

Abraham N. Edelcrantz

A Man Named Clewberg

The designer and builder of the Swedish optical telegraph network was born on 29 July 1754 in the city of Åbo, named Abraham Niclas Clewberg.¹ Like Claude Chappe, Clewberg came from a relatively well-to-do family and seemed destined to become a scholar. His father, Carl Abraham Clewberg (1712-1765) was professor of ancient languages at the Royal Academy of Åbo. In 1752 he married 16-year-old Agatha Charlotta Fahlenius (1736-1817), 24 years his junior. As far as we know, Abraham Niclas had just one sibling, a sister named Sara Charlotta, who was born just after his father's death in 1766.

Abraham Clewberg was a bright student. On 18 July 1772, two weeks before his eighteenth birthday, he completed a doctoral thesis in optics. But Clewberg also had an interest in the arts, and to round out his education he wrote a second doctoral thesis in 1773, in literature. The young Doctor in Science and Literature then started working as a teacher and librarian.



Figure 3.1 **King Gustaf III (left) and A. N. Edelcrantz (right).**???
(Coll. Statens Konstmuseer (left), Tekniska Museets Arkiv (right))

In his spare time, Clewberg wrote poetry. He became a member of *Utile Dulce*, a society dedicated to the study of everything that was "Useful and Beautiful." There he met Johan Henrik Kellgren (1751-1795), also a student at Åbo at the time, who would soon acquire fame as a Swedish poet. They became lifelong friends. When the Swedish king Gustaf III (1746-1792) visited Åbo in 1775, \n???

For some years Clewberg alternated between working as a librarian in Stockholm and teaching at the Royal Academy in Åbo. He taught both courses on electricity and on literature.

In April 1783 Abraham Clewberg decided to move to Stockholm permanently, and quickly started acquiring a series of prestigious titles. He first received an appointment at the court

¹ Åbo is located on the west coast of Finland, which was part of Sweden until 1809. The Finnish name of the city is Turku. Finland is officially bilingual.

as Secretary of Protocol. In 1786 he gained membership in the Swedish Academy, partly in recognition of a poem, *Ode to the Swedish people*, he had written to celebrate the opening of the Swedish Parliament that year.² In 1787 he was promoted further to Private Secretary of King Gustaf III.

Two years later, at the age of 35, Clewberg was raised to the peerage. As one of the marks of this honor he was given a new name: Edelcrantz.³

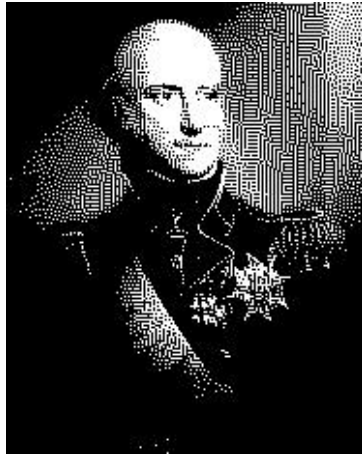


Figure 3.2 **Gustaf IV Adolph (left) and His Uncle Carl (right).??**

(Coll. Kon. Kommerskollegium. Photos: Svenska Porträttarkivet.)

THE THEATER

One of Edelcrantz's assignments from 1783 was as the assistant director, and later director, of the Swedish Royal Theaters. As a perk benefit of that job, he obtained an apartment in the Opera House in central Stockholm, directly opposite the Royal Palace.⁴ He lived there from 1790 until his death.

The king had a strong interest in the arts, particularly in the Royal Theaters, so Edelcrantz's appointment must have been significant. The king actively invited scholars, poets, artists, and actors to the Swedish court. Among them were Louis-Jean Desprez, a French architect and artist of fame at the time, who worked on the decoration of the Royal Theater. The king often attempted to set strict rules for those who worked on his projects. Mediating disputes with the artists, who naturally still demanded their creative freedom, was a task that fell to Edelcrantz.

From 1790 until 1791 Edelcrantz traveled through Europe, at the king's request, to study the European theaters and to persuade more actors to come to Sweden. Shortly after his return, perhaps as a reward for a job well done, Edelcrantz received the estate *Stora Skuggan*, located on royal hunting grounds just outside Stockholm, for his personal use for one century. He built the land in classical English style, with a park, a villa, and an octagonal two-story greenhouse that has since been converted into a house. The villa and the

² This Academy was created by King Gustav III, inspired by the French Academy. It dealt with literature, not the sciences.

³ "Edel" means "noble." "Crantz" means "wreath."

⁴ The current Opera House stands on the same spot, but dates from 1898. The old Opera House building was demolished in 1892 to make room for the current, larger, one.

greenhouse are believed to have been designed by Desprez. Edelcrantz used the house as his summer residence, and named it *The Shadow*.

It seemed that things couldn't go better for Edelcrantz. But the tide soon changed.



Figure 3.3 **Count Reuterholm (left) and J. A. Ehrenström (right).**??
(Coll. Nationalmuseum (left), Statens Konstmuseer (right))

Difficult Times

On 16 March 1792 the man who had brought Edelcrantz to Stockholm and nurtured his career, King Gustaf III, became the victim of a plot and was shot by a young officer during a masquerade at the Opera House. He died two weeks later.⁵

As in the rest of Europe, the end of the eighteenth century was an uneasy period in Sweden. The monarchy came under attack, and those protected by it started losing their privileges. Gustaf III was succeeded by his 12-year-old son, Gustaf IV Adolph, but because of his age, a regency was formed under his uncle, Count Carl (Figure 3.2).

One of Edelcrantz's friends from his early period in Stockholm was Johan Albert Ehrenström. Both Edelcrantz and Ehrenström had been employed as Secretary to King Gustaf III, and had both been fairly close to him. A survival instinct in Edelcrantz made him keep a low profile and take small steps to earn the confidence of the new rulers. Ehrenström was less careful. Since the assassination, he had maintained a correspondence with another former aide of King Gustaf III, General Gustaf Mauritz Armfelt, who was now employed as the Swedish ambassador in Naples. The correspondence was intercepted by the Reuterholm regime. Both Armfelt and Ehrenström were curtly accused of treason and sentenced to death.

The execution of Ehrenström was to be performed at Normalms Torg, today named Gustaf Adolph's Torg, next to the Royal Opera House where Edelcrantz had his apartment. Passing the Opera House on the way to his execution, Ehrenström spotted Edelcrantz watching the proceedings from his apartment. This is how he described what happened.⁶

⁵ Verdi's opera *A Masked Ball* (1859) is based on this assassination.

⁶ Ehrenström 1883" "Vol. 2, p. 263

When I arrived at Normalms Torg I saw how my friend Edelcrantz hurried to draw the curtains at the window of the room in which I had spent so many pleasant evenings with him and with the great [author Johan Henrik] Kellgren.

The First Experiments

In September 1794 the first news came from France about the telegraph developed by Claude Chappe. Intrigued by this idea, Edelcrantz immediately started to work on his own version of an optical telegraph. Within a few months, he was ready for a demonstration. It was held on King Gustaf IV Adolph's fourteenth birthday, 1 November 1794.

Edelcrantz's first telegraph design consisted of a single support beam with two rotating indicators. Each of the indicators could be set in one of four distinct positions, allowing sixteen combinations. As Edelcrantz later explained in his treatise, he had compressed the alphabet to sixteen symbols so that each sign could represent one letter from this set.⁷ Edelcrantz also explained that the number of signals could be increased to 64 by allowing the indicator arms to be set in eight instead of four distinct positions, at the risk of making it harder to distinguish between the signs.

Edelcrantz constructed three telegraph stations. One was on the roof of the royal castle in the center of Stockholm. The second station was about 5 km (3 miles) away on the outskirts of Stockholm in Traneberg, opposite the island of Stora Hässingen. The third was 7 km (4 miles) further down on a tower near the so-called China Castle, a summer house on the grounds of the Royal Palace in Drottningholm, just outside Stockholm. The tower, Götiska Tornet, designed by Desprez in 1791, was the highest point in the area.

A report published on 5 November 1794 in the Swedish Newspaper *Inrikes Tidningar* (Domestic Events), described the experiment as follows:

Experiments with a Swedish Telegraph

In the honorable presence of the Royal family, on October 30, 31 and November 1, experiments were conducted with a machine that is intended for the fast exchange of messages between distant places, a similar purpose as the French Telegraph, about which the newspapers have given occasional news. The machine is invented by Chancellor Edelcrantz, one of the eighteen members of the Swedish Academy. It consists of a long standing beam with two arms of 6 ells long, each movable on an axis, the upper arm at 3 ells and the lower arm at 6 ells distance from the top of the beam. These arms indicate, through their position relative to each other and relative to the beam, 16 fixed symbols and 33 with movements [the number 33 is most likely an error by the reporter], out of which the former, characterized by concatenation of the numbers 1, 2, 3, 4, actually are used to indicate letters from the alphabet, which can be reduced to this number.

The movements of the machine are observed with ordinary telescopes, and can, when the air is clear, be seen at a distance of several tens of kilometers. The correspondence took place between the roof of the Royal Castle in Stockholm and the China Castle in Drottningholm. But, since these two places cannot be seen from each other, there was an intermediate station, where the signals were repeated, situated on a mountain opposite to Stora Hässingen.

⁷ Chapter Four, p. _tag4_8.

After the machines were erected, tested and adjusted at these 3 locations, the real experiment was conducted on October 31, when His Royal Majesty the Regent Himself posed questions which were answered by the Count etc. Jacob DelaGardie, using the telegraph from the Castle of Stockholm, after they had been sent by the Chancellor Edelcrantz using the telegraph at China Castle and repeated at the intermediate station by Mr. Öfverbom, Premier Engineer at the Royal Surveyor Office. For 8 questions and equally many answers, ciphering and deciphering, one hour and 26 minutes were required including the adjustment of the machines.

For the last question a new cipher was used, randomly chosen among 128 distinct, and about which the correspondent in Stockholm was not previously informed. Each signal requires approximately 4 seconds, which makes 16 signals per minute, and one minute for a distance of 160 km if the stations are 10 km apart. Thus, if the sending of a message at the first station requires 3 minutes, it can be read after 4 minutes at a distance of 160 km, after 5 at 320 km and after 6 at a distance of 480 km, etc. It should, however, be possible to increase this speed when the persons involved gain more experience than can be gained after some days of practice and for which Mr. Chappe in Paris used a full year.

On November 1, the king's birthday, the telegraph sent the following quatrain from Stockholm to Drottningholm. It was delivered in 7 minutes and humbly presented to the king by Count Jacob DelaGardie.

This greeting from the Swedish nation
That loves and honors their King
Today to His Heart will bring
A blessing to this new creation

The inventor of the Swedish telegraph has developed another version of his machine, for which a model is being built by which more than 1,000 distinct characters can be sent at greater speed and with smaller chance of error.

[Image Not Included in Original]

**Figure 3.4 The Experimental Line to Drottningholm (1794)
and the First Network Line Stockholm-Vaxholm (1795).**

We can guess who wrote the poem that made up the first message transmitted. As indicated by the closing sentence of the report, though, even at the time of the first experiment Edelcrantz was already thinking about new designs that would allow for more signal combinations. The ten-shutter design that he later adopted, allowing $2^{10} = 1,024$ combinations, may have already occurred to him at this time. First, however, he experimented with a variation of his semaphore telegraph design, this time allowing for eight positions per indicator, rotating the indicators not in the middle, but from their endpoints. Simultaneously, he increased the number of indicators from two to five, giving a maximum of $8^5 = 32,768$ possible combinations.

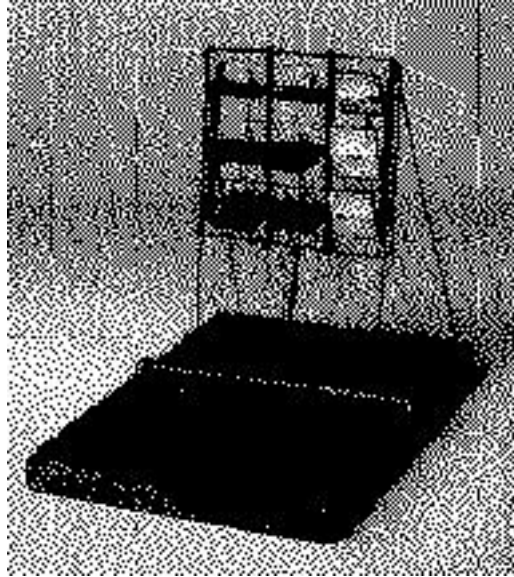


Figure 3.5 **Model of a Nine-Shutter Telegraph, ca. 1808.**
(Coll. Telemuseum, Stockholm)

[Image Not Included in Original]

Figure 3.6 **Control Panel of Ten-Shutter Telegraph, Top View.**
(Source: Risberg 1938, p. 49)

The young king was pleased with the experiment. There would be no long struggle for Edelcrantz to gain official approval for further experiments. On 7 November, less than one week after the first demonstration, the king requested that his special Council of Advisors study the construction of an optical telegraph network in Sweden, with connections to Denmark and to Finland. In the same letter, the young king nominated Edelcrantz as a new member of the same prestigious council, virtually sealing the outcome of the study.

The Shutter Telegraph

After a series of experiments that is documented in Edelcrantz's treatise on telegraphs (see p._sec4.1_), Edelcrantz had decided to abandon the Chappe-like design of a semaphore telegraph with articulated arms, and switched permanently to a ten-shutter system. In his own words:⁸[

... I was soon induced to give preference to the following [shutter] design with its smaller size, greater speed, and ease in its movements, increased clarity and visibility, in addition to several other factors, such as its possible use at night.

The shutter telegraph consisted of a matrix of three by three shutters, with a tenth, extra large, shutter mounted on top. The positions of a single column of three shutters could now be represented with an octal encoding. Per column, each shutter was assigned a number. From top to bottom, the shutters were numbered 1, 2, and 4. Summing the numbers of the shutters that were closed produced a column code between zero and seven. The code for a

⁸ Chapter Four, p. _tag4_9.

complete telegraph signal consisted of three of these octal numbers, one for each column, which could be prefixed by the letter A if the tenth shutter was also closed. The code A636 then encoded the position where the top two shutters in the middle column, the bottom two shutters in the first and last column, and the tenth shutter were all closed, and thus visible to the next station.

To set the shutter signals quickly, Edelcrantz designed a sophisticated control mechanism, which is illustrated in Figure 3.6. The operator could set a telegraph code on the panel and then slide it over to grab onto the wires that connected to the shutters. By pushing down on a foot pedal, the right wires were pulled, and the signal was displayed. While waiting for the signal to be copied by the next station, the operator could already prepare the next signal, by using the mirror half of the control panel. As soon as a signal had been confirmed, the foot pedal was released, the control panel moved to the opposite side, and by pushing down on the pedal again the next signal was set without delay. Meanwhile the telegraph signal unavoidably passed through an all-zero position, as an extra warning to the remote station that the signal had changed.

The design from 1794 was used in a number of small variations. In some systems the function of the foot pedal was performed by a crank that was rotated to pull down the shutter wires. In others, there were some changes in the way in which counterweights were attached to the shutters. In the most common version, the counterweights were attached directly to the shutters. In others the weights were suspended from longer strings. In the early models, the frame of the telegraph was a complete grid that enclosed all shutters. In the later models the outer frame was deleted, and only an inner frame remained, consisting of one or two posts with side-bars to hold the shutters. The smaller frames were probably cheaper, and easier to construct. The simplest construction, with two posts, is illustrated in Figure 3.9. When a single post was used, as shown in Figure 3.7, the shutters in the middle column had an additional opening at the top, which allowed them to clear the post when moved into the horizontal position.

THE FIRST NETWORK LINK

On 30 January 1795, barely three months after the first test, Edelcrantz obtained permission to build a first telegraph line from the Katarina Church in the center of Stockholm to the fortress of Vaxholm. The line went into operation on 28 July 1795. Between 1795 and 1797 two more telegraph lines were built: from Stockholm to Fredriksborg and from Grisslehamn to Signilsskärand Eckerö on Åland. In 1799 a short stretch of line near Göteborg was added.

The telegraphs were initially operated by military personnel. Edelcrantz described the minimal requirements for an operator as follows:

The officers and soldiers selected to operate the telegraphs should be able to read and write numbers passably, and it would help if they also could make simple arithmetic calculations.

The training of the operators took one week, one hour each day. One non-commissioned officer per regiment in the Stockholm area and one soldier per company was assigned to a Royal Telegraph Corps.

In 1796 Edelcrantz documented his efforts in the book that he called *A Treatise on Telegraphs*. The book was soon translated into German and French, and firmly established Edelcrantz's name as an inventor. In addition to his membership in the Swedish Academy

(of literature), he now also won, in 1797, election to the Swedish Academy of Sciences. He quickly became one of the most prominent members of that body.

An Inter-Networking Experiment

Meanwhile, France was still at war with Austria and Britain. Sweden's policy was initially to remain neutral in the European conflict. When, around 1800, the British blockade of France began to damage Swedish foreign trade, King Gustaf IV Adolph decided to enter into a pact with Russia, which was soon joined by Prussia, Denmark, and Norway (then part of Denmark).

Britain, of course, was ready to enforce its blockades, so a war with the Scandinavian countries seemed likely. The king decided that an early-warning telegraph network had to be constructed along the southwest coast of Sweden, and on 19 February 1801 he gave orders for Edelcrantz personally to make the preparations. Edelcrantz left the next day. He first went to Helsingborg, the point on the Swedish coast that is closest to Denmark.

The cities of Helsingborg in Sweden and Helsingör in Denmark are separated by a narrow strait, called the Öresund. Along the shore of the Öresund, Edelcrantz selected six sites for the new line of telegraphs: Kullen, Svedberget, P\o'a°lsjö (??), the Kärnan fortress in Helsingborg, Glumslöv, and Kirsebergs Backar at Bulltofta, close to Malmö. Provisions were made to allow for telegraphic communications between the commanders of the Swedish fleet at sea and the shore.

A possible attack or invasion by the British was expected at the Öresund, but it was not clear which of the two countries would be the target of the first assault. Edelcrantz proposed to establish a telegraph link across the Öresund between Sweden and Denmark: the first-ever international network connection.



Figure 3.7 Seal of the Royal Telegraph Institution and its Approval by King Karl XIII (1748-1818).

(Coll. Telemuseum, Stockholm)

In a letter to Governor Toll in Helsingborg, dated 14 March 1801, Edelcrantz reported that all preparations had been made, and he asked the governor to issue the necessary orders for the construction of the telegraphs. He also asked the governor to have the military select four sober men, who could write numbers, for each of the six telegraph stations. This order was to be given immediately so that the men could assist during the transportation and erection of the telegraphs. The letter also details Edelcrantz's proposal for inter-networking with the Danes. He had already spotted a suitable site for a telegraph on the Danish side of the Öresund, on Kronborg Castle near Helsingör. He wrote:

This connection makes it possible to maintain a continuous contact between the commanders; the Danes will get the reports from Kullen at the same time as we do. From your own window, governor, the Kärnan Tower should be visible and you should therefore be able to send your orders from your home directly to Kullen, Landskrona, Malmö and the other stations.

Farther north, the telegraph line near Göteborg was also being extended at this time, and required Edelcrantz's presence. In the company of King Gustaf IV Adolph, Edelcrantz went to Göteborg, leaving the further preparations for the southern line to Governor Toll. The British, meanwhile, had decided to send a fleet under Admiral Nelson to attack Copenhagen. The fleet was first observed from Kullen on 21 March 1801.

With Edelcrantz in Göteborg, and the threat of a British attack greatly increased, the initiative to establish the crucial telegraph link between Denmark and Sweden moved to the Danes. Edelcrantz's counterpart in Denmark was Captain Lorenz Fisker who, inspired by the Swedish ten-shutter telegraph, had designed a variation for use in a Danish optical telegraph network.⁹ In early 1801 the Danes had established a telegraph line based on the Fisker system along the east coast of Själland. The telegraph from this line at Kronborg castle, however, was directed to the south and could not be read easily from Helsingborg, as had been proposed by Edelcrantz.

By order of the Danish crown-prince Fredrik, Fisker wrote to Governor Toll on 29 March 1801 and suggested that the existing telegraph at Kronborg be used by Swedish observers from an observation point either to the north or to the south of Helsingborg, where it could be read more easily. He proposed that a high flagpole would be placed at the spot selected, so that a flag could be used to acknowledge the receipt of messages sent from the Danish side. A ball would be hoisted at a similar pole in Kronborg when messages were to be sent to the Swedes. Since the telegraphs on the Swedish side had not been constructed yet, the inter-network link could only be operated in one direction. Fisker enclosed a full description of his telegraph in his letter to Toll. He also included a code list of the 18 most relevant signals, all of which concerned the expected movements of the British fleet.

On 2 April 1801, the British fleet attacked Copenhagen. As planned, the events were reported via the telegraph to Sweden, but Sweden failed to come to Denmark's aid. The Danish fleet was defeated. The Danes signed a treaty with the British, and, understandably, declined further exchanges of intelligence with the Swedes. The first international network link was abandoned after just four days of service.

When Edelcrantz returned to Helsingborg a few days later, part of the motivation for the construction of the southern line had disappeared. Edelcrantz, nevertheless, reported to Governor Toll on 28 April that he had erected the telegraph on the Kärnan tower in Helsingborg. The other stations were never constructed. Sweden signed a treaty with Britain, and a relatively quiet period followed.

The Diplomat

The telegraphs on the Swedish network were used only intermittently in the next few years. Edelcrantz temporarily shifted his attention to other pursuits. During the next ten years Edelcrantz pursued just about every avenue that opened up to him, while somewhat neglecting his interests in the Royal Theater and the further development of the telegraph network.

From December 1801 until May 1804 Edelcrantz made a second trip through Europe at the request of King Gustaf IV Adolph, visiting Germany, Holland, Belgium, France, and England. His mission was to collect information about new industrial processes, especially on the production of alcohol, which was, at the time, an important source of income to the Swedish state.

Edelcrantz managed his task skillfully. He made contacts everywhere, using charm, wit, and intelligence. He reported his findings in letters sent back to Sweden, often using secret

⁹ King Karl XIII is Gustaf IV Adolph's uncle, and regent, Count Carl, from earlier in the story. Carl's regency ended in 1796. He succeeded Gustaf IV Adolph as king in 1809 when Sweden had lost Finland to Russia. Count Carl then changed his name to King Karl XIII. Gustaf IV Adolph, blamed for the defeat, was exiled that same year.

messages added to a regular, innocent text by using a special invisible ink which could be read only by heating the paper on which it was written. He brought back close to one thousand books from his journey.

Edelcrantz's ingenuity opened doors virtually everywhere he went. While he was visiting Berlin, for instance, Edelcrantz invented an improved boiler and was promptly admitted as a member of the Royal Academy of Sciences in Prussia. The appointment made it possible for him to visit many places that would otherwise have been inaccessible, and he used the easy access to study the organization and technology of Prussian agriculture and industry in detail.

Similarly, while visiting Paris in 1802, he is said to have invented a new lamp, and he was admitted as a member of the *Société d'Encouragement de l'Industrie Nationale*. When he was shown Chappe's competing optical telegraph design, Edelcrantz is said to have remarked:

There is nothing in this device that I would want to copy.

Chappe and Edelcrantz never met, and never corresponded about their designs. While in Paris, Edelcrantz did meet another inventor of a competing telegraph design--a meeting that would have important consequences for him. That person was Sir Richard Lovell Edgeworth, the Irish inventor of the so-called *Tellograph*, about which we will learn more later.¹⁰

LOVE AT FIRST SIGHT

Both Edelcrantz and Edgeworth became honorary members of the *Société d'Encouragement de l'Industrie Nationale*, in both cases in recognition for their work on optical telegraphs. The acquaintance led to a number of social calls on Edgeworth and his family, who had accompanied him to Paris. Among the people Edelcrantz met there was Edgeworth's daughter, Maria.

On 3 December 1802 Maria Edgeworth was in the middle of writing a long letter to her aunt, and confidante, Mrs. Ruxton. This is, in part, what she wrote:¹¹

Here I am at the brink of the last page, and I have said nothing of the Apollo, the Invalides, or Les Sourds et Muets. What shall I do? I cannot speak of everything at once, and when I speak to you so many things crowd upon my mind.--

Here, my dear aunt, I was interrupted in a manner that will surprise you as much as it surprised me, by the coming in of Monsieur Edelcrantz, a Swedish gentleman, whom we have mentioned to you, of superior understanding and mild manners: he came to offer me his hand and heart!!

¹⁰ Chapter Five, p. [_tag5_H](#).

¹¹ Chapter Five, p. [_tag5_5](#).



Figure 3.8 Maria Edgeworth.
(Source: Edgeworth 1895)

Edelcrantz had fallen in love. It could, by all means, be the beginning of something good. But, the letter continued:

My heart, you may suppose, cannot return his attachment, for I have seen but very little of him, and have not had time to have formed any judgement, except that I think nothing could tempt me to leave my own dear friends and my own country to live in Sweden.

My dearest aunt, I write to you the first moment, as next to my father and mother no person in the world feels so much interest in all that concerns me. I need not tell you that my father -- "Such in this moment as in all the past," -- is kindness itself; kindness far superior to what I deserve, but I am grateful for it.

But, Maria could not be persuaded by Edelcrantz's charm. On 8 December she wrote about the proposal once more, this time in a letter to her cousin, Miss Sophy Ruxton.

I take it for granted, my dear friend, that you have by this time seen a letter I wrote a few days ago to my aunt. To you, as to her, every thought of my mind is open. I persist in refusing to leave my country and my friends to live at the Court of Stockholm, and he tells me (of course) that there is nothing he would not sacrifice for me except his duty; he has been all his life in the service of the king of Sweden, has places under him, and is actually employed in collecting information for a large political establishment. He thinks himself bound in honor to finish what he has begun. He says he should not fear the ridicule or blame that would be thrown upon him by his countrymen for quitting his country at his age, but that he should despise himself if he abandoned his duty for any passion. This is all very reasonable, but reasonable for him only, not for me; and I have never felt anything for him but esteem and gratitude.

There seems to have been no further contact between them, not even so much as a letter or a visit. Maria Edgeworth established herself as a successful Irish novelist, producing a wealth of books that were printed and reprinted many times. Her first major work, called *Castle Rackrent*, had been published in 1800, just before she met Edelcrantz. Her stepmother, Sir Edgeworth's fourth wife, later suggested that one of her later novels, *Leonora*, was written specifically for Edelcrantz. She described how the affair had affected Maria:¹²[

And even after her [Maria's] return to Edgeworths town, it was long before she recovered the elasticity of her mind. She exerted all her powers of self-command, and turned her attention to everything which her father suggested for her to write. But *Leonora*, which she began immediately after our return home, was written in the hope of pleasing the Chevalier Edelcrantz; it was written in a style which he liked, and the idea of what he would think of it was, I believe, present to her in every page she wrote. She never heard that he had even read it. From the time they parted at Paris there was no sort of communication between them, and beyond the chance which brought us sometimes into company with travelers who had been in Sweden, or the casual mention of M. Edelcrantz in the newspapers or scientific journals, we never heard more of one who had been of such supreme interest to her, and to us all at Paris, and of whom Maria continued to have all her life the most romantic recollection.

Neither Maria Edgeworth nor Edelcrantz ever married.

The visits to the Edgeworths during his brief courtship had some unpleasant consequences for Edelcrantz. Since the treaty of Amiens of March 1802, France and Britain were temporarily at peace, but the two countries were still on unfriendly terms. Edelcrantz was suspected of being involved in a plot against the French and was promptly asked to leave the country as a *persona non grata*. For a short time Edelcrantz went to prison. Only a personal intervention by the Swedish ambassador to France could help release him and avoid his forceful expulsion from France. A short while later Edelcrantz decided to leave on his own accord. He went to England.

¹² Edgeworth 1894" "pp. 112-113



Figure 3.9 Cover of a Book by Sehlstedt.
(Source: Sehlstedt 1858)

STEAM ENGINES

In London, in 1803, Edclcrantz invented a new safety valve for steam engines, for which he was awarded a silver medal and yet another coveted membership in an esteemed organization, this time the *Society for the Encouragement of Arts, Manufactures, and Commerce*. He met James Watt, who invited him to visit his steam engine factory in Birmingham. While in Birmingham, Edclcrantz promptly decided to buy four steam engines to bring back to Sweden. He persuaded Samuel Owen, Watt's collaborator in Birmingham, to come to Sweden to install the steam engines for him. Owen would later decide to stay in Sweden and start a new company. He became an important figure in Swedish industrialization.

Excited about the potential of steam engines, on his return to Sweden in 1804 Edclcrantz proposed to build a steam-driven mill in central Stockholm. He had to overcome many more obstacles in this venture than he had in the construction of the optical telegraph lines. It took him a year to obtain the necessary permissions for the construction of the mill. At the spot where City Hall now stands, Edclcrantz built his Fire-Mill. After two years of preparation, it was ready to start production. Edclcrantz used the plant not just for milling, but also for experiments with devices such as spinning machines. The mill was in operation for more than seventy years. It was destroyed by fire in 1878.

At this time Edclcrantz also became involved in serious discussions in the Academy of Sciences about its internal organization, as well as in many of its special investigations. He became especially active in the discussions about the position of agriculture in the Academy. At his summer house *The Shadow* he had already begun some agricultural experiments, and therefore his interest in the topic was piqued. He opposed those who thought that the Academy should concentrate on the fundamental sciences and leave agricultural experiments

to others. Instead, he argued that agriculture was one of the most important applied sciences to serve Sweden's interest.

In 1805 another member of the Academy of Sciences suggested that the government should prescribe the use of crop rotation in farming. Edelcrantz argued that the government should withhold its support until the issue was thoroughly studied and the benefits of crop rotation could be demonstrated and calculated. His position was adopted by the Academy, and eventually by the government.

Edelcrantz obtained a range of new honors and titles. He was promoted to Director of the Theaters, appointed Superintendent in Charge of the Royal Furniture, Household Utensils and Art Collections, and Chairman of the Academy of Painting and Sculpture and its schools, which included the Royal Collection of Mechanical Models and the School of Mechanics, a predecessor of the current Royal Institute of Technology. In 1806 he described the state of this academy in his annual speech:

The School of Mechanics is in full inactivity. It misses its director who has been absent for two years, one of the teachers has been on leave, another almost always ill and the new building for the school remains unfinished.

The statement reflects the no-nonsense approach that is said to have characterized Edelcrantz as an administrator.

The peak of Edelcrantz's career came in 1807, when he was appointed a member of the interim Cabinet that governed Sweden during an absence, for an extended trip abroad, of the king.

[Image Not Included in Original]
Figure 3.10 Optical Telegraph Network, 1808-1809.
(Source: Risberg 1938, p. 91)

The Swedish Telegraph Network

In the period 1807-1809, with the renewed threat of war with France and Russia, Edelcrantz made new efforts to extend the telegraph network in Sweden. In 1809 the Swedish king, and Edelcrantz's protector, was exiled. But again, Edelcrantz managed to survive the upheaval.

Table 3.1 **Punishment Codes.**

Code	Meaning
001-244	Warned for neglect
001-245	Hard labor
001-246	Confinement to own room
001-247	Confinement to telegraph
001-250	Confinement to telegraph at ...
001-251	Is expected to be punished
001-721	Step onto the lower telegraph arm
001-723	Do you see anybody on the arm at ...
001-724	Is allowed to step down
001-725	Is free from custody
001-727	I am in custody

In the spring of 1808 a decision was made to create a Royal Telegraph Institution, with Edelcrantz as its first director. Edelcrantz secured a position as assistant director of the Telegraph Institution for his nephew Carl Christian Linnell on 7 October 1808. Edelcrantz had taken his nephew under his wing in 1798 when his sister Sara Charlotta died, just 32 years of age. From 1809 on, Christian Linnell also shared Edelcrantz's apartment at the Royal Opera House.

Around this time the design of the shutter telegraph was modified and the outer framework that enclosed the shutters was deleted, as can be seen, for instance, in Figures 3.7 and 3.9. The signaling codes, which had remained unchanged since 1796, were also revised. The new code allowed for up to 5,120 signals, which were documented in a total of thirteen code tables.¹³ In these new codes, there was also more room for regulating some things that Edelcrantz may have overlooked initially. There were, for instance, several codes that dealt exclusively with the punishment of negligent telegraph operators. Some of these codes are listed in Table 3.1.¹⁴

The curious command to step onto the telegraph arms as a form of punishment appears to have been popular at some locations. Risberg reports that he had learned from a former telegraph superintendent that this particular form of punishment had been used by preference when the operators at the telegraph station in Hissingen, close to Göteborg, had committed an offense. He hints at the possible reason:¹⁵

The telegraphing [at Hissingen] was often performed by the superintendent's, at the time, young daughters.

Fortunately, the daughters did not seem to mind this treatment much. Risberg continues:

When they were asked a couple of years ago how it felt to stand on the telegraph arm, they remembered the experience well, but noted that "it was just fun."

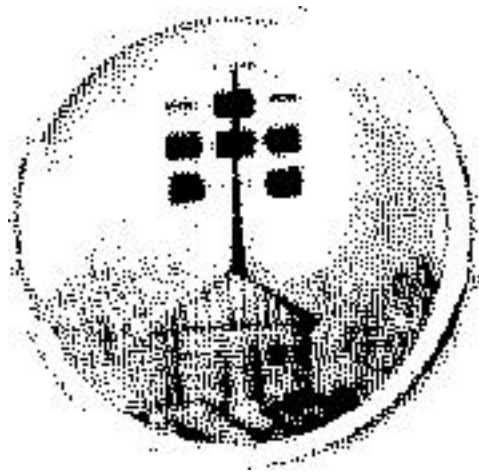


Figure 3.11 **Button from a Telegraph Operator's Uniform.**
(Coll. Televerket Archive, Stockholm)

¹³ Risberg 1938" "p. 57

¹⁴ Ibid., p. 62. See also the penal code from 1809, reproduced in Appendix C, see p. [_tag9_1](#).

¹⁵ Ibid., p. 62.

After the new codes of 1808 were adopted, the motto of the Telegraph Corps became signal 636, which meant *Passa väl upp*, or "Be on guard." The signal appeared prominently in the seal of the Telegraph Institution, and on the buttons of the telegraph operator's uniforms, to serve as a reminder of the telegraph operator's duty.¹⁶

In November 1809 the Swedish network consisted of approximately 50 stations spread out over a distance of some 200 km (124 miles), and provided employment for 172 people.¹⁷ It included lines from Stockholm to the city of Gävle in the north, Landsort in the south and Eckerö on Åland in the east. The telegraphs were used to signal the arrival of ships, but they also served an important early warning task for enemy attacks.

In March 1808 the Russian cavalry made such an attack, invading Åland over the ice, in the process destroying the telegraphs at Signilsskär and Eckerö. Two months later, the population revolted and expelled the Russian troops. By the end of the summer the telegraphs were back in operation. The next winter, the Russian troops invaded Åland again and this time the Swedish had to retreat over the ice to the mainland. Although surrounded by the Russians, the telegraph operator at Signilsskär stayed at his post and signaled to the retreating troops where the enemy was hiding, to prevent them from being ambushed.



Figure 3.12 Sketch of Edelcrantz by Sergel.
(Coll. Nationalmuseum, Stockholm)

After the war with Russia ended in September 1809, the telegraphs on the east coast of Sweden ceased to be of value. They were dismantled and placed in storage. In 1810 plans were renewed to establish a telegraph line on the south coast. Edelcrantz was asked to establish a telegraph line between Karlskrona and Helsingborg. The preparations were almost complete when, on 15 May 1811, the Swedish crown decided to stop the project for lack of funds. In August of that year, the position of Telegraph Inspector was created, with Carl Wilhelm Venus (1770-1851) receiving the first appointment. As one of his first acts, Venus proposed to establish a new telegraph line from Stockholm via Arholma to

¹⁶ It is said that Edelcrantz himself had proposed to use the signal for the letter E in the logo, but did not receive the approval of the king.

¹⁷ Krigskollegium, Krigsförvaltningen 1808-09 GIb Huvudboksverifikationer, Vol. XXXIV-XXXV.

Söderarm. But, this proposal too was unsuccessful. Temporarily, the Swedish telegraph network disappeared almost completely.

More Titles

The lapse of interest in optical telegraphs did not diminish Edelcrantz's popularity in Sweden. Edelcrantz had participated actively during the 1809-1810 sessions of Parliament in discussions about government support for agriculture, and had made a favorable impression on the new crown-prince, Karl Johan. Edelcrantz was soon asked to draft plans for a new Academy of Agriculture. Concurrently with the design of a new steam engine, the invention of a spinning machine, and the construction of a linen-spinning mill, he started making plans for the new Academy.

The Academy of Agriculture was established in December 1811 and started its work in 1813 with the crown-prince as president and Edelcrantz as its director. Edelcrantz's plan for the Academy emphasized experimental research. In 1814 some land next to *The Shadow* was donated to the Academy to be used for agricultural experiments. The School of Mechanics, which included the royal collection of mechanical models and its workshop, was also transferred to the new Academy.

In 1813 Edelcrantz had received another appointment, this time as President of the Government Office of Commerce. This appointment made him the prime administrator of Swedish agriculture and commerce. Edelcrantz was raised to the rank of Baronet (Friherre) in recognition of his public service.

Edelcrantz's Death

Edelcrantz was as intrigued by the phenomenon of death as he had been with all the other endeavors throughout his life. In his final days, with his friends collected around him, he made a point of commenting in detail on his feelings about the approaching inevitable. His last observation, on 15 March 1821, was:¹⁸

Death has arrived ...

Edelcrantz was buried 7 April 1821 in the Klara Kyrka in Stockholm. Since he had no heir, the sign of arms that he had received from the king when he was raised to peerage (a laurel wreath with a lyre) was destroyed at the grave.

Although recipient of many honors, Edelcrantz did not die a rich man. It seems that money was never of great importance to him. He always had to work hard to raise funds to realize his projects. His belongings, including his summer house, were left to his nephew Christian Linnell. His library was willed to the Academy in Åbo, and his private letters were donated to the Royal Library in Stockholm.

Not until fifteen years after Edelcrantz's death was the optical telegraph network revitalized one last time, under the threat of new military attacks.

¹⁸ Gierow 1964" "p. 274

Reconstruction

After Sweden's resounding defeat in the war of 1809, the optical telegraph had, for all practical purposes, disappeared. Of the more than 100 optical telegraph operators working in the Stockholm Archipelago on 1 November 1809, only four remained on the payroll of the Telegraph Institution on 1 January 1810.¹⁹

In 1811 Carl Wilhelm Venus was appointed the new Telegraph Inspector, a first indication that the shutdown of the telegraph network was not intended to be permanent. Still, it lasted until 1827 before the restoration of the telegraph network around Stockholm was reconsidered. For a short time the Telegraph Institution was integrated with the Royal Engineering Corps, and thus given a military status.

On 18 March 1834 the Telegraph Institution was made part of the Topographical Corps, headed by Carl Fredrik Akrell (1779-1868). One of the first assignments Akrell received was to investigate the changes that had to be made in the Telegraph Institution after the lapse of about 25 years. Akrell proposed a comparison of the original shutter system with more recent semaphore systems that had been developed in the other European countries. It was decided to compare Edelcrantz's system with one that had been developed by Colonel Pasley in England in 1822.²⁰ Pasley's system, also called the "Universal Telegraph," had been in operation for some time on a trial basis in Karlskrona, so Akrell was familiar with it.

The king approved Akrell's proposal and the first tests were performed in August 1834 between Karlskrona and Drottningstaden. More tests, including night transmissions, were done in 1835 between the Katarina church tower in Stockholm and Fredriksborg.

Akrell submitted his report on 21 October 1835. He concluded that the shutter telegraph was easier to operate, was faster, provided a larger code space, and in the long term would prove to be more cost-effective. On the other hand, Pasley's system was considerably easier to construct. Akrell recommended the adoption of Edelcrantz's original design for the permanent stations, and Pasley's design for mobile stations.

By 1836 the optical telegraph network had been completely restored. On 18 June 1836, the lines from Stockholm to Vaxholm and from Stockholm via Dalarö to Sandhamn were back in operation. In 1837 the first telegraph line to Vaxholm, which had up to that point only been used as a side-branch on the line along the east coast, was extended to Furusund, about 70 km (43 miles) northeast of Stockholm. In 1838 the line to Sandhamn was extended to Landsort.

The last addition to the optical telegraph network was made in 1854, when the line to Furusund was extended to Arholma and Söderarm.

¹⁹ Krigskollegium, Krigsförvaltningen 1808-09 GIb Huvudboksverifikationer, Vol.XXXIV-XXXV.

²⁰ Chapter Five, p. _tag5_2.



Figure 3.13 **Uniform for Shutter-Telegraph Operators**
with King Carl XIV Johan's Signature, Indicating Approval.
(Coll. Televerket Archive, Stockholm)

The Switch To Electrical Telegraph

The electrical telegraph started making headlines in the late 1830's. The first electrical telegraphs were installed in England and in the United States in 1837,²¹ in France in 1846,²² and in Germany in 1848.²³ But the function of the optical telegraphs in the Stockholm Archipelago was much harder to challenge than in other countries. Here it was not a simple matter of stringing lines on poles through the landscape.

At last, in April 1852 Akrell submitted a proposal to the Swedish minister of defense to establish an experimental electro-magnetic telegraph line between Stockholm and Dalarö. Most likely Akrell did not initiate the study but followed up on a request, perhaps even reluctantly.

Since electro-magnetic telegraphs now exist and are used for correspondence in the whole civilized world, Sweden must, without doubt, sooner or later also connect to the rest of Europe using these rapid-writing machines, the more as Denmark already has taken the initiative and provided the necessary intermediate link. This long-term objective should be remembered also in the discussion about a small experimental line. It seems to me that such a line should be established in such a direction and between such end stations that it can serve as the starting point, or connecting link, in a longer line, and that in the meantime it can provide an integral system in itself. To fund such an experiment only for the purpose of testing is not necessary. We already have in our possession machines of the model most commonly used in Europe and their use on a distance of 10 ells or 10 miles is all the same when going

²¹ Chapter Five, p. _tag5_1.

²² Chapter Two, p. _tag2_B.

²³ Chapter Five, p. _tag5_B.

from idea to practice. What we have not yet tested is the preparation of the electrical cable. This must be acquired from abroad and should later be possible to manufacture domestically to provide for future needs.

Of course, it was not clear that stringing lines across the landscape was even feasible. As Dr. Jules Guyot had pointed out so eloquently in France, it would be very easy, and perhaps tempting, for an adversary to destroy the cables. The report foresees the problem:



Figure 3.14 **Inside the Reconstructed Station in Furusund.**
(Coll. Telemuseum, Stockholm)

The gentlemen von Heland and Fahnehjelm consider an experimental line necessary to investigate whether the population of Stockholm would let an open air cable be without destroying it, and want to conclude that this experience would be sufficient evidence that also other areas would see the cable undestroyed and thus avoid the larger cost to put the cable underground. However, absence or presence of singular mischiefs in one place cannot be used to conclude anything about the situation elsewhere. Mischievous persons can be found anywhere but to try to find out where the most of them are to be expected will always be in vain.

In the Royal Garden, open to us all, also to the least well-bred in the population of the capital, there is no destruction of the constructions, plantations, etc. Open flower-beds at the beautiful Rosendal Castle are left unharmed as is the Garden Associations building where people are crowding on the small walk ways during occasions when public amusements are organized. On the other hand, in the Royal Garden in Copenhagen, every flower-bed and lawn is fenced to protect it from public abuse. None of these examples provide evidence but give us hope that in Sweden, as in other countries, a telegraph line could be established through the country without having to dig it into the ground, an undertaking which in most cases should be avoided, and anyway is not very efficient as a protective measure. ...

Akrell is almost apologetic for even raising the issue:

The intention behind these remarks is not to dispute the usefulness of establishing an experimental electrical telegraph line. I consider such an undertaking not only useful but necessary to make the electrical telegraph more widely known and get support for a larger effort in the public opinion, without which a future development of a complete electrical telegraph network would be hard to achieve. However, this experimental line should be established in such a direction and between such end stations that it will be easily accessible and of interest to use by as many individuals as possible, and also forms a starting point for a larger network. ...

Next, after raising some doubts about the wisdom of the proposed trajectory for the first experimental line, Akrell makes it clear that, in his opinion, the outcome of the experiment is hardly an issue. He knows that the days of the optical telegraph are numbered:

In whatever direction the line is established, the central office in Stockholm should be independent of that of the existing optical telegraph network at Mosebacke. It should, in my opinion, be located in the Post office or in a government building, if a suitable office space can be found in any of these places. If not, some of the crown houses on Riddarholmen could probably be used so that all cables could converge in an expanded network in the future. . . .

Based on this proposal, Carl Akrell received permission to build an experimental line between Stockholm and Södertälje. On 29 October 1852 he submitted his next report. Again, the issue of sabotage came up, but it seemed to be under control now. The report begins:

Humble memorandum containing a proposal for an electrical telegraph line Stockholm-Södertälje, 29 October 1852, by Carl Akrell

During the local investigations on which this proposal is based, the Captain of the Navy Mechanical Corps Fahnehjelm has served as an assistant, who during travels abroad has had the opportunity to learn more about electrical telegraph systems in England, France and northern Germany. In comparison between the different machines and methods used in these countries, we have reason to consider those now in use between Hamburg and Cuxhaven to be the most appropriate for use in Sweden, due to simplicity and low cost. Such a telegraph is also imported from Hamburg together with several other machines necessary for the planned experiments, such as galvanometer, lightning conductor, insulation made of gutta-percha, etc. The price of the materials necessary to import is calculated from information received by mail conversation with the manager of the Hamburg Telegraph line.

Two different methods can be used when wiring between the telegraphs: One is to insulate the wire with gutta-percha and put it underground, the other is to wire it between poles in the open air, uninsulated. The former method is expensive, partly due to the preparation of the wire, partly due to the trouble to dig ditches in the kind of terrain we have in Sweden. It also introduces inconveniences. The insulation from the ground is easily broken and can also be cut by mischievous persons, resulting in a damage which is hard to detect and repair. The latter method does not introduce these difficulties. Zinc-plated wire can be used without coating and the cost is thus considerably lower. The open wire could also be cut by mischievous persons, although not as easily and the damage is easy to detect. And as the charge of electricity in the wire caused by lightning can be dealt with using lightning-insulators, all reason seems to support the use of open air wire on poles.

The starting point of the telegraph line can and should be determined considering convenience of the public only, when sending and receiving messages. In Stockholm, the post office is the most suitable since it is located in the middle of the city, close to the Royal Castle, the expeditions, the government offices, the police, the harbor, etc, which is why this location is assumed in the sequel. In Södertälje, the end-station should be close to the channel, the road and the guesthouse, and in this respect also there the post office is the most suitable ...

Next Akrell submits a detailed budget for the construction and management of an experimental line. He comments on ways to recover some of the expenses, first by closing some of the optical telegraphs, but also by opening up the use of the telegraph to the general public -- something that had rarely been tried before:

By charging a small fee for the use of the telegraphs, a possibly not insubstantial compensation could be received for the annual operating cost. According to one tariff issued this year in Halle for telegraph messages, a message containing at most 20 words and sent over 100 km distance costs 1 Rdr 5 s and 20-50 words 2 Rdr 16 s. Such a high tariff should not be adopted here initially but it could as a test be set to 12-16 s for 20 words and less and 24-32 s for 20-50 words and an additional 8 s for every 10th word exceeding 50.

An additional income could be generated and also a large number of visitors attracted by selling tickets for visitors that wish to see the telegraph and learn about its principles and operation. This is done in Hamburg and several other German locations.

As a result of the experiments, the Swedish Electrical Telegraph Institution was soon instituted, again headed by Akrell. Then, in 1856, the administration of the optical telegraph was combined with that of the new Electrical Telegraph Institution, as a first step towards its disappearance. But, over the next five years little else happened. The problem of a more rapid switch-over was, to a large extent, a financial one. The annual report of the Telegraph Institution from 1863 explained,

Since the purpose of the telegraph institutions is to convey messages from one place to another as fast and safely as possible, and this purpose can only incompletely be reached using optical telegraphs due to the signaling often being hindered by fog or haze and furthermore can not be conducted during the dark hours, the question of replacing the optical telegraphs erected on the east coast of the country, outside the entrance to the capital, was raised as early as 1857, but as the calculation of all the involved costs made by the Telegraph Board on Royal Command resulted in such a high cost that funds for the realization of the entire plan could not be raised, it was decided only to establish an electrical telegraph line from Stockholm to Dalarö and as a consequence [only] three optical telegraphs were closed in 1858.

For almost ten years electrical and optical telegraph stations were used side by side, the optical telegraphs reaching where the electrical cables could not lead, such as some remote Swedish islands. In 1864 there were 174 electro-magnetic telegraphs, with 250 operators, but also 24 optical telegraphs with 66 operators (49 on the east coast, and another 17 at the west coast, near Göteborg). Three years later there were still 18 optical telegraphs in service, employing 42 people.

In the annual report of the Telegraph Institution from 1867 the following comments can be found:

The lack of electrical telegraph lines to several important places, like Arholma, Sandhamn and Marstrand, which for the moment are connected to the rest of the telegraph network only by optical telegraphs, is becoming increasingly serious. The optical telegraphs are often out of operation due to natural hindrances, such as rain or snow, storm, haze, etc. Due to such reasons, signaling has not been possible for the following number of hours of normal duty hours during 1867 at the different stations: Arholma 213, Sandhamn 252, Landsort 360 and on the west coast up to 404 hours of the normal duty hours. The large degree of inconvenience and endangerment for sea travelers caused by this is obvious. Consequently, requests have been made to the Telegraph Board to act in favor of the establishment of electrical telegraph connections to Arholma and Sandhamn, and regarding the latter, the Royal Majesty has approved the inclusion of an electrical connection to Sandhamn in the budget for construction work on the telegraph lines next year and that the necessary local investigations can be started this fall using a crown vessel, at the expense of the Telegraph Board.

The last three optical telegraphs were closed in 1881, later than in any other European country.²⁴ The annual report of the Swedish Telegraph Board from that year reflected on the event:



Figure 3.15 **The Shutter Telegraph in Furusund.**
(Photo: Gerard J. Holzmann, 1991)

With the closing of these stations, the last part of the optical telegraph institution in Sweden has been discontinued. Regarding the introduction of the same, it should be

²⁴ The only other country where they remained in service this long in parallel with the electrical systems, was Australia (cf. p. _tag5_L). An optical telegraph line in Curacao remained in operation until 1910 (p. _tag5_M), but electrical telegraphs had not been installed there before.

mentioned that the first optical telegraph institution in Sweden was of Swedish origin and erected in 1794, but then only for messages between Stockholm and Drottningholm, whereafter, during the wars of Sweden 1808 and 1809, such telegraphs were erected in the Archipelago of Stockholm to Gavle, Landsort and Sandhamn. These telegraphs, which shortly thereafter and due to several reasons, decayed, were reerected in 1836 so that correspondence could be conducted not only in military and official matters, but also on the account of the public ...

As replacement for the, in several aspects incomplete, optical telegraph system, new inventions have made it possible for the transport of immaterial communications to benefit from the great advantages of the electrical telegraph and, especially for military purposes, the heliograph and the electrical light given access to new methods for optical messages to replace the now abandoned signaling system.

As in the United States, the era of the optical telegraphs was followed by a brief period of enchantment with heliographic devices. In the end, of course, the electrical telegraphs won decisively.

Bibliographic Notes

An extensive study of the Swedish optical telegraph network was made by Allan Cyrus in 1912, [Cyrus 1912]. A second important study was performed in 1938 by N. J. A. Risberg, [Risberg 1938]. Both works are in Swedish and have not appeared in English translations. Many details about the size of the telegraph network in each year can be found in the annual reports published by the Royal Telegraph Institution, of course, also in Swedish. An overview in German can be found in [Herbarth 1978]. The network is also described, though in less detail, in Wilson 1976, and in our own [Holzmann and Pehrson 1994].

The Telemuseum in Stockholm has a permanent exhibition on optical telegraphs. The only complete station of the Swedish network that still exists can be found in Furusund. It is described in Malmgren 1964, Risberg 1938, and [Cyrus 1912]. The post was in operation from 1837 until 1866, and restored to its original state in 1964. It is opened to the public one day each year. Locally, however, Furusund derives more fame from more recent visitors.²⁵ The writer August Strindberg (1846-1912) is said to have spent some time in the town during occasional summer visits. Curiously, Strindberg had been an (electrical) telegraph operator at Sandhamn, in 1873, before he became an author. There is no record that he ever stayed at the telegraph house in Furusund.

²⁵ The telegraph house is located at Strindbergsvägen, no. 6.