THE

TELEGRAPH MANUAL

A COMPLETE

HISTORY AND DISCRIPTION

OF THE

Semaphoric, Electric and Magnetic Telegraphs

OF

EUROPE, ASIA, AFRICA, AND AMERICA

ANCIENT AND MODERN.

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PREFACE.

In the preparation of this volume, the author has not advanced theories, other than those, which are founded upon demonstrated philosophy. It is to be understood, however, that many of the views expressed concerning questions in the sciences may, from time to time, be modified by new developments. In every instance, the opinions given are based upon the known sciences as manifested through the medium of the arts, and more particularly the electric telegraph.

I have reviewed the early semaphore telegraphs, and explained their respective modes of operation. These visual systems have, however, ceased to be employed by civilized nations, except for the marine service.

As preliminary to the consideration of the electric telegraph, I have introduced a few chapters explanatory of the sciences immediately blended in that art; such, for example, as static and voltaic electricities, magnetism, and electro-magnetism. These questions of philosophy the telegrapher should most carefully study. The data given are from the most reliable authorities.

In the collection of materials for this work I have spared neither labor nor expense. For nearly fifteen years I have made the subject-matter of this volume my most careful study. For the greater part of that time, practical telegraphing has been my sole vocation. I have instituted thousands of experiments, and have traveled over most of the civilized world " in search of light" upon this, the most important of all arts. The information herein imparted has cost me years of toil and a heavy expenditure of money. Still, I cannot regret my devotion, either past or present, to the cause. In its study I have found new truths, serving to increase my admiration of that mysterious Providence who knoweth all things.

I have not written this book for gain. It has been to me a work of love. For several years I have been urged by friends to prepare a work on practical telegraphing, and I have in the present volume complied with that wish. I have not confined the work to the telegraph of any particular locality, but, on the contrary, I have grouped together the various systems of both hemispheres. Nearly every combination herein described I have witnessed in operation and most carefully studied. I may have failed to comprehend the full merits of each, and my descriptions of them, respectively, may be imperfect, though I have tried to make them clear and concise.

I have not attempted to arrange the various systems with regard to priority of invention, nor as to their relative efficiency. I have given dates wherever it was possible, and have refrained from exhibiting any preferences. I indulge the hope that the many inventors, who have distinguished the age by the production of their respective contrivances, will not accuse me of an undue partiality. I have tried to be fair in the consideration of the merits of each discovery and each invention. If I have failed in accomplishing this desideratum, the fault lies, not with the heart, but with the judgment.

Notwithstanding that this volume has been greatly extended, I have been compelled to omit several important chapters; such, for example, as the organizations for generating magnetoelectricity, the aurora-borealis, the fire-alarm and railway telegraphs, repeating apparatuses, &c. These will be duly considered in some subsequent edition, together with such emendations and additions to the present work as shall be found necessary.

To M. Blavier and his publishers in Paris, to the publishers of Noad's "Electricity," the "Illustrated London News," and others who have given me full permission to copy from their respective works, I am especially indebted. On the other hand, some authors and publishers have refused me that permission; and although I could have copied whatever I might have wanted from any foreign work without legal liability, yet I have not done so, knowingly, in a single case where the privilege was refused me.

I cannot conclude this review of my labors, without expressing my most profound thanks to my very able and accomplished friend George Jaques, of Worcester, Massachusetts, for his aid in translating from the various languages of the Old World, and in searching for new light and authorities. For the services thus rendered, I cannot but feel the highest appreciation, and a sincere desire that his future life may be blessed with that which will enable him to fill the measure of his creation, and that his fireside may be surrounded with those jewels which are more brilliant than the pearls and gems that sparkle from and adorn the imperial crown.

In preparing this work I have made copious extracts from various publications, among which may be particularly mentioned, Noad's Manual of Electricity, Highton's History of the Electric Telegraph, Dr. O'Shaughnessy's Electric Telegraph, Bakewell's Manual of Electricity, Moigno's Traite de Telegraphie Electrique, Blavier's Cours Theorique et Pratique de Telegraphie Electrique, Davis's Manual of Magnetism, Walker's Electric Telegraph Manipulation, Shaffner's Telegraph Companion, Dr. Schellen's Electro-Magnetische Telegraph,; Vail's Electric Telegraph, Dr. Trumbull's Electric Telegraph, Shaffner's Telegraph Tariff Scale; Smithsonian Reports, American and European Patent Reports, &c., &c. I have not, in all cases, particularly marked, the extracts taken, because, in many of them, I have blended new matter, and, to a greater or less extent, expressed their ideas in different language. In justice, however, to the respective authorities I make this general acknowledgment.

To the respective governments of Europe I feel deeply grateful, especially to the French, Belgian, Prussian, Danish, Swedish, Norwegian, and Russian. For the facilities given, and the vast amount of material placed at my command on my visits to them respectively, and for the documents from time to time transmitted, I have been placed under lasting obligations. To M. Chauvin, director-general of the Royal Prussian Telegraphs, I have to express my sincere thanks for recent valuable documents; though their reception was too late for the present edition, they will serve a good end in the future.

It is my purpose to continue this work by subsequent editions, and embrace the improvements continually making in the art of telegraphing. Should the reader find any errors in this volume of either omission or commission, he will serve a good end by informing me of the fact. It is very desirable to promulgate truths well sustained by practical demonstrations; and if there be anything in this volume otherwise, it is for the weal of the enterprise that the false doctrines should be at the earliest moment suppressed.

In conclusion, I would add, that I have been compelled to write this volume piecemeal, on the steamboat, on the railway, at various hotels, and at places thousands of miles apart. All this I have had to do within the past six months. And while, in obedience to other duties, it has not been possible for me to give that personal attention to its passage through the press I should have wished, the novel and technical character of its contents rendered more difficult the labors of the correctors of the press, to whose care it was necessarily left.

With these explanations, I submit the " Telegraph Manual" to the generous and impartial consideration of the telegraphers throughout the world.

TAL. P. SHAFFNER.
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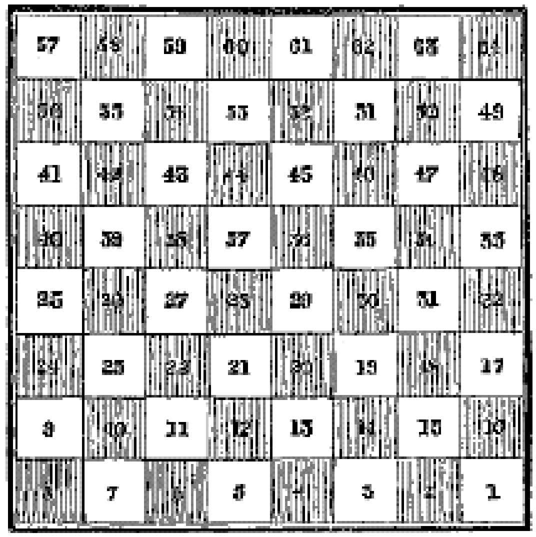
TELEGRAPH CHESS-BOARD



THE MEANING OF THE TERM TELEGRAPH.

TELEGRAPH - Greek, Tele, at a distance, and graph, to write. The original meaning of the word, as taken from the Greek, is to perform the act of writing at a distance. In its modern application it means the art of "communicating at a distance." For example, the semaphore telegraph composed of angles, communicated intelligence by certain mechanical contrivances, which had to be seen and understood by the operator miles distant. Also the needle systems of the electric telegraphs of Europe: they do not write; yet they communicate to points far distant. The term has been applied to any and all systems of transmitting information by signs or sounds to another beyond the reach of speech.

The art of conveying intelligence by the aid of signals has been practiced for centuries, and for aught we know since Adam and Eve commenced their pioneer career in the Garden of Eden.

I have searched the Bible in vain for some tangible mode of signaling among the early nations. The most definite reference to communicating by signals mentioned in the Old Testament is to be found in chapter vi., verse 1, of the prophet Jeremiah, viz.: "0, ye children of Benjamin, gather yourselves to flee out of the midst of Jerusalem, and blow the trumpet in Tekoa, and set up a *sign of fire* in Beth-haccerem; for evil appeareth out of the north, and great destruction!"

The writings of Jeremiah date 588 years before Christ, and the above reference to communicating intelligence to others by the "sign of fire," or by any means of signaling is the earliest on reliable record.

DIVINE TELEGRAPH.

In the New Testament there is nothing more potent and more sublime than the signal placed in the heavens to indicate that the Son of God was born. The humble shepherds in the open fields of Judea, while guarding their flocks, beheld in the vaulted firmament a STAR, the brilliancy of which had no twin. It was a signal- “a divine signal”- communicating to man the glad tidings of the birth of the Prince of Peace.

The Gospel of St. Matthew teaches that the signal light suspended in the heavens by the hand of the Creator was seen by the wise men of the east:

"Now when Jesus was born in Bethlehem of Judea, in the days of Herod the king, behold, there came wise men from the east to Jerusalem,"

“Saying, Where is he that is born King of the Jews? For we have seen his star in the east, and are come to worship him."

TELEGRAPHS MENTIONED IN THE CLASSICS AND ANCIENT HISTORY.

In profane history and the classics, various methods of communicating by signals are mentioned.

Homer is the first who mentions the telegraphic art. He compares the lambent flame which shone round the head of Achilles, and spread its lustre all round, to the signals made in besieged cities by clouds of smoke in the daytime, and by bright fires at night, as certain signals calling on the neighboring states for assistance, or to enable them to repel the powerful efforts of the enemy.

Julius Africanus minutely details a mode of spelling words by a telegraph. It appears that fires of various substances were the means made use of. He says the Roman generals had recourse to such media of distant communication. In Livy, in Vegetius, and in the life of Sertorius, by Plutarch, it is mentioned that these generals frequently communicated by telegraphs.

In book iv., page 238, of Brumoi's account of the Theatres of the Greeks, it is stated that fire signals were used to communicate the events of wars, and likewise to direct the commencement of battles. This description of signals was anterior to the use of trumpets. A priest, crowned with laurels, preceded the army, and held a lighted torch in his hand. He was respected and spared by the enemy, even in the heat of battle. Hence the old proverbial expression for a complete defeat, that even the very torch-bearer had not been spared. Hence, also, it is highly probable that the usage arose of rep- senting discord with inflamed torches.

The Chinese, like the ancient Scythians, communicated intelligence by lighting fires or raising a cloud of smoke at different stations. Polybius gives the general appellation of Pyrsia to the telegraphic modes then practised; indicating that fires were the principal means made use of. An ingenious though limited species of telegraph was invented by 2Eneas, who lived in the time of Aristotle, and who wrote on the duties of a general. Two oblong boards had various sentences written on their surfaces, as, " The enemy have entered the country," " The invasion has been repelled," " The enemy are in motion," &c., &c. These boards were fixed perpendicularly in pieces of cork which fitted very nearly the mouth of two similar circular vessels filled with water, and having a cock adapted to each vessel. One of the vessels was stationed where the intelligence originated, and the second at the place to which it was to be conveyed. A person, as at present, was always on the lookout; and when he perceived one or more torches raised up at the primary station, he understood that intelligence was about to be communicated. On observing a second torch raised, he instantly answered the signal and opened or turned the cock of the vessel he was in charge of; the cock of the vessel at the primary station having been turned immediately on raising up the second torch at that station and on observing this signal answered. As the cocks were opened simultaneously at both stations, the circular corks with the board standing perpendicular to their respective centres, would descend in the vessels equally, as the water subsided. At the instant when the sentence to be communicated descended or sunk to the level of the edge of the vessel at the primary station, the person in charge there raised a torch. The person at the second station, on observing this, instantly answered this signal, and turned the cock of his vessel, and thus stopped the flowing of the water, reading at the same time the sentence then level with the edge of the vessel, such sentence, on account of the equal flow of the water, corresponding to the one, similarly situated at the original station.

TELEGRAPH INVENTED BY POLYBIUS-PUNIC WAR, B. C. 264.

Polybius writes, in his history of the Punic wars, that he improved a mode of communicating ideas by the letters of the alphabet applied to a telegraph invented by Cleoxenus, or according to some authors, by Democlitus. The letters of the Greek alphabet were divided into five parts, and those in each division were inscribed on a board fixed perpendicularly to an upright post for each of those divisions of the alphabet. These posts stood in an opening between two walls about ten feet by six, and situated on each side of the posts. Two long tubes (a dioptical instrument) were fixed in one position or direction. The telegraph workers could readily perceive through these tubes, which excluded all lateral rays, the right or left of the station viewed, and what number of torches might be raised above the top of the wall, either on the right or left of the station looked to. Things being thus prepared at the primary and second station, the person in charge at the primary station would raise up two torches as a commencing signal that intelligence was about to be conveyed.

The looker-out at the other station would, on perceiving this, hold up a couple of torches, thus indicating that he was prepared. The ideas to be communicated were reduced previously to as few words as possible. The posts on which the letters were, being numbered 1, 2, 3, 4, and 5, one or more torches raised up above the left-hand wall, would indicate to the person at the second station, on what post was situated the first letter of the sentence to be communicated. The person at the second station, on observing through one of his tubes the torch or torches held up, would immediately raise torch or torches corresponding to the display exhibited. The person at the primary station, seeing his signal taken up, would lower his torch or torches, which would at once disappear on sinking under the level of the top of the wall. The column on which the letter was, being thus ascertained, the person at the primary station would hold up from behind the right-hand wall, a torch or torches, indicating the position of the letter on the post already pointed out. For instance, if it was the first letter at the top of the column, he would hold up one torch, and if the second, two torches, and so on to the fifth letter on the column. The person at the second station would exhibit a corresponding number, to make it appear that he understood the signal. Every letter in each word would be communicated in this manner; and we are to suppose that an agreed-on signal would be made to indicate the termination of a word and of a sentence. It is further evident that information could be conveyed along any number of stations, on the principle of the modern telegraph of keeping up every signal until taken up at the succeeding station. But in this case two parallel walls would be requisite on each side of the posts, in order that the torches, when depressed, might disappear to the two contiguous stations at the same instant. This was a night telegraph; but it could obviously and readily have been converted into a day telegraph by substituting flags in lieu of torches.

AGAMEMNON'S TELEGRAPH, B. C. 1084.

Eschylus, who was born five hundred and twenty-five years before Christ, wrote a tragedy in which he gave an account of the fall of Troy, which occurred, 1084 years before the Christian era. For ten years Agamemnon had besieged the city. The news of the memorable event was signaled to his queen, Clytamnestra. The following is from Eschylus:

"WATCHMAN, I pray the gods a deliverance from these toils, a remedy for my year-long watch, in which, couching on my elbows on the roofs of the Atreidse, like a dog, I have contemplated the host of the nightly stars, and the bright potentates that bear winter and summer to mortals, conspicuous in the Firmament. And now I am watching for the signal of the beacon, the blaze of fire that brings a voice from Troy, and tidings of its capture; for thus strong in hope is the woman's heart, of manly counsel. Meanwhile I have a night-bewildered and dew-drenched couch, not visited by dreams, for fear, in place of sleep, stands at my side, so that I cannot firmly close my eyelids in slumber. And when I think to sing or whistle, preparing this the counter-charm of song against sleep, then do I mourn, sighing over the sad condition of this house, that is not, as of yore, most excellently administered. But now, may there be a happy release from my toils as the fire of joyous tidings appears through the gloom. Oh hail! thou lamp of night, thou that displayest a light as like the day, and the marshalling of many dances in Argos on account of this event. Ho! ho! I will give a signal distinctly to the wife of Agamemnon, that she, having arisen with all speed from her couch, may raise aloud a joyous shout in welcome to this beacon, if indeed the city of Ilion is taken, as the beacon light stands forth announcing; and I myself will dance a prelude. For I will count the throws of my lord that have fallen well; mine own, since this kindling of the beacon light, has cast me thrice six. May it then befall me to grasp with this hand of mine the friendly hand of the sovereign of this palace on his arrival.

Chorus:. But thou, daughter of Tyndarus, Queen Clytamnestra, what means this? What new event? What is it that thou hast heard? and on the faith of what tidings art thou burning incense sent around? And the altars of all our city guarding gods, of those above and those below, gods of heaven and gods of the forum, are blazing with offerings; and in different directions different flames are springing upward, high as heaven, drugged with the mild, unadulterated cordials of pure ungent, with the royal cake, brought from the inmost cells. Concerning these things, tell one both what is possible and lawful for thee to say, and become thou the healer of this distracting anxiety, which now, one while, is full of evil thought, but at another time, because of the sacrifices, hope blandly fawning upon me repels the insatiate care, the rankling sorrow that is preying upon my heart.

I have come revering thy majesty, Clytamnestra; for right it is to honor the consort of a chieftain hero, when the monarch's throne has been left empty. And gladly shall I hear whether thou, having learned aught that is good or not, art doing sacrifice with hopes that herald gladness-yet not if thou continuest silent will there be offence.

Clytamnestra. Let morning become, as the adage runs, a herald of gladness from its mother night; and learn thou a joy greater than thy hope to hear, for the Argives have taken the city of Priam.

CH. How sayest thou? thy word escaped me from its incredulity.

CLYT. I say that Troy is in the power of the Argives- speak I clearly?

CH. Joy is stealing over me, that calls forth a tear.

CLYT. Ay, for thy countenance proves thy loyalty.

CH. Why, what sure proof hast thou of these things?

CLYT. I have a proof-why not? -unless the deity hath deluded me.

CH. Art thou then reverencing the vision of dreams that win easy credence?

CLYT. I would not take the opinion of my soul when sunk in slumber.

CH. But did some wingless rumor gladden thy mind?

CLYT. Thou sharply mockest my sense as that of a young girl.

CH. And at what time hath the city been sacked

CLYT. I say in the night that hath now brought forth this day.

CH. And what messenger could come with such speed?

CLYT. Vulcan, sending forth a brilliant gleam from Ida; and beacon dispatched beacon of courier-fire hitherward. Ida, first, to the Hermsean promontory of Lemnos, and third in order Athos, mount of Jove, received the great torch from the isle, and passing o'er so as to ridge the sea, the might of the lamp as it joyously travelled, the pine-torch transmitting its goldgleaming splendor, like a sun, to the watch towers of Macistus. And the watchman omitted not his share of the messenger's duty, either by any delay, or by being carelessly overcome by sleep; but the light of the beacon coming from afar to the streams of the Euripus gives signal to the watchmen of Mlessapius, and they lighted a flame in turn and sent the tidings onward, having kindled with fire a pile of withered heath. And the lamp in its strength not yet at all bedimmed, bounding over the plain of the Asopus, like the bright moon to the crag of Cithheron, aroused another relay of the courier fire. And the watch refused not the light that was sent from afar, lighting a larger pile than those above mentioned; but it darted across the lake Gorgopis, and having reached mount Egiplanctus, stirred it up that the rule of fire. might not be stint, and lighting it up in unscanting strength, they send on a mighty beard of flame, so that it passed glaring beyond the headland that looks down upon the Saronic frith, then it darted down until it reached the Arachnaean height, the neighboring post of observation, and thereupon to this roof of the Atreide here darts this light, no new descendant of the fire of Ida. Such, in truth, were my regulations for the bearers of the torch fulfilled by succession from one to another; and the first and the last in the course surpass the rest. Such proof and signal do I tell thee of my husband having sent me tidings from Troy.

CH. To the gods, my queen! I will make prayer hereafter, but I could wish to hear and to admire once more, at length, those tidings as thou tellest them.

CLYT. On this very day the Greeks are in possession of Troy. I think that a discordant clamor is loud in the city. If you pour into the same vessel both vinegar and oil, you will pronounce that they are foemen, and not friends. So you may hear the voices of the captured and the conquerors distinct because of a double result; for the one party having fallen about, the corpses of men, both those of brothers, and children those of their aged parents, are bewailing, from a throat that is no longer free, the death of those that were dearest to them. But the other party, on the contrary, is hungry, fatigued from roaming all the night after the battle, arranging at meals of such things as the city furnishes, by no fixed law in the distribution, but as each hath drawn the lot of fortune. Already are they dwelling in the captured houses of the Trojans, freed from the frost beneath the sky, and from the dews, thus will they, poor wretches, sleep the whole night through without sentries."

NORTH AMERICAN ABORIGINAL TELEGRAPH.

The most remarkable signaling records are to be found on various parts of the North American continent. The aborigines, or a race of people centuries since extinct, had their signal stations or mounds. Upon the loftiest summits beacon fires were built, and the rising smoke by day and the red flame by night communicated intelligence to others far distant. These mounds, these beacon remains, are still to be seen in different parts of America. An eminent author upon this subject says, that the most commanding positions on the hills bordering the valleys of the west, are often crowned with mounds, generally intermediate but sometimes of large size; suggesting at once the purposes to which some of the cairns or hill-mounds of the Celts were applied, namely, that of signal or alarm posts. Ranges of these mounds may be observed extending along the valleys for many miles. Between Chillicothe and Columbus, on the eastern border of the Scioto valley, not far apart, some twenty may be selected, so placed in respect to each other, that it is believed, if the country was cleared of the forest, signals of fire might be transmitted in a few minutes along the whole line. On a hill opposite Chillicothe, nearly six hundred feet in height, the loftiest in the entire region, one of these mounds is placed. A fire built upon it would be distinctly visible for fifteen or twenty miles up, and an equal distance down the valley.

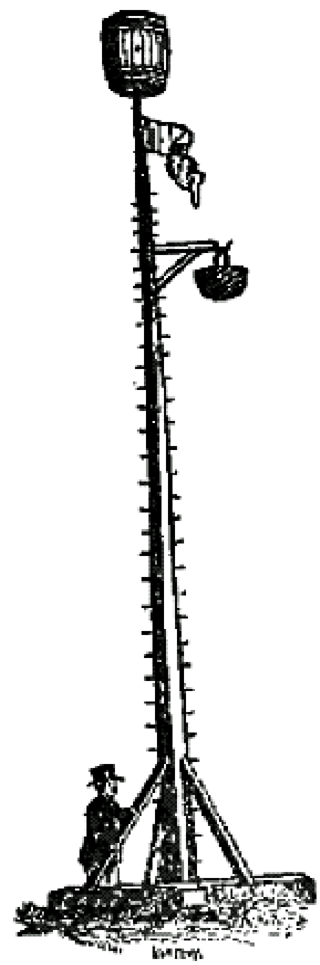
In the Miami valley similar works are found. Upon a hill three hundred feet in height, overlooking the Colerain work, and commanding an extensive view of the valley, are placed two mounds, which exhibit marks of fire on and around them. Similar mounds occur at intervals along the Wabash and Illinois, as also on the Upper Mississippi, the Ohio, the Miamis, and Scioto. On the high hills, overlooking Portsmouth and Marietta, mounds of stone are situated; those of the former place exhibit evident marks of fire.

These mounds, or beacon hills, are to be found in different parts of the continent. The remains of these beacon fires are silent records left by a people, long since gone. Above the cinders have grown stately oaks, and upon the surface of the earth nothing but the new soil is to be seen. On removing the earth some few feet, the charcoal and ash beds are found. How many centuries they have been there no human being can divine. It remains a sealed history to the world.

The savage Indians, which rove in the wild regions of America, have their means of communicating by beacon and other modes of signaling. When Lieut. Fremont penetrated into the fastnesses of Upper California, his appearance created an alarm among the Indians. He there observed the primitive telegraph communicating his presence to tribes far distant. In his report, he says: " Columns of smoke rose over the country at scattered intervals-signals, by which the Indians, here, as elsewhere, communicate to each other, that enemies are in the country. It is a signal of ancient and very universal application among barbarians."

AMERICAN REVOLUTIONARY ARMY SIGNALS.

During the American Revolutionary war, the people had their modes of signaling to each other the movements of the enemy, and especially when they were approaching. Among the different plans of communicating between the divisions of the army, was the next representation, of a barrel at the head of a mast, a flag below it, and the basket hanging to a cross-beam. This mast was moveable. The parts were moveable, and this simple contrivance could carry out any arranged system of signaling. For example, suppose the enemy was approaching, the pole might be left bare, so that there would be no reason for the enemy to suspect the objects of its use. The basket or either of the others, alone or combined, or any transposition, could be made to communicate a variety of information.



END CHAPTER 1

THE SEMAPHORE TELEGRAPH.
CHAPTER II.

ORIGIN OF THE SEMAPHORE OR AERIAL TELEGRAPH.

The visual telegraph system, of late in universal use over Europe and a part of Asia, has been superseded by the electric system. Notwithstanding it has passed away, yet a description of its beautiful mechanism must ever be of interest to the telegrapher. The most perfect aerial telegraph was that invented by the Messrs. Chappe, and first adopted in France.

There were three brothers Chappe, nephews of the celebrated traveler, Chappe d'Auteroche, who were students —one at the Seminary d'Angers, and the other two were at a private school about a half league from the town. Claude Chappe, the pupil of the seminary, wishing to alleviate the separation with his brothers, contrived the following means by which they might correspond one with the other.

He placed at the two ends of a bar of wood two wing pieces of wood, to be moved at pleasure, by means of which he was enabled to produce 192 signals, which were distinctly visible by means of a spy-glass. He conceived the idea of making words of these signals, and he communicated the same to his two brothers. This took place a few years before the French revolution in 1793. His invention was first tried in 1791, but, like all inventors, Chappe met with great opposition and discouragement. The people were opposed to the use of the telegraph at all, and the populace destroyed his first telegraphs and the stations. His second telegraph shared the same fate, and was burnt to the ground, and poor Chappe narrowly escaped with his life; the people threatened to burn him with his telegraph. Not daunted by these misfortunes he renewed his efforts for government aid, with increased zeal, until success crowned his efforts.

ADOPTION OF THE SEMAPHORE TELEGRAPH IN FRANCE.

Continuing his efforts with the zeal common to great inventors, he finally succeeded in getting the government to favor his project, and a commissioner was appointed to examine into it. The commissioner reported favorably, and his system was adopted, and Chappe was honored with the appointment of telegraphic engineer to the French government.

Fortunately, before the presentation of the invention to the government, the Chappe brothers perfected the system entire, and in the preparation of the signals they had the aid of Leon Delaunay, who had formerly been consul, and who was well acquainted with the cipher language of diplomacy. In this perfect state it was presented to the convention, adopted and subsequently executed. Circumstances favored these inventors remarkably; for their telegraph, after the government had once adopted it, it was fortunately inaugurated by the announcement of a victory. The following was the first dispatch, having been transmitted by the telegraph from the frontier of France to Paris, viz.:

"CONDE IS TAKEN FROM THE AUSTRIANS"

To which the convention, then in session, responded as follows, viz.:

"THE ARMY OF THE NORTH DESERVES THE GRATITUDE OF THE COUNTRY."

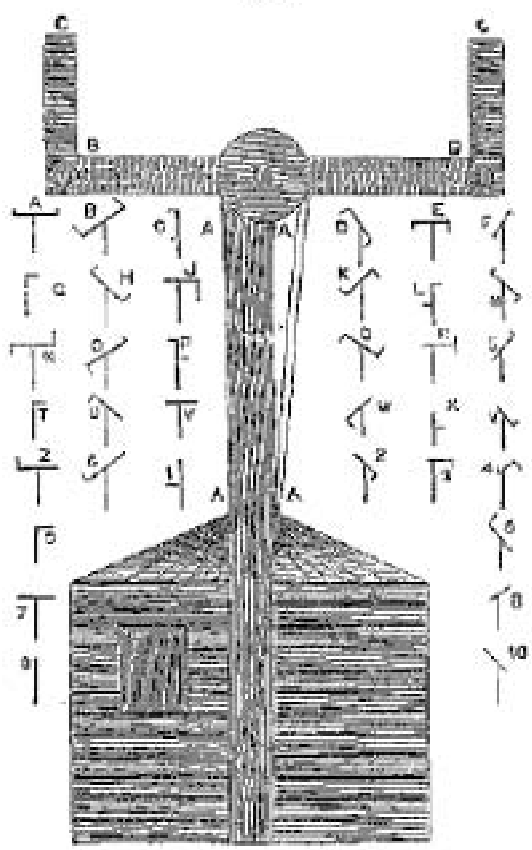
These two dispatches ran like an electric shock through the convention, and soon thereafter throughout Paris. The Chappe telegraph was then the pride of the nation! The telegraph and the victory were rejoiced over as twin-sisters in French glory. From this time the telegraph spread with wonderful rapidity to all parts of France, and thence to the other governments of Europe. The line from Paris to Lille was constructed in 1794, and two minutes only were occupied in the transmission of a dispatch.

In the perfection of the beautiful mechanism for the production of the signals, Chappe had the invaluable assistance of that most ingenious mechanic, M. Breguet, whose fame as a watchmaker had spread throughout Europe.

EXTENSION OF THE SEMAPHORE TELEGRAPH OVER EUROPE.

After the perfection of the semaphore telegraph in France, the other governments of Europe observed its usefulness. In 1802, a modified system was adopted in Denmark. About the same time it was adopted in Belgium. About 1795, it was adopted in Sweden, with some improvements over the Chapp6 system of that time. Soon after the establishment of the lines in France, the telegraph was erected in some parts of Germany. But the mechanism of the stations of that day was not so perfect as it has since been made by the brothers Chappe, and as will be described hereafter. In 1823, the visual telegraph was established between Calcutta and the fortress of Chunore, in Asia. A year later Mohammed Ali erected it between Alexandria and Cairo, in Egypt, In some form or other it has spread mostly over the inhabited globe.

Fig. 1.



German Telegraph Station, 1794.

THE GERMAN TELEGRAPH STATION.

While at Frankfort on the Main, Germany, in 1854, I found a drawing of the ancient semaphore telegraph, used in that country more than a half century ago. The house or station was a plain hut, and the mechanism for manipulation very simple, as will be seen in figure 1. The ropes were drawn by the hand, moving the regulator B B, and the indicators B C, as desired. The position of the regulator and the indicators, in the figure above, forms the letter A. Suppose the indicators A c were let down so as to hang below B B, the position then would form the letter E. The different angles assumed by the regulator and the indicators form letters, as illustrated by the alphabet given in figure 1. A A is an upright post made permanent in the earth or to the house. The descending cords move B B and B c separately. The organization of the mechanism, and the mode of manipulation, will be more particularly described in the next chapter, in reference to the Chappe telegraph.

THE SEMAPHORE TELEGRAPH IN RUSSIA.

It was not until the reign of the great Emperor Nicholas I., that Russia organized a complete telegraphic system, which was executed in the most gigantic style in the principal directions required by the government. From Warsaw to St. Petersburg, to Moscow, and on other routes, the towers and houses were constructed for permanency and beauty. They were neatly painted, and the grounds were beautifully ornamented with trees and flowers. I have seen these stations, situated on eminences along the routes mentioned, every five or six miles, and the towers were in height according to the face of the country, and sufficiently high to overlook the tall pine so common in Russia. The system employed was, like those of all the other governments of Europe, the Chappe telegraph.

Fig. 2.

Russian Telegraph Station, 1858.

The erection of these towers cost several millions of dollars, and the expense of maintaining them was very great. The line from the Austrian or Prussian frontier, through Warsaw to St. Petersburg, required about 220 stations, and at each of these stations were some six employees, making an aggregate of 1,320 men. Besides these, there were managing men at different localities having charge of the general administration.

The great Emperor Nicholas I. -ever watchful and progressive- at an early day inaugurated the semaphore telegraph in a manner commensurate with the vastness of his government and its wants; and, notwithstanding the immense cost that it had been to the government, as soon as he saw a superior telegraph he adopted it, and bade farewell to the visual signals which had served him so faithfully for a quarter of a century. It was a noble example to the fixedness of the bureau departments of other governments. These stations are now silent. No movements of the indicators are to be seen. They are still upon their high positions, fast yielding to the wasting hand of time. The electric wire, though less grand in its appearance, traverses the empire, and with burning flames inscribes in the distance the will of the emperor to sixty-six millions of human beings scattered over his wide-spread dominions.

THE CHAPPE TELEGRAPH.

CHAPTER III.

DESCRIPTION OF THE CHAPPE SEMAPHORE TELEGRAPH.

I will now proceed to describe the Chappe semaphore telegraph according to the modern mode of operating it. The description is from the best authorities, and I presume it will be sufficiently clear, to enable any one to understand the system in its most complete sense.

The Chappe telegraph is composed of three pieces: one is large and called a regulator, and two small ones, which are called indicators. The regulator A B, fig. 1, is a long rectangular piece, 18 inches wide and 14 feet long, and from 11 to 2 inches thick. At its centre, and in the direction of its centre, it is traversed by an axis, which traverses also a mast or vertical post D D at its upper extremity. The regulator thus situated and elevated little over 14 feet above the roof T T, can turn freely on its axis, and describe a circle of which the plane is vertical. It can therefore give as many signals as it can represent distinguishable diameters of a circle; but to avoid all confusion Chappe wisely reduced its telegraphic positions to four, and it can never take any other but the four, namely, the vertical, horizontal, right oblique, and left oblique; the oblique Fig. 4., forming an angle of 45 degrees. It would be impossible to find four positions better defined and more distinct. They are represented in figs. 2, 3, 4 and 5.

Fig. 4.

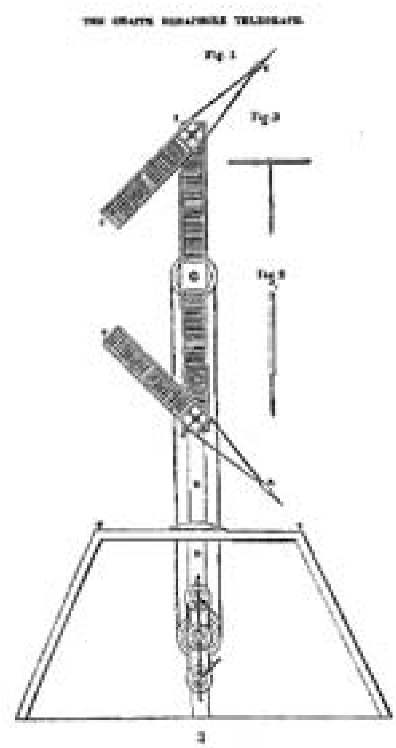
Fig. 5.

The two indicators A C and B C, fig. 1, are also two rectangular pieces, six feet long, one foot wide, and of a thickness a little less than that of the regulator. They are attached to the two ends of the regulator as the figure represents. Each indicator has at its extremity A and B an axis that traverses the regulator at the same point. The extremity C C is free and moveable, each indicator can therefore describe a circle, of which the plane is parallel to the plane of the circle, which the regulator may describe; thus, in this manner, all the signals are made in the same way, vertical and perpendicular to the line of vision.

The regulator having its axis of rotation at its centre of form and gravity, remains indifferently in whatever position it is put; but the indicator, revolving on an axis placed at one of the ends, are free, and are disposed to fall toward the earth. To counteract this tendency, a weight placed on a branch invisible at distance A K and B K counterbalance the visible branches of the indicators B C and A C. This branch at first formed of two rods of iron 1/2 of an inch in diameter, fixed at the extremities B and A of the indicators, was soon changed into a single rod, by forming with the two an acute angle.

Toward its extremity the branch has a counterpoise K of lead, which keeps the indicator in equilibrium in all its various positions around its axis. It is understood that the two indicators should be of the same weight, and that their axis should be at equal distances from the axis of the regulator.

The distance from the centre of rotation of the regulator to the centre of rotation of the indicators is 6 1/2 feet, that from the centre of rotation of the indicators to their movable extremities is 5 1/2 feet; when, therefore, the two indicators are turned inwardly, their moveable ends are two feet apart. The regulators and the indicators are made like a window shutter with alternate slot or bar, and aperture, one half of the bars setting to the right and the other half to the left, to divide the force of the wind, and to produce light and shade.

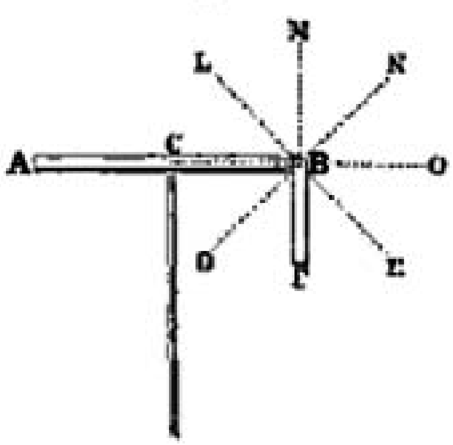


The assemblage of these three pieces forms a complete whole, elevated in space, and sustained by a single point of support, namely, the rotating axis of the regulator, which axis turns with a hug sufficiently tight to stand at any given point, at the upper extremity of the post through which the said axis traverses horizontally. The mast, or post sustaining the telegraph, ought to be very solid and strong. It may be double, but whether single or double, the surface that is presented to the eye ought always to be much less than the width of the regulator and indicator, to avoid confusion. The line presented by this elongated surface is nevertheless useful as the datum line, since it always indicates the direction of the vertical line. This post is furnished with iron pins on each side to serve as a ladder by which to ascend.

ORGANIZATION OF THE CHAPPE SIGNAL ALPHABET.

The regulator should only occupy four positions: the vertical, fig. 2; the horizontal, fig. 3; the right oblique, fig. 4; and the left oblique, fig. 5; each separated from the other by an angle of 45 degrees.

Fig. 6



Let us now suppose the regulator placed in a horizontal position, and having single indicator B E, describe a L circle around its axis B, and by stopping it at every 45 degrees we thus give to it 8 different positions in regard to the regulator B A. Of these 8 positions, 6 are angular B L, B M, B N, B F, B E, and B D. Two are parallel B C and B O. This last position has been abandoned, because as it is merely a prolongation of the regulator, it is not seen distinctly.

The 7 relative positions of the indicator and of the regulator thus give 7 distinct indexes, all combining to form the desired signals. For whatever be the position of the regulator, the indicator is always placed in a horizontal, or vertical, or right oblique, or left oblique position, respectively. Of these seven signals, one, c B, confounds itself with the regulator, and is called zero. Two, B L and B D, form with the regulator an angle of 90 degrees, and two, B N and B r, an angle of 135 degrees. It is necessary, therefore, to find simple means of distinguishing them. In the method adopted for the formation of signals, the indicator in the positions B L, B hr, and B N, has always its free extremity turned toward the sky, and its other extremity toward the earth, in the positions B F, B E, and B D. In designating angles, the words sky and earth will be used to avoid prolixity. On the other hand, it would be tedious to say 45 degrees sky, 90 degrees sky, 135 degrees sky or earth. These different terms have been adopted to economize in the language. The terms used are zero, 5 sky, 10 sky, 15 sky, 15 earth, 10 earth, 5 earth they are written as indicated in fig. 7. The regulator being fixed in any of the four positions, which it can take, a single indicator produces with it 7 distinct and separate signals. It is evident that the indicator placed at the left of it, will produce the same number, and these are called the same, except they are described as at the left of the indicator as seen in fig. 8.

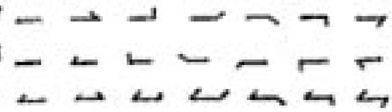


Fig. 7
Fig. 8
Fig. 9

Now, if we consider the signals which may result from the combination of the seven signals of one indicator with the seven signals of the other indicator, we shall see that if one of the indicators is placed at zero, and the other is passed through its seven positions, we shall obtain, in the first place, the double horizontal, or rather the horizontal closed line, then, zero 5 sky, zero 10 sky, zero 15 sky, zero 15 earth, zero 10 earth, and zero 5 earth, as seen in fig. 8.

Elevating and keeping at " 5 sky" one of the indicators, we shall have 5 sky zero, two 5 sky, 5 and 10 sky, 5 and 15 sky, 5 sky and 15 earth, 5 sky and 10 earth, 5 sky and 15 earth, which makes 7 other signals, as seen in fig. 9.

Elevating and keeping at " 10 sky" one of the indicators, we will obtain seven more signals, and so on, until the seven signals of one indicator have been combined with each of the seven signals of the other, giving in all 49 signals, without changing the position of the regulator; but the regulator takes four different positions, giving four different values to the 49 signals, and raising the whole number of possible signals to 196, furnished by the Chappe semaphore telegraph. These signals are clear, simple, and easy to name and to write. It is impossible to commit an error, on a clear day, in seeing, designating, or writing them. One grave difficulty, however, presented itself in communicating, that is, how to designate to the neighboring station that the signals formed were correct, and how to indicate the time to repeat them.

The brothers Chappe decided that no signals should be formed, with the regulator in a horizontal or perpendicular position; that all signals should be formed on the right oblique or left oblique. They also decided that no signal should have value until the regulator should be returned to a vertical or horizontal position.

In this way the operator who sees a signal formed on the right or left oblique, notices, and prepares himself to repeat it back to the station; but he does not record it. As soon as he sees it carried to the horizontal or vertical position, he knows it to be correct, and he immediately writes it down, and then repeats it to the same station. This maneuver is called "' verifying the signal." From that time each signal formed on each oblique takes a double value. Since it may be carried to the horizontal or vertical line, 49 signals, there can be received 98 significations in passing from the right oblique to the horizontal or vertical line; and the same for the left oblique, in all 196 signals. Nevertheless, the signals of the two obloquies would not be intelligible if the signals of the right oblique were not different from those of the left oblique; for both being brought to the horizontal or vertical line, they being in all respects similar, would really represent only 98 signals, unless we noticed the direction in which they are moved to a horizontal or vertical position.

As the necessity of the telegraph requires a great portion of the signals for the purposes of regulation and police of the line, the rest of the signals being devoted exclusively to the transmission of dispatches, these two classes of signals, being perfectly distinct, cannot be placed in the same journal of business. The signals formed on one. Oblique are, therefore, devoted to the administration of the line, and those on the other oblique are devoted to the correspondence. There are thus 98 regulation signals, and 98 dispatch signals, which are all written on horizontal and vertical lines, but written separately in the journal book, marked out for the registration of the respective services. The signals take their names when they are formed on the obliques, as seen in Fig. 10., and it is important to remark that the designation of a signal must commence always from the upper extremity of the regulator. The signals are never written as in the table, fig. 10, but always, on the horizontal lines, as in fig. 11, or in the vertical line, as in table, fig. 12. The stationmaster writes them as he sees them, but never until he is sure they are correctly understood. It now remains to be explained how the mechanism, which produces these signals, is operated. To one not familiar with signaling, The process may seem surrounded with complications, and tardiness of action. Such, however, is not the case; and a knowledge of the more modern electric needle system of telegraphing would prove the error. But as to the rapidity in transmission, the facts hereafter stated will more fully demonstrate that the Chappe telegraph is not a slow process of communicating intelligence, but that it has subserved well the purposes contemplated by its patriotic and enthusiastic founder.

Fig. 10.

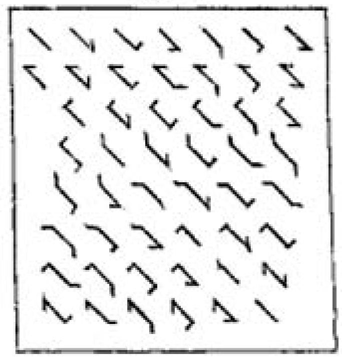


Fig. 11.

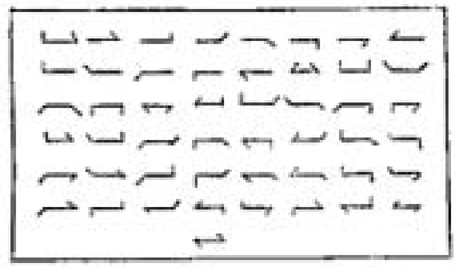
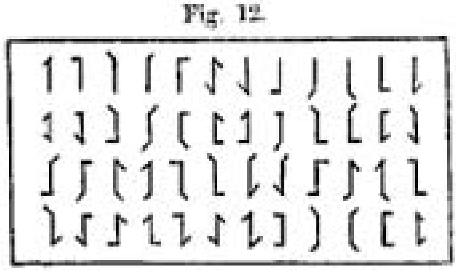


Fig. 12.



THE PROCESS OF MANIPULATING THE CHAPPE TELEGRAPH.

The axis a a' a'', fig 13, which commands the regulator, is turned by a pulley, p, fixed at its extremity, a, opposite to that of a, which carries the regulator; this pulley, from 16 to 18 inches in diameter, contains two deep grooves, and under this pulley in the interior of the post about three feet from the ground is another similar one, q, which also has two grooves. The second pulley, q, is also fixed at the x extremity b, of an axis b b' b'', which traverses horizontally the interior prolongation of the post D D', figures 1 and 13. In order to receive upon a square b, a double lever l l, which serves to place it in rotation, as well as the pulley fixed at its other extremity. This lever, or double right-hand crank, is about three-and-a-half feet long, and is terminated by two wooden handles situated at right angles from each other, tn tn. Let us suppose now that the lever which represents a diameter, and describes a circle, the plane of which parallel is to that of the

circle described by the regulator; let us suppose, I say, that this lever is fixed, in the first place, parallel with the regulator, and at the moment we transmit to the pulley p the rotatory movement, which it will give to the pulley q by means of two tightly strained bright wire cords, of which one passes to the right of the two pulleys in one of their two grooves, and the other to the left in the other groove. Suppose now, that the free extremities of these two cords are fastened at the bottom of their respective grooves, after having surrounded the upper and lower pulleys by at least half the circumferences, it is evident that the movement described by the lever l l will be transmitted by the axis b b' b'' to the pulley q, which will transmit it exactly, by means of the two cords c c' c'' to the pulley p; and that this latter will transmit by the axis a a' a'' to the regulator R R, and to all the parts which it carries, and that the regulator will also follow the movement of the lever l l, and remain perfectly parallel with it. It is also evident that the lever and the regulator may describe at least a circle, because the cords are wound upon each pulley for each half of a circumference at each extremity. As a substitute for the cords, and to give them easily the proper tension which the movement causes them to lose, the middle portion of them, which is never required to pass over the pulley, are iron rods with screws, by which they may be lengthened or shortened at pleasure. These rods are terminated above and below by hooks, which hold the cords by a single ring in the end of the cord. The extremity of the cords which answer to the pulleys, traverses the bottom of the groove, through a hole made for that purpose, and is attached to a spoke of the pulley which is shortened or lengthened by means of a screw. By this very simple system a station-master may change very rapidly the cords or the rods, and lengthen or shorten them at pleasure. The rods or cords pass through the roof of the house, through holes, in such a way as to avoid friction as much as possible.

To communicate movement to the indicators, the mechanism is the same as above described, only a little more complicated or extended, because there must be two return cords, one from the extremities, the lever 1 1 at its axis b'' and the other from the axis of the regulator a'' to its extremities R R. In the second place the rotary movement must be transmitted to two different and independent circles. Let us consider in the first place, the transmission of the movement to a single indicator.

The indicator is governed by an axis i' i'', which also governs the pulley with two grooves m; this pulley is fastened to the pulley o' by two metallic cords, which renders all their movements dependent and identical; the pulley o' forms a single piece with the pulley o; these two pulleys are united by a hollow axis traversed by the axis of the regulator a a' a'', around which it turns freely. The pulley o, and consequently the pulley o' receives all its movements from the pulley u', which receives them from the pulley u, to which it is connected by a hollow axis, which turns upon the axis b b' b'' of the lever;

the pulley u receives its movement from the pulley r; this last pulley is controlled by an axis which traverses the lever l l, in which it turns; the extremity l" of this axis is fixed to one lever forming the ray l" u"; this lever, or handle or hand, in describing a circle, causes the pulley r to describe a circle in the same direction, which causes the same result to the pulley u, which in its rotation draws the pulley u', and this rotation is transmitted to the pulley o, which communicates it to the pulley o', and this latter causes the pulley m to turn, which causes the regulator I I to describe a complete circle in the same direction as the hand l” n” has done. By causing this hand to describe a circle, in an opposite direction, it is easily seen that the indicator will do the same thing. Let us now follow the transmission of the movement to the second indicator.

By causing the hand l' n' to turn, the pulley r' is made to turn, which causes the pulley u’ to turn. This pulley forms a single piece with its neighboring pulley u", and both turn by means of one common hollow axis; around the common hollow axis of the two pulleys u u', the pulley w", transmits the movement to the pulley o”, united by a hollow axis to its neighbor o". This hollow axis turns, also, around the hollow axis common to the pulleys o' and o. The pulley o" puts in rotation the pulley m', which makes the indicator i' i' describes identically the same movement which the hand l' n” had made.

If we observe, now, that the large lever l l makes the regulator describe movements similar to its own, and that it draws by these movements the rays 1' n' 1" n”, without changing the relations established between them and itself, and that the indicators cannot change their relative positions with the regulators, but by change of relation with the said rays of the grand lever, without changing the relation of the said rays to the grand lever, we shall easily understand.

1st. That the rays l’ n’ l” n” making any angle with the diameter l l, the indicators will make precisely the same angles with the regulator R R.

2d. Whatever be the horizontal, vertical, right oblique, or left oblique, in which we put the lever l l, the regulator will take the same position; and, as this same movement affects no change in the value of the angles formed by l’ n’ l” n”" with l l, the indicators will also remain invariably in their angles with the regulator.

Thus the interior mechanism gives a constant and exact image of the exterior mechanism, and the signals are always reproduced with precision before the eyes of the operator.

In order that the angles of the indicators and of the regulators should be invariably fixed, the hands l’ n’ l” n” are furnished with a spring and a tooth. This spring is designed to make the tooth t enter into the notches of the steel dividing circle d. These divisions are seven in number, of 45 degrees each. The axis of the large lever also carries a divisor of 8 notches; but while the divisors of the two hands are fixed in relation to the axis which traverses them, said divisor of the large lever is fixed upon the axis and turns with it. When we wish to hold the regulator on account of high wind, or for other cause, we place a kind of bolt fixed in the post to enter one of these notches, and this bolt stops all movements of the regulator.

As the indicator ought always to remain motionless, when the regulator is moved after a signal is made, the spring above mentioned always holds the tooth of the hand fixed in the notch of the divisor when said hand has been placed in such a way that the operator is obliged, when he wishes to change the position of an indicator, to draw the hand toward himself in order to disengage the tooth, and to let go of the hand when the tooth has arrived opposite the new notch in which the tooth is to be fixed. From these facts it will be seen that the mechanism of the Chappe telegraph is a model of simplicity and precision. It fulfills the conditions of rapidity, clearness, and variety in execution.

Let us suppose that the telegraph is at rest in the position represented in fig. 13, which position is called the vertical closed, and that the operator enters his office in the morning; he commences by applying his eye alternately to first one, and then the other of his neighboring telegraph stations, to see if either of them are giving a signal, and, in the meantime, he arranges on his desk, pen, ink, and record-book.

As soon as he sees one of the two stations move, he draws the bolt which holds the large axis at rest, and puts one hand upon the upper handle of the great crank, and then looks at the signal which has been formed.

If the regulator is to be carried to the right oblique, or left oblique, which is indispensable, he pushes the upper extremity of the handle to the right or left, aiding the movement at the same time by pushing the lower extremity with his leg, at the same time he puts his other hand upon the small lower crank l' n' in order to commence moving the indicator; the regulator being once set in motion, he lets go the upper handle in order to take hold of the handle l" n", and move the second indicator, thus the signal being formed, he stops it on the oblique which belongs to it. He thus looks through his telescope to the station whence the signal came, to see if said signal has been carried to the horizontal or to the vertical. If it has been carried, he knows it to be correct, and accordingly records it as he sees it horizontal or vertical in the square of signals of correspondence; if it has been formed on the other oblique, he records the hour and minute at which the labor commences; and lastly, he makes his own signal, and watches to see if the station to which he communicates the dispatch repeats and carries it correctly. If he is sure that the signal has been well understood and properly reproduced, he turns to the first telescope, repeats the signal which he sees on the oblique, waits till it is carried to the horizontal or vertical, in order to record it, repeats it in his turn, watches if it is correctly taken by the other station, and the operation thus continues indefinitely.

CELERITY OF DISPATCHING BY THE CHAPPE TELEGRAPH.

The greatest speed which can be attained in the passage of signals without producing confusion, is three signals a minute, whence it follows that 20 seconds is necessary to execute all the steps of a signal, to record it, and to verify it. All the signals, however, do not require this period of time, as there are half signals. These half signals are four in number- the double zero or vertical closed, the closed or double horizontal zero, the right oblique closed and left oblique closed. These are all made in their place, and it is only necessary to fold in the two indicators. These demi-signals are very useful, because they serve to distinguish groups of signals; and, because, being frequently necessary, they waste less time than a signal execution, of which requires several steps and movements. The movements of the regulator are so easy, when the machine is in good order, and there is no wind, that generally the operator can, by using the two hands to develop the indicators, at the same time bring the regulator to the position, which it is to occupy.

The complete operation of a signal is as follows 1st. Observe the signal which is formed on the oblique. 2d. Form it. 3d. Observe if it is carried to the horizontal or to the vertical. 4th. Carry it in a corresponding manner. 5th. Record it. 6th. See if the next station reproduces it exactly. These six steps ought to be equal in duration of time; if it were otherwise a signal would be badly observed by the two stations corresponding. We also remedy inequalities of strength and of agility, in the operators, by directing that there must never be a change of a signal carried, before the station to which it is communicated has also carried it.

Suppose a passage of 3 signals a minute, the different steps ought to be thus divided; for observing, 4 seconds; forming on the oblique, 4 seconds; observing the carrying, and carrying, 4 seconds; recording, 4 seconds; and verifying with the next station, 4 seconds: total, 20 seconds. This rapidity of three signals a minute is far from being constant. It can only be depended upon when the weather is fine, when the operators are well disposed, experienced, and faithful.

Chappe said, that when the weather was fine, and the fogs and haziness of the atmosphere are not a hindrance to vision, the first signal of a communication ought not to occupy more than 10 or 12 minutes in passing from Toulon to Paris, cities situated 215 leagues or 475 miles apart, and connected by a telegraph line of 120 stations; but Chappe added, that if we suppose a continuous correspondence between Paris and Toulon, there would ordinarily arrive at Toulon but one signal a minute.

To recapitulate, the Chappe telegraph gives 98 primitive signals for the correspondence, and 98 primitive regulating and indicating signals. These two classes of signals, although alike, must not be confounded, because they are formed one on the left oblique, and the other on the right oblique; and because they are recorded one in the regulation column, and the other in the column of correspondence. This record I have arranged in the following form, viz.:

No. of Signals.	Regulations and Office Signals.		Signals of Correspondence.	
	Right Oblique.	Left Oblique.	Right Oblique.	Left Oblique.
	How Carried.	*How Carried.*	*How Carried.*	*How Carried.*

These signals may succeed each other with the rapidity of 3 per minute. They form figures easy to observe, easy to record, and without an effort of the mind; the machine is solid, light, and elegant. A man of moderate intelligence is entirely competent to manage the correspondence.

To show the immense superiority of the Chappe telegraph over all other aerial telegraphs which have been devised or temporarily established, either before or since his time, it would be sufficient to describe them and notice their resources; and we shall see that none of them, if we except the Swedish telegraph invented by Edelcrantz, can be said to have subserved the purposes of science or telegraphic art. In France, where the most perfect model has been before their eyes, all efforts made previous to the time of Chappe were but rude approaches to the Chappe system, and but one of those efforts still in existence. The system of Chappe produced, as a first and inevitable result, a diminution of just one third in rapidity of the signals. By analyzing its movements it is easy to anticipate such a result; but it is easier to be convinced of it by taking such a position as to have a view of the towers of St. Sulpice. Upon one of these towers is the Chappe telegraph, and upon the other, the telegraph devised by Mr. Flocon, the third administrator of the telegraph. By watching these two telegraphs for an hour, and counting exactly the number of the signals, it will be seen that the Chappe telegraph gives exactly three signals, while the other gives two. A second objection to Mr. Flocon's telegraph is, that it requires a greater degree of intelligence to operate it; consequently it is more liable to fault in transmitting correspondence and in recording them. The regulator is placed upon a vertical mast or post, and the indicators are attached to the extremities of a fixed horizontal bar; all the signals are therefore given horizontally. We must observe the regulator separately, in order to know if we understand whether the signals belong to the right oblique or to the left oblique, and we must record them vertically or horizontally. If they are to be recorded vertically, we must then make an abstract of what we have seen, and after arranging the figure in the head, then make a draft of it. The telegraph, modified by Mr. Flocon, nevertheless offers one advantage, that of being less difficult to operate when the wind is light; but, it is said that it is not by means of new machines, or retrenchments, or additions to them, as perfected by Chapp6, that the aerial telegraphing can be improved. The true and only way of progress in semaphore telegraphing is to find the means of multiplying the number of primitive signals; to combine these signals in such a way as to express, with the least motion and in the shortest time possible, the greatest quantity of numbers; to represent by these numbers as many ideas as possible, and to double the period of correspondence by continuing it through the night.

The greatest effort and the most active inventive talent have been thwarted in every effort to make an aerial telegraph effective at night, and even Chappe admitted its impracticability after the most arduous labors to consummate the object. Like result has followed the labors of others down to the present time.

“We may at present," says Mr. Jules Guyot, from whom much of this description has been copied, " without changing anything in the exactitude of the signals, and without changing anything in the mechanism that produces them, double their number. We may raise them to 82,944 words; parts of, or the whole of phrases, by two signals expressed by 4, 5 and 6 movements; and we may devise plans to establish the Chappe telegraph by night as it is by day. Thus the resources of the telegraphic art are far from being exhausted, and to accomplish these ends the inventive mind can be directed."

End Chapter III