THE CHRONOLOGY OF THE TELEGRAPH.

In his critical and laborious review of the origin and development of the electro-magnetic telegraph, with special reference to Professor Joseph Henry's contributions thereto, Mr. William B. Taylor has gone over the literature of this vast subject with great minuteness and thoroughness. We speak of the "development of the telegraph" designedly, and without reference to the world-embracing systems of telegraphic lines, for the record conclusively justifies the assertion of Robert Sabine that the electric telegraph had, properly speaking, no inventor. "It grew up little by little, each inventor adding his little to advance it toward perfection."

The more notable impulses and developments in this long evolution we propose to summarize, following Mr. Taylor throughout.

TELEGRAPHS BY ELECTRICITY.

1774.—Georges Louis Lesage, Geneva, set up the first telegraph line, which consisted of twenty-four insulated wires for the alphabet, each terminating in a pith-ball electroscope, duly lettered, for indicating by its excitation the succession of letters in the message, the transmitting operator using a manual conductor from an electrical machine.

1787.—Mons. Lomond, Paris, employed a single brass wire in connection with pith-ball electroscopes, making use of an alphabet of motions.

1794.—M. Reiser, Geneva, used thirty-six insulated wires for letters and numerals, in connection with a like number of narrow strips of tin foil pasted on glass; the letters and figures were cut in the foil and made visible by the passage of the electric spark.

1795.—Tiberius Cavallo, England, sent explosive and other electric signals through fine insulated copper wire, using Leyden jars, and sending "sparks at different intervals according to a settled plan."

1798.—D. F. Salva, Spain, worked an electric telegraph through the unprecedented distance of twenty-six miles, using a single wire, and the sparks of a Leyden jar for signals.

1816.—Francis Ronalds, England, constructed an experimental telegraph line, of a single insulated wire 8 miles long, operated by an electrical machine, or small Leyden jar. His elementary signal was the divergence of the pith balls of a Cauton's electrometer, produced by the communication of a statical charge to the wire. Lettered dials, rotated synchronously at each end of the line, served, in connection with the pith-balls, to indicate the letter designated by the sender. This dial system was the precursor of Wheatstone's dial telegraph in 1839; House's letter printing telegraph in 1846; and Hughes' printing telegraph in 1855.

1828.—Harrison Gray Dyar, America, constructed a telegraph on Long Island, supporting his wires by glass insulators fixed on trees and poles; the electric signals printed themselves upon litmus paper, the spacing of the marks indicating the letters and other signs. Just as Dyar and his partner Brown were seeking capital to set up a line between New York and Philadelphia, a black-mailing agent, failing to extort the concession of a large share in the enterprise, obtained a writ against the two partners or a charge of conspiracy to carry a secret communication between the cities! The case was never brought to trial, but the enterprise was blocked.

According to Steinheil, these various experiments put it beyond a doubt that frictional electricity might be made a successful means of telegraphic intercourse.

TELEGRAPHS BY GALVANISM.

1808.—The first to apply to telegraphy the galvanic battery introduced by Volta, in 1800, was Dr. Samuel Thomas Von Soemmering, of Munich. He employed the energy of a powerful voltaic pile to bring about the decomposition of water by means of thirty-five gold pins immersed in an oblong glass trough. Each of these electrodes was in connection with one of the thirty-five wires forming the line. The bubbles evolved at these electrodes were received in lettered and figured tubes, and the messages were thus spelled out. In 1810 Soemmering telegraphed through two miles of wire.

1816.—Dr. John Redman Coxe, of Philadelphia, suggested a system substantially the same as Soemmering's (of which he appeared to be ignorant). He also proposed to accomplish the same result by decomposing metallic salts, as was afterwards done.

1843.—Mr. Robert Smith, Scotland, devised a galvano-chemical telegraph carrying out practically the suggestion of Dr. Coxe. At first he used a separate wire for each letter, the message being printed on a strip of paper wet with a solution of ferrocyanide of potassium. Subsequently Mr. Smith reduced his line to a single circuit of two wires, and worked his system through 1,800 yards of fence wire (1846).

1846.—Mr. Alexander Bain, Scotland, patented in England a galvano-chemical telegraph, different in mechanical details, but similar in its chemical record to the system of Smith.

1849.—Prof. Samuel F. B. Morse, New York, patented in this country a telegraph similar to Smith's.

TELEGRAPHS BY GALVANO-MAGNETISM.

1820.—Hans Christian Oersted, Copenhagen, rediscovered the directive influence of a galvanic conductor on a magnetic needle (Romagnosi's observations of the same in 1802 having attracted no attention). The same year (1820) Professor Schweigger, of Halle, made the first real galvanometer; and shortly after Ampère, in Paris, proved experimentally the feasibility of an electro-magnetic telegraph, in which the galvanometer should take the place of the electrometer employed by Lesage.

1823.—Baron Paul L. Schilling, of Cronstadt, Russia, practically applied Ampère's suggestion. In his apparatus signals were produced by five galvanometer needles, provided with independent circuits.

1824.—Peter Barlow, England, experimenting with considerable lengths of wire, to test the practicability of Ampère's suggestion, was convinced that it was impracticable, owing to the rapid diminution of effect (due to increased resistance). by lengthening the conducting wire. Other inconclusive experiments in the same direction were made by Fechter in 1829, and Ritchie in 1830.

1833.—Prof. Carl Friedrich Gauss and Wilhelm Edward Weber constructed at Gottingen a galvanometer telegraph of a single circuit of uninsulated wire a mile and a half long. The alphabet of signs was made up of right and left deflections of the needle, observed by reflections from a small mirror. Gauss was the first to employ magneto-electricity in telegraphs. Weber added to the signaling device a delicate apparatus for setting off a clock alarm.

1836.—Prof. C. A. Steinheil, of Munich, undertook, at the request of Gauss, the development of the arrangement above described, and constructed a similar galvanometer telegraph line two miles in length, introducing considerable improvements. The next year Steinheil discovered that the ground might be made a part of the circuit, thus dispensing with a second wire for the return circuit.

1837.—Mr. William Fothergill Cooke and Prof. Charles Wheatstone patented in England a galvanometer or needle telegraph very similar to the earlier one of Schilling, employing six wires and five indicating needles. An experimental line a mile and a quarter long was worked with partial success July 25; and one thirteen miles long was established in 1838.

While these experiments with the needle were going on the electro-magnet was being developed and applied.

1820.—The germ of the electro-magnet was discovered by Arago, who observed that the electric current would develop magnetic power in strips of iron and steel.

1824.—William Sturgeon, England, produced the true electro-magnet with its intermittent control of an armature.

The electro-magnet of Sturgeon was improved by Professor Henry in 1828; and in 1829 he exhibited a larger magnet of the same character, tightly wound with 35 feet of silk covered wire. A pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, was soldered to the ends of the wire, and the whole mounted on a stand. This was the first magnetic spool or bobbin. This invention was further improved the same year, and in 1830 Professor Henry, assisted by Dr. Philip Ten Eyck, constructed an electro-magnet which lifted 750 pounds. In 1831 he made one weighing 82½ pounds, which sustained over a ton. In the meantime Professor Henry practically worked out the differing functions of quantity and intensity magnets, and experimentally established the conditions required for magnetizing iron at great distances through long conducting wires. This first made the electro-magnet available for telegraphic purposes.

1831.—The transmission of signals through a mile of copper bell wire interposed in a circuit between a small Cruickshank's battery and an intensity magnet—a practical telegraph—was practiced by Professor Henry.

"This memorable experimental telegraphic arrangement involved three very significant and important novelties. In the first place, it was the first electro-magnetic telegraph employing an 'intensity' magnet capable of being excited at very great distances from a suitable 'intensity' battery. . .

"In the second place, it was the first electro-magnetic telegraph employing the armature as a signaling device, or employing the *attractive* power of the intermittent magnet, as distinguished from the directive action of the galvanic circuit. That is to say, it was, strictly speaking, the first magnetic telegraph.

"In the third place, it was the first *acoustic* electro-magnetic telegraph."

Further on Mr. Taylor pertinently remarks that it is suggestive to consider how different would have been the popular estimate of Professor Henry's labors if he had been worldly-wise enough to secure an early patent on these three indisputably original and most pregnant features of telegraphy.

1837.—Professor Samuel F. B. Morse devised a magneto-electric telegraph capable of transmitting signals through a circuit of forty feet, but failed for longer distances from the circumstance that he used a quantity current. His friend, Dr. Gale, made for him an intensity battery, and added a hundred or more turns to the coil of wire around the poles of the magnet. With these necessary (and radical) improvements the apparatus was made to work through ten miles of wire. In applying for a caveat for his invention, October 6, 1837, Professor Morse specified six distinct parts, not one of which enters into the established "Morse" telegraph of to-day. Mr. Taylor shows that Professor Morse's real contribution to telegraphy consists first in the adaptation of the armature of a Henry electro-magnet to the purpose of a recording instrument; and second, in connection therewith, the improvement on the Gauss and Steinheil dual-sign alphabets, made by employing the single line dot and dash alphabet.

In his general summary of the history of the origin and development of the electro-magnetic telegraph, Mr. Taylor sets down the leading preparatory investigations and discoveries as these five:

1. The discovery of galvanic electricity by Galvani, 1786–1790.
2. The galvanic or voltaic battery by Volta, 1800.
3. The directive influence of the galvanic current on a magnetic needle by Romagnosi, 1802, and by Oersted, 1820.
4. The galvanometer by Schweigger, 1820 (the parent of the needle system).
5. The electro-magnet by Arago and Sturgeon, 1820-1825 (the parent of the magnet system).

The second half dozen capital steps in the evolution of telegraphy were:

1. Henry's most vital discovery, in 1829 and 1830, of the intensity magnet and its intimate relation to the intensity battery.
2. Gauss' improvement, in 1833 (or probably Schilling's, considerably earlier), of reducing the electric conductors to a single circuit by the ingenious application of a dual sign, so combined as to produce a true alphabet. (The anticipations of this idea by Lomond in 1787, Cavallo in 1795, and Dyar in 1825, are not regarded as practically influential in the progress of telegraphy.)
3. Weber's discovery, in 1833, that the conducting wires of an electric telegraph could be carried through the air, without insulation, except at the points of support.
4. As a valuable adjunct to telegraphy, Daniell's invention of a constant galvanic battery in 1836.
5. Steinheil's discovery, in 1837, that a single conducting wire is sufficient for telegraphic purposes.
6. Morse's adaptation of the armature of a Henry electro-magnet as a recording instrument, 1837, and the single line dot and dash alphabet in 1838.

The earlier needle type of electro-magnetic telegraph has found its special application in ocean lines, no element of the Morse system entering into the operation of submarine cables.

The more recent telegraphic developments do not fall within the scope of Mr. Taylor's review. A few other dates, as given by Prescott, may appropriately serve to complete this chronology.

1861.—Reiss discovered that a vibrating diaphragm could be actuated by the voice so as to cause the pitch and rhythm of vocal sounds to be transmitted to a distance and reproduced by electro-magnetism.

1872.—Stearns perfected a duplex system, whereby two communications could be simultaneously transmitted over one wire.

1874.—Edison's quadruplex system was invented.

1874.—Gray invented a method of electrical transmission, by means of which the intensity of tones as well as their pitch and rhythm could be reproduced at a distance; and subsequently conceived the idea of controlling the formation of electric waves by means of the vibrations of a diaphragm capable of responding to all the tones of the human voice.

1876—Telephone invented.—Bell invented an improvement in the apparatus for the transmission and reproduction of articulate speech, in which magneto-electric currents were superposed upon a voltaic circuit, and actuated an iron diaphragm attached to a soft iron magnet. During the same year Dolbear conceived the idea of using permanent magnets in place of the electro-magnets and battery previously employed, and of using the same instrument for both sending and receiving.

1877.—Edison's carbon telephone was brought out.

To these may be added Edison's electro-motograph, or electro-chemical telephone, 1877.

1878.—Duplexing of ocean telegraph.

1879.—Cowper's writing telegraph.

1880.—Field's successful substitution of dynamo-electricity for galvanic batteries in telegraphing.

Another Comet.

Capt. A. H. Markham, R. N., of H. M. S. Triumph, the flagship on the Pacific Station, reports that a comet was observed during the voyage from Payta in Peru, to Manta on the coast of Ecuador. The Triumph left Payta on February 7. The comet was first seen on the evening of the 7th at about 8 o'clock. The nucleus was distinctly made out, bearing southwest at an altitude of 7° above the horizon. The tail, a long spreading one, was not very brilliant, but could be clearly traced to an altitude of 35°, the observed termination bearing about south-southwest. The whole phenomenon subtended an angle with the horizon of about 70°. It was situated in the constellation of Argo Navis, and the direction of the tail was in a line almost equidistant between Sirius and Canopus. It set at about 9:30 P.M.

On the next evening it was again seen at about 8 P.M., but nearer the horizon, which proved that it had been traveling with extraordinary rapidity. Although the nucleus was closer to the horizon than on the preceding evening, the altitude of the end of the tail was 40°, showing that it had increased in size. Clouds banking up to the southward prevented Capt. Markham from observing the time of setting. On the 9th, the third evening of observation, it was very hazy, but the tail could still be seen, resembling the streamer of an aurora, in the same position as on the two previous evenings. At the same time a bright luminous patch was observed immediately under Canopus.

ACID PROOF CEMENT.—Make a concentrated solution of silicate of soda, and form a paste with powdered glass. This simple mixture is said to be invaluable in the operations of the laboratory where a luting is required to resist the action of acid fumes.