudot.

In 1934, CCIT's Plenary Assembly in Prague discussed the matter, and a test system for the new telex-service was demonstrated. The name 'telex' is short for 'teleprinter exchange' and became the international name for the teleprinter-subscriber telegraphy. The same year, a telex service was opened in Denmark, Germany and Switzerland using dedicated telegraph lines. Great Britain and the Netherlands used a different approach to combine it with the telephone service, but this was later abandoned. The teletypewriter exchange (TWX) service in the USA was introduced in 1930, but it did not apply with the recommendations from CCIT, thus making it difficult to interconnect the European and American telex networks.

The electric telegraph comes to Norway

The Norwegian State Telegraph (Statstelegrafen)[1)] was established January 1, 1855 with the first Morse telegraph line between Christiania (Oslo) and Drammen. Already in the first year of *Technical Information*, in 1904, the 50th Anniversary of the public telegraph in Norway is treated.

But before Statstelegrafen, in 1853, a telegraph line owned by the first railway company in Norway was opened between Christiania[2)] and Strømmen/Lillestrøm (approximately 20 km east of Oslo). *Telektronikk*, issue 2, 1961 contains the lectures from the Norwegian Telephone Engineers Conference (Telefoningeniørmøtet – NTIM) in 1960. In this issue, Head engineer *L. Saxegaard* from the Norwegian State Railways (NSB) introduces a lecture about the State Railways' telecommunications with this fact.

On September 19, 1853, the year before the first Norwegian railway ('Hovedbanen' between Christiania and Eidsvoll) was opened, the first railway telegram was dispatched from a workmen's barrack somewhere between Strømmen and Lillestrøm, east of Oslo. The sender was *Mr. Greener*, the telegraph constructor for the railway, and it was received by Greener's Norwegian assistant, *Christian Wiger*. The message was simple: "The telegraph in order between here and Christiania." Wiger later became NSB's telegraph inspector, a position he had for over 50 years.

This was not a Morse telegraph but used a double-needle system with a different alphabet. In March 1854, the line was opened also for private traffic, and it was frequently used for ordering transport. The price of a transport-telegram was 12 'skilling' (40 'øre')[3)] for 15 words. Other types of telegrams cost twice as much. Up to 70 telegrams per day were dispatched.

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1) *Norw.: 'Statstelegrafen'. The name of the national Norwegian Telegraph and Telephone has changed throughout the years. We will use the Norwegian terms 'Statstelegrafen' for the early years and 'Telegrafverket', which was the name until 1969. Then, the name 'Televerket' and 'Teledirektoratet' came into use, which in English was common to name 'Norwegian Telecom (Administration)'. From January 1, 1995, the name of the company is 'Telenor', which makes no difficulties in English.*

2) *The Norwegian capital, Oslo, had the name 'Christiania' until 1925.*

3) *The Norwegian currency became 'krone' = 100 'øre' in 1875. Before this, the system was based on 'Speciedaler' = 120 'skilling'. 1 Norwegian 'krone' was defined to be 1/4 'Speciedaler', thus 30 'skilling'.*

After Statstelegrafen/Telegrafverket was opened in 1855, the development went fast. The following year, a line to Sweden was opened, and from there, Denmark and parts of the European continent could be reached. In a few years, lines were built from Oslo to Bergen and Trondheim, and during the next decade lines to North Norway were ready. Lofoten were in a special position when it came to expanding the telegraph in the north, because of the important fisheries in the area. That is the reason why Lofoten already in 1861 had a telegraph line, going from Sørvågen to Brettesnes (see also the article on the wireless telegraph in this issue [4]). This line was connected to the main national network in 1868. In 1870, the line had reached Norway's eastern outpost, the town of Vardø. In 1867, the first sub sea cable between Norway and Denmark was opened (see later in this article).

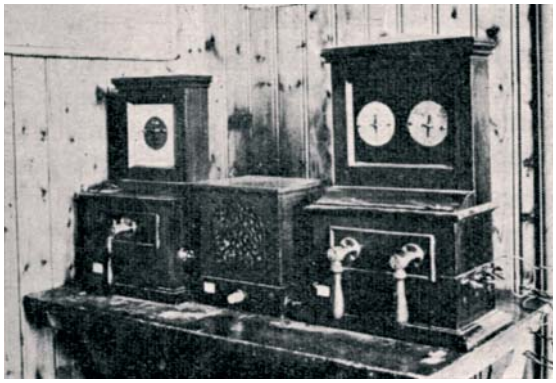
Telegrafverket's history has been covered on several occasions in *Technical Information* and *Telektronikk*. It is especially covered in 1955, on the occasion of the 100 years anniversary of Telegrafverket. Issue 1-3 in 1955 contains a 24-page article by the editor, *Julius Ringstad* (Editor from 1942 to 1957) and his successor *Nils Taranger* (Editor from 1957 to 1978).

Taranger later writes a retrospective article about telegraphy in *Telektronikk*, issue 3-4, 1963, in which he draws up the development of the telegraph until then. The spirit of the article is optimistic on behalf of the telegraph, and also competitive in the sense that he promotes telegraphy to the expense of the telephone, which has had a rapid growth in the period until 1962. In a sense, he foresees the need for data communications in the future, something in the endnotes he calls 'a kind of telegraphy'.

Morse telegraphy was gradually superseded by the telex system also in Norway, and the first manual telex exchange was opened in Oslo in February 1946. Initially it had 20 numbers, which was increased to 35 a month later. In 1946, there were 10 subscribers in Oslo, 4 in Bergen and 1 in Trondheim. The growth was slow, and in 1953, there were only about 290 subscribers in total. By the end of 1961, the number had grown to 1290.

In July 1957, the first automatic telex exchange was opened in Oslo with a capacity of 500 numbers. Bergen followed in April 1961, and the Trondheim exchange was under installation in 1962.

In Norway, the telex network was closed on June 30, 2000, however telex messages to and from the international telex network can still be sent and received via electronic mail. At the time of closing, the network had about 800 subscribers.



The first telegraph apparatus owned by the railway company operating 'Hovedbanen' between Christiania and Eidsvoll was used on the section between Christiania and Strømmen/Lillestrøm. It was of the double-needle type. On the right there are two 'needles', which moved right or left, according to the position of the two transmission handles below. When the handles were resting in the vertical position, the apparatus was in receiving mode (Illustration from Telektronikk, issue 2, 1961, p 87)

The first transatlantic telegraph cable

The following story is based on an article on cable telegraphy, which appeared in *Technical Information* in 1907. The author is unknown, as the rule was not to ascribe articles in the early volumes.

Already in 1842, Samuel Morse had tested a cable in New York harbour across part of East River through which he sent signals, and the following year he had suggested to the US government to establish an electric connection between Europe and America.

In 1855, the American telegraph network had reached Newfoundland, and on the European side, several places on the Irish west coast also had telegraph service. Thus, the possibility of inter connection was discussed on both sides of the Atlantic. Severe difficulties were reported, the shortest distance was 3,700 km and the sea depth reached down to 5,500 m. One was only in doubt whether it was possible to transmit telegraph signals on such a long distance with a feasible speed.

The Atlantic Telegraph Co. was incorporated in October 1856. The original capital was 300 shares at £ 1,000 each. Of this, Cyrus Field and John W. Brett took 25 shares each. The capital was increased by £ 50,000 a few days later. The total of £ 350,000 was secured by December 1856. At the end of 1858, all the company's assets had been spent, and with more liabilities than it could meet [2].

Professor *Charles Wheatstone*[4] had, in his laboratory, measured the 'speed of electricity' to be 300,000 km/s. In telegraph wires, the speed had been determined to 30,000 km/s and the speed on the subterranean and sub sea connection between London and Dublin was found to be much lower. In 1854, Charles Bright had estimated the speed on gutta-percha insulated cables to be less than 2,000 km/s.

However, the doubts were resolved by *Edward O.W. Whitehouse*[5], who tested this by interconnecting several subterranean cables to form a length of approx. 3,700 km and achieved a speed of 210 – 270 signals per minute[6]. Morse himself participated in these tests during autumn 1856. After having slept on it, he estimated that eight to ten words per minute, or twenty messages an hour, could be sent between Ireland and Newfoundland [2].

In 1856, *John Watkins Brett*, *Charles Bright* and *Cyrus W. Field*[7] founded the *Atlantic Telegraph Company* (see frame). The necessary initial capital corresponding to 6 mill Norwegian kroner (NOK)[8] was raised in London, Liverpool and Glasgow. The following year it was raised to 8.5 mill and with a guarantee from the English State corresponding to 250,000 NOK per year and available ships for deployment.

Fig 3.

The cable used consisted of 7 strands of 0.7 mm copper wire covered with three layers of gutta percha. The outer diameter was just 10 mm. The core was wrapped in jute yarn soaked with a composition consisting of 5/12 Stockholm tar, 5/12 pitch, 1/12 boiled linseed oil and 1/12 common bees wax. Armouring consisted of 18 strands, each strand composed of 7 of the best charcoal iron wires, each 0.7 mm. The finished cable was then dipped in a heated mix of tar, pitch and linseed oil (Illustration from 'Technical Information', issue 1, 1907)

The production of the cable started in 1857 with a time schedule of four months. The distance between the landing points was determined to be 3,000 km, thus a cable length of 4,600 km was set. The European landing point was the island of Valentia[9], off the Irish southwest coast, and Trinity Bay in Newfoundland was chosen on the American side.

A lot of problems and improvisations were needed. For example, no housing was established on the beach for the manufactured cable, and it had to lie in the open exposed to the sun, which deteriorated the outer layers of the cable. This was probably an additional factor which influenced the rapid failure of the cable (see later).

Two ships were used for the deployment, the British Battleship, H.M.S. *'Agamemnon'* and the American steam frigate *'Niagara'*. With half of the cable on board each ship, the idea was to start in the middle of the Atlantic Ocean and lay the cable towards each side. For some reason, Whitehouse disturbed this plan, and the deployment started in Ireland on August 6, 1857. After several problems, the cable broke on 4,200 m depth after 620 km had been laid. The ships had to return to England where 1,300 km of new cable had to be manufactured.

On June 16, 1858, the deployment was started again, now from the mid Atlantic as originally planned. In this attempt, the cable broke three times, and they had to start afresh again. More than 1000 km of cable was lost and more cable had to be manufactured. On the

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4) *Sir Charles Wheatstone (1802–1875) is for electrical engineers best known for the 'Wheatstone's Bridge', a method of doing precision measurements of electrical resistance. However, he was heavily engaged in the telegraph from 1835, and together with partner William Cooke, laid the first experimental line between Euston terminus and Camden Town station of London and North Western Railway on July 25, 1837. He had already in 1840 devised a method to connect Dover with Calais across the English Channel.*

5) *Edward O. Wildman Whitehouse was a retired medical doctor who had taken an interest in electricity and telegraph signalling. He had a practical approach to the problem and was later blamed for the failure of the cable by driving too much current through it. He was in conflict with another of the 17 directors of the project, Prof. William Thomson of Glasgow University, in 1892 to be knighted as Lord Kelvin for his achievements in science, among them the Atlantic telegraph cable project in 1866.*

6) *The article does not say what is meant by the term "signals per minute", but the same numbers are given in [2].*

7) *Cyrus West Field was an American entrepreneur from Massachusetts. By age 20, he was a partner in a paper manufacturing company and at 33 (1852) he had retired from business as a wealthy man.*

8) *At the time, the exchange rate between Norwegian kroner (NOK) and £ (GBP) was close to GBP = 20 NOK.*

9) *Today, Valentia is best known as a resort island. The cable station from 1865 was closed in 1965, and is now partly a factory and partly residential. In 2000 it was recognized as an IEEE Electrical Engineering Milestone, and a plaque is placed at the station. See: http://indigo.ie/~cguiney/valentia.html.*

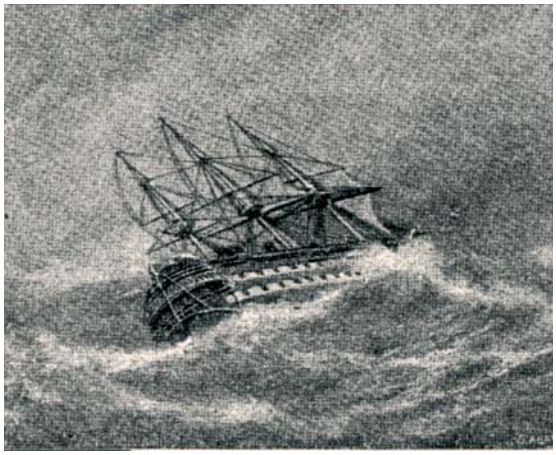
third attempt, which started on July 29, things went well. The *'Niagara'* landed in Newfoundland on August 5, and the *'Agamemnon'* reached Ireland at the same time after only one accident with the cable. Immediately after the cable ends had been brought ashore, the first signal was received. "The joy was great in England and America, and great festivities were held in both countries." Of course, congratulatory telegrams were sent between Queen Victoria and U.S. President James Buchanan.

A major error was however soon discovered 550 km from Valentia, and on the 1 September, the connection was broken. In total, 732 telegrams had been sent through the cable. One of these is apparently said to have saved the English government a sum corresponding to 900,000 NOK[10].

The first transatlantic telegraph cable which worked reliably for a longer time was laid and opened on July 27, 1866, this also between Valentia and Newfoundland; however the short-lived cable laid in 1858 shows the feasibility of such a project. The article from 1907 just briefly describes the 1866 cable.

Norway's first sub sea cable

In the early years after the telegraph had come to Norway, international traffic had to go through Sweden and Denmark, however the Danish-German War in 1864 demonstrated the necessity for multiple choices and redundancy. The first sub sea cable from Norway was then opened on July 1, 1867. In 1866, a licence was given to an English company for the deployment of a cable between Norway and Denmark. Obviously, a conflict has existed towards another powerful telegraph company, which wanted to take over this licence as well as a licence for a Danish-English cable. Because of this conflict, the cable could not be manufactured in England. A later licensee was the cable manufacturing company *Newall & Johnson*, and they were forced to use parts of an old cable, which had been used in Greek waters. The parts were sent to Arendal, on the south coast of Norway, where Telegraph Director *Carsten Tank Nielsen* and Telegraph Commissary *Jonas P.S. Collett*[11] evaluated the state of it. They could not approve it; however, it was sent to Copenhagen and



The British Battleship H.M.S. 'Agamemnon' experienced rough weather on its trip from the mid Atlantic until it reached the Irish coast on August 5, 1858 (Illustration from 'Technical Information', issue 1, 1907, p 4)

examined by Professor Thomsen[12], who found it to be all right. The cable was then laid and opened on July 1, 1866.

Sub sea cables both for telegraph and telephone are the subject of articles in *Technical Information* and *Telektronikk* on several occasions into the 1960s. Overview articles of different cables from Norway to the continent as well as the British Isles are published, as well as technical tutorials for specific problems.

A curiosity can be mentioned. In 1929, volume 9-10, a notice is printed under the signature 'He' about plans for a transatlantic telephone cable. It is a transcript of the *Journal of A.I.E.E*[13] and reports that the Bell Telephone Laboratories in 1928 had completed a deep-sea cable, which could be feasible for a transatlantic telephone connection. It is also reported that one is undertaking work to develop a cable system 'of this type' to connect London and New York City, and that the connection can possibly be made as early as 1932. Obviously, it took longer, and whether that stems from technical, economic or political problems shall remain unsaid. The first transatlantic telephone cable was completed in 1956, the Trans Atlantic Cable No. 1 (TAT-1), between Oban on the coast of Scotland and Clarenville, Newfoundland.

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10) According to Cookson [2] one significant message was about the news that the Sepoy Mutiny in India had been put down, which halted the mobilisation of two British regiments from Canada. Nine words had saved the British Government £ 60,000.

11) Carsten Tank Nielsen was the first Norwegian Telegraph Director from 1855 – 1892. Jonas P.S. Collett was temporary Director for three and a half months in 1892 until Jonas Severin Rasmussen was appointed.

12) This could be Professor Julius Thomsen from the University of Copenhagen. He was a professor of chemistry from 1866, and he has a merit in being the first to suggest the modern form of layout of the Periodic Table.

13) A.I.E.E. – American Institute of Electrical Engineers – is the predecessor of IEEE until this was formed in 1963.

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