THE AMERICAN INVENTORS OF THE TELEGRAPH.*

WITH SPECIAL REFERENCES TO THE SERVICES OF ALFRED VAIL.

THE University of the City of New York, then but recently organized, established, in 1835, a professorship of the Literature of the Arts of Design, and chose Samuel Finley Breese Morse, who had already achieved reputation as an historical painter, as the incumbent. In July of that year Professor Morse took possession of a suite of apartments which had been provided for him in the new University building on Washington Square and entered upon his duties.

Eleven years prior to this date, Alfred Vail, a youth of seventeen, having completed his studies in the village school of Morristown, New Jersey, found congenial opportunity to gratify his inherited mechanical tastes by going to work in the Speedwell Iron Works, of which his father, Judge Stephen Vail, was the proprietor. One of his characteristics, from an early age, had been a marked fondness for study and investigation in matters relating to the natural sciences; and as his mind gradually matured and unfolded itself, his aspirations for a broader and more systematic mental culture, and a higher degree of attainment than was possible under the conditions which then surrounded him, were with difficulty repressed. It was the natural desire and expectation of Judge Vail that both his sons, Alfred and George, should identify themselves with the manufacturing business, an extensive one for those days, which he himself had prosecuted with industry and success. In compliance with his father's wishes, Alfred contented himself for a time with the duties of his position. Upon attaining his majority, however, his inclination for a more appropriate field of labor could no longer be restrained; and, after much anxious consideration of the matter, he determined to prepare himself for the ministry of the Presbyterian Church. In 1832, at the age of twenty-five, he entered the University of the City of New York, from which institution he was graduated in due course in October, 1836.

Towards the close of his term his health became impaired, and as his physical condition precluded the prosecution of his theological studies, he appears for a time to have labored under much uncertainty as to his future course. The problem of his life-work was, as the event proved, soon to be solved by a fortunate and unexpected incident.

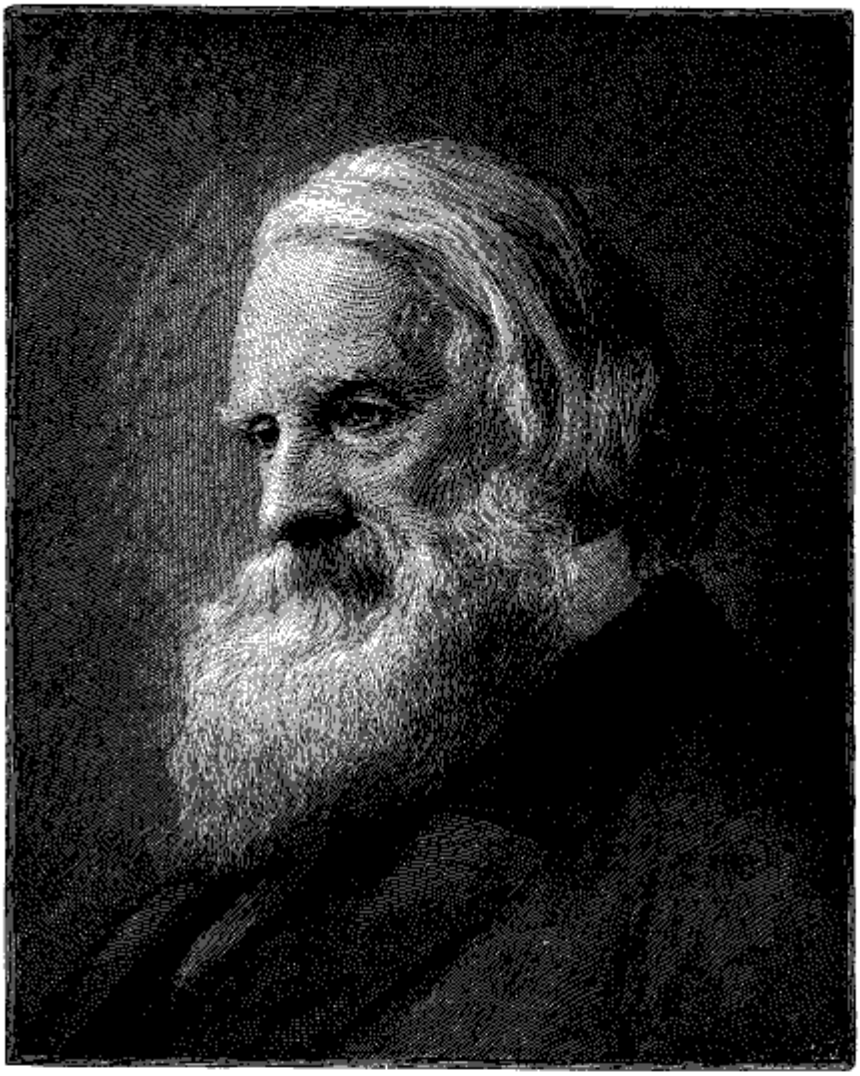
In the year 1832 Professor Morse, on a voyage from Havre to New York in the packet *Sully*, had conceived and drawn in his sketch-book an apparatus for recording signals at a distance by electro-magnetism.

The history of the inception and early development of Morse's invention is familiar and need not be repeated, except as may be necessary to enable the successive steps by which it was wrought into a practical and commercial form to be properly understood. Until Morse became one of the faculty of the University, he had been prevented, by the nomadic life imposed upon him by his straitened circumstances, from making any effort beyond the molding and casting of a set of leaden type to reduce that conception to practice. This, according to his original scheme, was automatically to open and close an electric circuit and thereby transmit certain signals, to which an arbitrary numerical signification was to be given.

During the latter portion of the time in which Alfred Vail had been a student in the University the chair of chemistry had been occupied by Professor Leonard D. Gale. In January, 1837, Professor Morse, who in the privacy of his apartments had constructed a rude but nevertheless operative experimental model, exemplifying the principle of the recording telegraph which he had devised on board the *Sully*, took Professor Gale into his confidence and exhibited to him the invention, so far as it had then been developed by his unaided hands and brain.

Professor Gale, whose knowledge and acquirements were of a character which enabled him to appreciate the ingenuity of the inventor and to forecast the possible success of the invention, became at once deeply interested in the plans of his colleague, and thenceforth the

* See also "Professor Morse and the Telegraph," by Benson J. Lossing, in this magazine for March, 1873, and a communication by Professor J. W. Draper, in May, 1873.



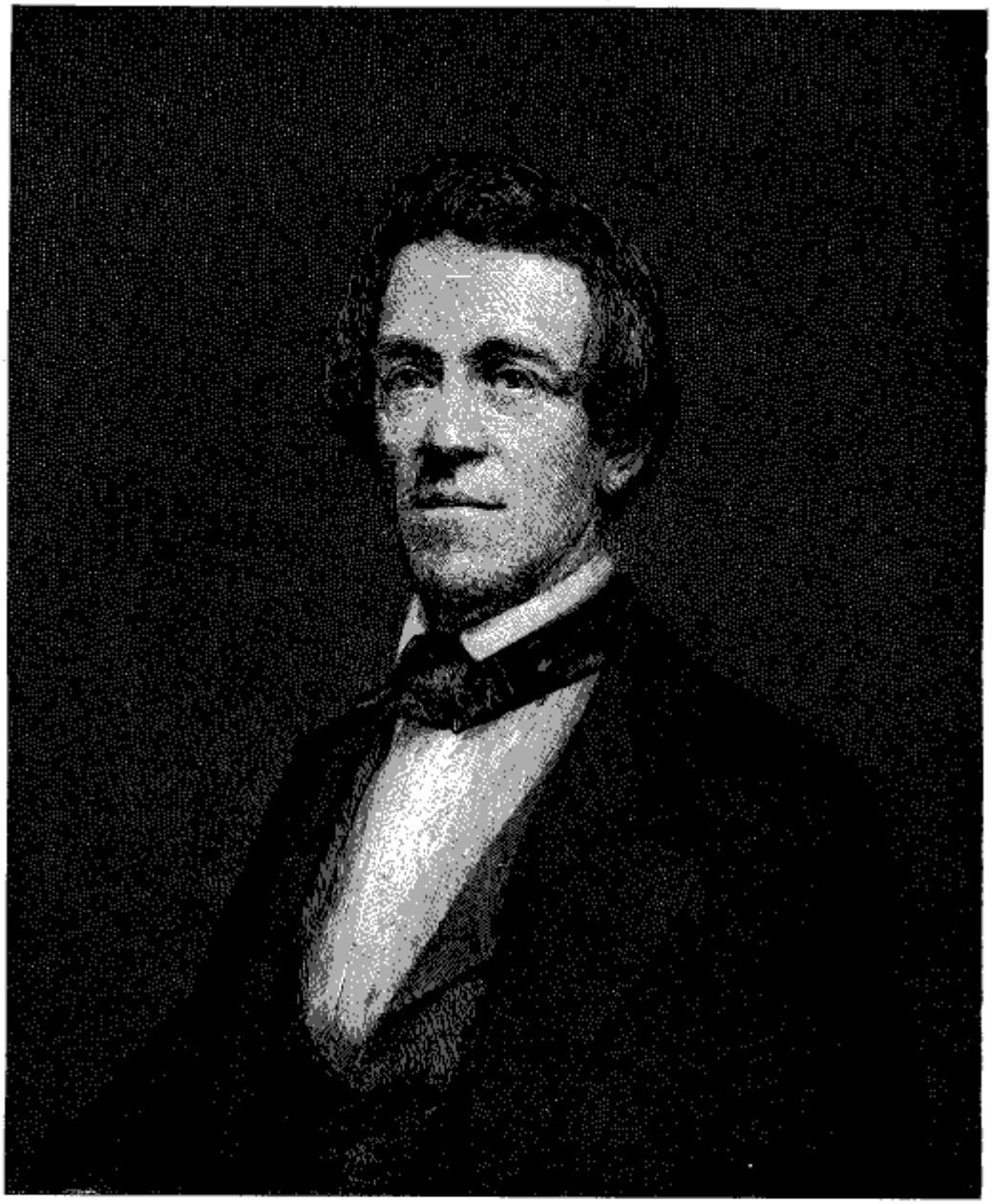
SAMUEL F. B. MORSE.

assistance which he rendered Morse in his experiments was of the utmost importance and value. For some time, the experimental instrument remained substantially unchanged. Morse himself possessed but moderate mechanical skill, while his poverty debarred him from employing trained workmen to put the invention into a more permanent form.

In February, 1837, the House of Representatives had passed a resolution requesting the Secretary of the Treasury to report upon the propriety of establishing a "system of telegraphs for the United States." With the view of gathering the necessary material for his report, the Secretary of the Treasury, on March 10, 1837, issued a circular of inquiry, a copy of which fell into the hands of Professor Morse, and doubtless led to his determination to complete his invention and, if possible, to secure its acceptance by the Government.

On Saturday, September 2, 1837, Professor Daubeny of Oxford University, then visiting the United States, was invited with others to witness the operation of the electro-magnetic telegraph at the University. The apparatus had been set up with a circuit of copper wire, stretched back and forth along the walls of a large room. Among the spectators was Alfred Vail, who then saw the apparatus for the first time. Notwithstanding the crude and imperfect character of the machinery in which the invention was embodied, the results were such as conclusively to demonstrate the possibility of recording signals at a considerable distance by the instantaneous action of electricity.

This exhibition produced a profound effect upon the mind of Vail. His inherited and acquired mechanical skill, and the knowledge of construction which his apprenticeship in his



ALFRED VAIL.

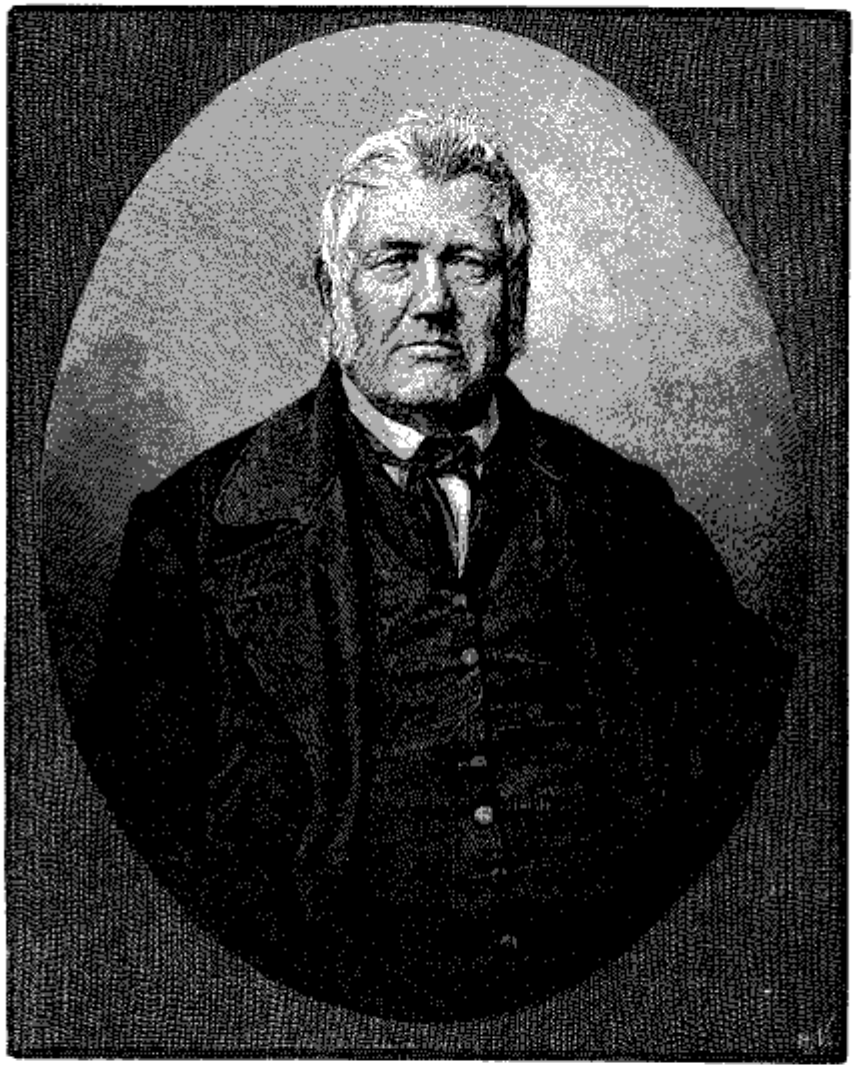
father's works had given him, satisfied him that it was possible to embody this grand conception in a concrete form, which should insure its successful employment for public purposes. More than this, his education and training at the University had given him some insight into the affairs of the world, and his mind intuitively formed a distinct conception of the vast scope and future importance of the invention.

Among the papers left by Mr. Vail is one giving an account of this incident. Referring to his occasional visits to New York during the year following his graduation, he says:

> On one of these visits, prior to September 4, 1837, I accidentally and without invitation called upon Professor Morse at the University and found him, with Professors Torrey and Daubeny, in the mineralogical cabinet and lecture room of Professor Gale, where Professor Morse was exhibiting to these gentlemen an apparatus which he called his "Electro-Magnetic Telegraph." There were wires suspended in the room running from one end to the other and returning many times, making a length of seventeen hundred feet. The two ends of the wire were connected with an electro-magnet fastened to a vertical wooden frame. In front of the magnet was its armature, and also a wooden lever or arm fitted at its extremity to hold a lead pencil. . . . I saw this instrument work and became thoroughly acquainted with the principles of its operation, and, I may say, struck with the rude machine, containing, as I believed, the germ of what was destined to produce great changes in the condition and relations of mankind. I well recollect the impression which was then made upon my mind. I rejoiced to

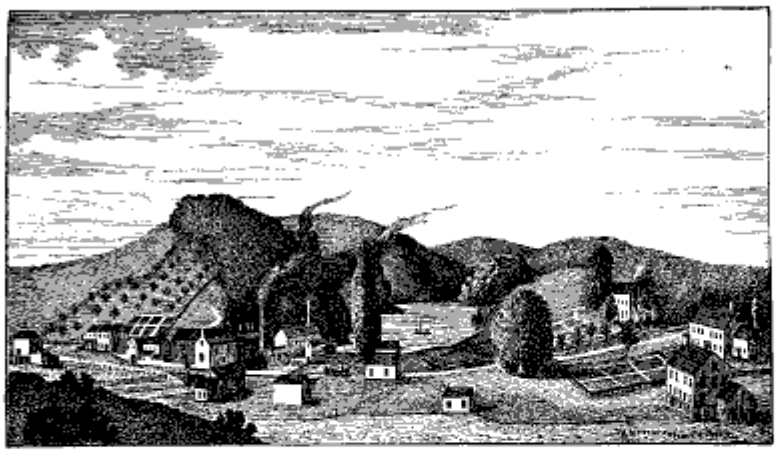
think that I lived in such a day, and my mind contemplated the future in which so grand and mighty an agent was about to be introduced for the benefit of the world. Before leaving the room in which I beheld for the first time this magnificent invention, I asked Professor Morse if he intended to make an experiment on a more extended line of conductors. He replied that he did, but that he desired pecuniary assistance to carry out his plans. I promised him assistance provided he would admit me in a share of the invention, to which proposition he assented. I then returned to my boarding-house, locked the door of my room, threw myself upon the bed, and gave myself up to reflection upon the mighty results which were certain to follow the introduction of this new agent in meeting and serving the wants of the world. With the atlas in my hand, I traced the most important lines which would most certainly be erected in the United States, and calculated their length. The question then rose in my mind whether the electro-magnet could be made to work through the necessary lengths of line; and after much reflection I came to the conclusion that provided the magnet would work even at a distance of eight or ten miles there could be no risk in embarking in the enterprise. And upon this I decided in my own mind to *sink* or *swim with it*.

This remaining doubt on the part of Vail was dispelled by a visit to Morse, during which the latter explained to him the plan, already conceived, but not embodied in the exhibited apparatus, of repeating signals from one circuit into another. The explanation of this feature appears to have convinced him of the truth of Morse's remark, "*If I can succeed in working a magnet ten miles, I can go round the globe.*"



JUDGE STEPHEN VAIL.
(FROM A DAGUERREOTYPE TAKEN IN HIS SEVENTY-THIRD YEAR, BY BESKER & RAW, 1852.)

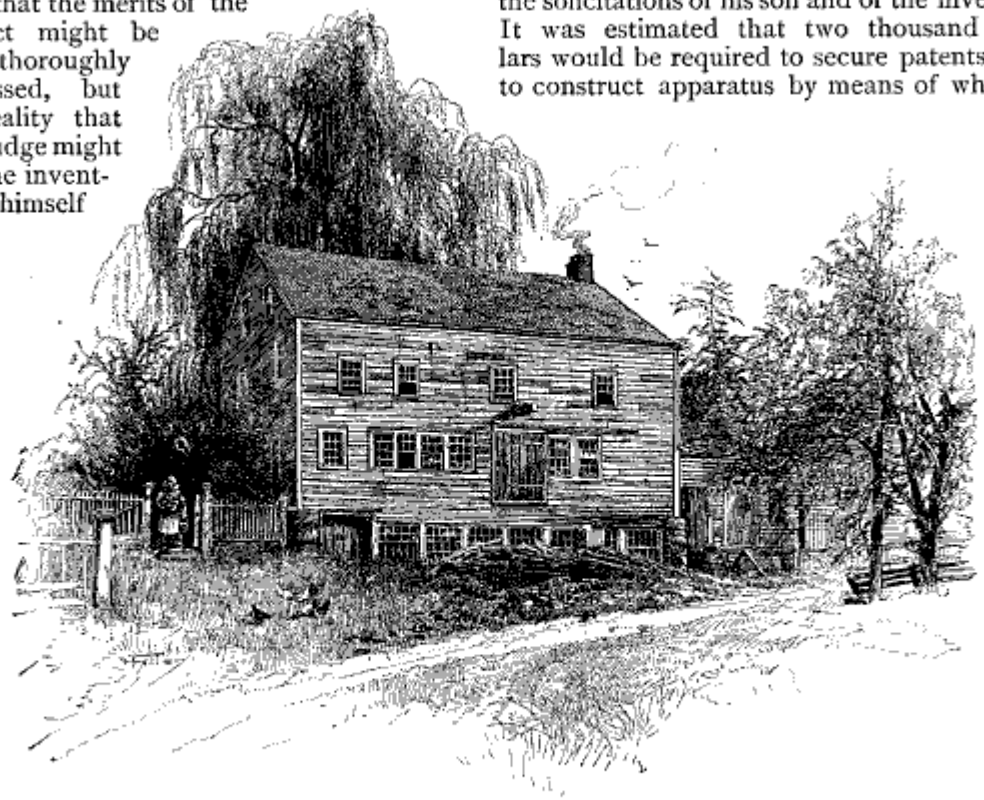
When Vail had once satisfied himself of the feasibility of the scheme of electric communication, his mind became fascinated with the field of achievement which opened before him. Here was indeed the promise of a career which satisfied alike his scientific and mechanical tastes and his highest aspirations. Having an opportunity thus opened to him to acquire an



THE SPEEDWELL IRON WORKS. (REDRAWN FROM AN INVOICE OF 1837.)

interest in the invention and to associate himself with Professor Morse in its development, he sought to interest his father in the enterprise, and to secure his sympathy and material assistance. The sanguine faith of young Vail in the future of the electric telegraph, exceeding, if possible, that of the inventor himself, was not without effect upon his father's mind. Judge Vail was a man whose ideas were in advance of his time. He had almost unconsciously acquired a marked respect for the judgment of his elder son in scientific matters, and so it came about that Alfred received permission to invite Professor Morse to Speedwell, ostensibly that the merits of the project might be more thoroughly discussed, but in reality that the Judge might see the inventor for himself before deciding to embark in such a novel and unprecedented enterprise. Having accepted the invitation, Morse was introduced by Alfred to his father and brother, who, as copartners, were carrying on the Speedwell works.

Judge Vail's business experience had been such as to dispose him towards the favorable consideration of an invention of this character. The annals of the Speedwell Iron Works had already become a part of the history of intercommunication in the United States. Here was forged the shaft of the *Savannah*, the first steamship which crossed the Atlantic. Here were manufactured the tires, axles, and cranks of the first American locomotives, and Judge Vail himself had invested no small share of the profits of his business in these and similar enterprises. It may be presumed that, with his characteristic shrewdness, he did not overlook the substantial benefits which would be likely to accrue from the ownership of a share in the telegraph patents, should the enterprise ultimately prove successful. At all events, he did not lend an unwilling ear to the solicitations of his son and of the inventor. It was estimated that two thousand dollars would be required to secure patents and to construct apparatus by means of which a



SHOP IN WHICH VAIL AND BAXTER CONSTRUCTED APPARATUS FOR EXHIBITION BEFORE CONGRESS.

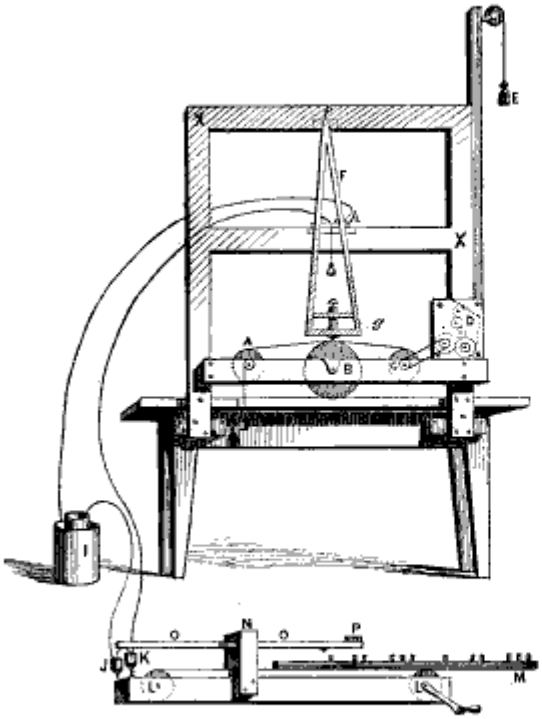


DIAGRAM OF MORSE'S EXPERIMENTAL INSTRUMENT, 1837.

sufficient demonstration could be made before Congress to secure a liberal appropriation for the construction of the first link in a system of Government telegraph lines.

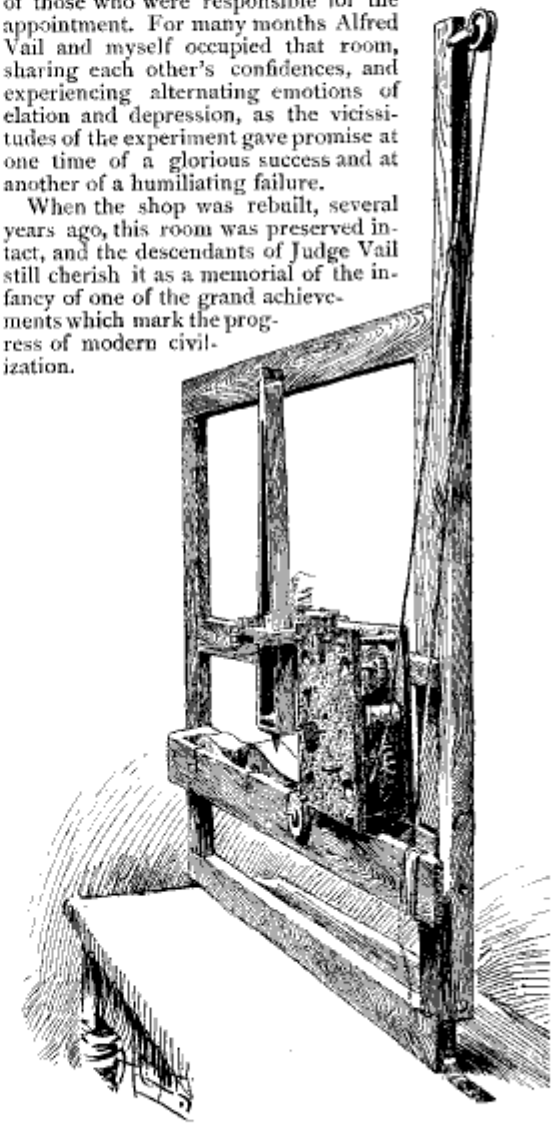
The occurrences which have been narrated took place during the incipient stages of a severe financial depression. It is almost impossible now to form an adequate conception of the difficulty of raising at that time even so small a sum as two thousand dollars, especially for a project so apparently illusive as the electric telegraph. It would be far easier to raise two millions for a like purpose at the present day. Under these circumstances, the timely and generous assistance given by Judge Vail at a most critical period, not only in the history of the telegraph, but in the condition of commercial affairs, entitles him to the grateful remembrance of the world.

These negotiations resulted in an agreement between Samuel F. B. Morse and Alfred Vail, on September 23, 1837, in which it was stipulated that the latter should construct at his own expense and exhibit before a committee of Congress one of the telegraphs "of the plan and invention of Morse"; that he should give his time and personal services to the work, and assume the expense of exhibiting the apparatus and of procuring patents in the United States. In consideration, Vail was to receive one-fourth of all rights in the invention in the United States. Provision was made for securing to Vail an interest in any foreign patents which he might furnish the means to obtain.

An interesting account of the operations at Speedwell during the construction of the early apparatus has been given by William Baxter, a skillful mechanic and inventor, well known as the designer of the "Baxter Engine." Mr. Baxter, who was an apprentice at Speedwell at that time, died in 1885, and was perhaps the last of those who were associated with the invention in its inception. Mr. Baxter says:

As it was important to keep the invention a secret from the public until it had been perfected and a patent secured, a special room in the shop was fitted up with tools and provided with a lock and key. It was necessary to employ a mechanic who could comprehend new ideas, execute accurate work, and who at the same time had the necessary judgment and discretion to keep an important secret. I was at that time an employee of the works and was in my fifteenth year. It was a high compliment for a boy of that age to be selected for such a trust, but it is not for me to criticise the judgment of those who were responsible for the appointment. For many months Alfred Vail and myself occupied that room, sharing each other's confidences, and experiencing alternating emotions of elation and depression, as the vicissitudes of the experiment gave promise at one time of a glorious success and at another of a humiliating failure.

When the shop was rebuilt, several years ago, this room was preserved intact, and the descendants of Judge Vail still cherish it as a memorial of the infancy of one of the grand achievements which mark the progress of modern civilization.



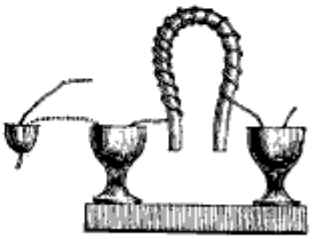
THE FIRST RECORDING TELEGRAPH, 1837.
(IN THE CABINET OF THE WESTERN UNION TELEGRAPH COMPANY, NEW YORK.)

PROFESSOR LEONARD D. GALE.

It is interesting, in looking back, to contrast the prevalent ignorance and misconception of that day with the present realization. No one could be made to believe that an electric telegraph, even if practicable, was either necessary or desirable. The more intelligent conceded that it might perhaps prove an interesting scientific toy, but the hard-fisted New Jersey farmers looked upon the experiment as a wanton and inexcusable waste of money, and were accustomed to speak of it as the one solitary instance of bad judgment on the part of the Vails. . . .

The mechanical difficulties of the undertaking can scarcely be comprehended by an electrician of the present day, who finds every conceivable material and appliance in the market ready to his hand. Our first voltaic battery was constructed of a rectangular box of cherry wood, subdivided into eight compartments, and lined with beeswax, in order to resist the action of acids. The form of the zinc and copper elements — and, in fact, the elaboration of every detail — involved a new series of experiments. Insulated wire was then unknown in the market, the best substitute obtainable being milliner's wire, such as was used to give outline to the sky-scraper bonnets of the day. It was of copper, that it might be made to take and retain any form that the deft fingers of the artist chose to give it, and was found to serve sufficiently well as a conductor, although the insulation of the cotton covering was somewhat imperfect. However, it was the best obtainable, and the entire New York market was drained for our experiments.

Before giving a further account of the work of Vail at Speedwell, in the autumn of 1837, it is desirable to understand the precise point of development which the original apparatus of Morse had reached when it was placed in his hands for reconstruction, and we therefore give a sketch and a brief description of the apparatus, which at that time formed the only material embodiment of the invention. The identical machine is still preserved, at the office of the Western Union Telegraph Company in New York City. The support for the mechanism is a rectangular frame of pine, X X, which, when in use, was fastened in an upright position to the edge of a table. Upon the lower part of this frame three wooden rollers, A B C, are mounted. A ribbon of paper is so arranged that it may be unwound from the first roller, passed over the second, and finally rewound upon the third. This movement is effected by the machinery, D, of a wooden clock put in motion by a weight, E, and cord passing over a pulley. A wooden pendulum, F, suspended from the upper part of the frame, swings transversely across the paper as it moves uniformly over the middle roller. A pencil, *g*, in the lower end of the pendulum has its point in constant contact with the paper. Midway of the length of the pendulum an electro-magnet, *h*, is mounted upon a stationary shelf, facing a soft-iron armature fastened upon the pendulum. This constituted the register, or recording apparatus. The arbitrary signs are written or drawn upon the moving paper by a transverse movement to and fro of the pendulum. This movement is effected by the alternate magnetization and demagnetization of the iron of the electro-magnet, caused by the alternate flow and cessation of an electric current traversing the wire coiled upon it. The manipulation of the current from battery, I, was to be effected by a circuit-breaking device at the transmitting point, consisting of metallic type, representing by convention numerical characters, set up in a "type-rule," M, in an order depending upon the matter to be transmitted. The type-rule and type were then placed upon an endless band of carpet-binding, and were carried forward by points extending downward into the band which passed over two rollers, L L, and was turned by a crank. The projections upon the face of the type impinged upon a tooth affixed to the extremity of a lever, O O, which carried a metallic fork. Thus, as each successive projection upon the type came in contact with the tooth upon the lever, the fork was caused to dip into two mercury cups, J K, completing the circuit of the battery through a few feet of wire and the coils of the electro-magnet.



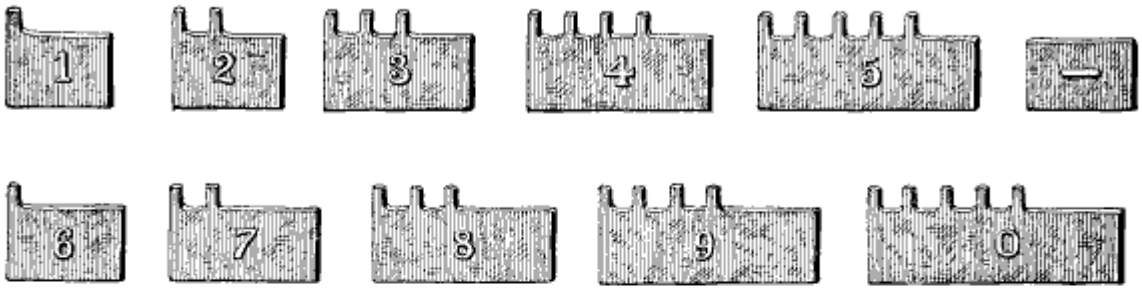
STURGEON'S ELECTRO-MAGNET.

This was the state of the invention when first shown to Professor Gale, in January, 1837.

PROFESSOR JOSEPH HENRY.

The recording machinery had been constructed, but could be made to operate through a very short wire only, the addition even of forty feet rendering the apparatus ineffective. Although Morse was doubtless at the time entirely ignorant of the fact that any other person had even conceived the possibility of the instantaneous transmission of intelligence to a distance by electricity, yet, as we now know, this had actually been attempted by a number of experimenters, who had one after another been confronted with the apparently insurmountable obstacle which now presented itself to Morse. Very fortunately, Professor Gale not only comprehended the nature of the difficulty, but was able to suggest the means of overcoming it. In a letter to Professor Joseph Henry, dated April 7, 1856, he writes:

> This apparatus was Morse's original instrument, usually known as the type apparatus, in which the types, set up in a composing stick, were run through a circuit-breaker, and in which the battery was the cylinder battery, with a single pair of plates. This arrangement also had another peculiarity, namely, it was the electro-magnet used by Moll, and shown in drawings of the older works on that subject, having only a few turns of wire in the coil which surrounded the poles or arms of the magnet. The sparseness of the wires in the magnet coils and the use of the single cup battery were to me, on the first look at the instrument, obvious marks of defect, and I accordingly suggested to the professor, without giving my reasons for so doing, *that a battery of many pairs should be substituted for that of a single pair*, and that *the coil on each arm of the magnet should be increased to many hundred turns each;* which experiment, if I remember aright, was made on the same day with a battery and wire on hand, furnished, I believe, by myself, and it was found that while the original arrangement would only send the electric current through a few feet of wire, say 15 to 40, the modified arrangement would send it through as many hundred. Although I gave no reasons at the time to Professor Morse for the suggestions I had proposed in modifying the arrangement of the machine, I did so afterward, and referred in my explanations to the paper of Professor Henry, in the 19th volume of the "American Journal of Science." . . Professor Morse professed great surprise at the contents of the paper when I showed it to him, but especially at the remarks on Dr. Barlow's results respecting telegraphing, which were new to him, and he stated at the time



that he was not aware that any one had even conceived the idea of using the magnet for such purposes.

The original telegraph type cast by Prof. Morse at his brother's house

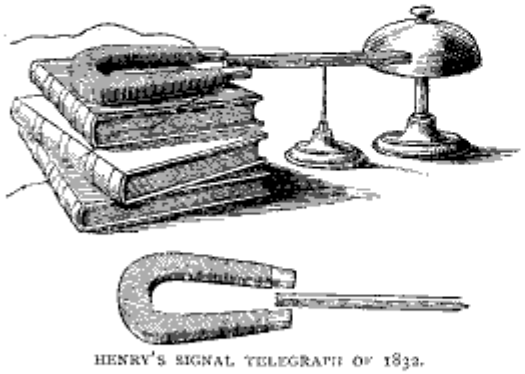
Prior to the investigations of Professor Henry, in 1830, the means of developing magnetism in soft iron had been but imperfectly known. The electro-magnet, as originally devised by Sturgeon of England, in 1825, consisted of an iron rod in the form of a horse-shoe, coated with varnish, and surrounded with a helix of naked wire composed of a small number of turns at a considerable distance from each other. A copy of this magnet was made by Professor Dana as early as 1827, and was familiar to Morse, and thus it happened that it was the Sturgeon magnet which Morse employed in his first experiment. It was found by Henry that the projectile force necessary to send the electric current effectively through a long conductor required a battery of a series of many pairs of plates; and that in order to utilize that power at the distant station it is necessary to surround the magnet with many turns of one long wire, superposed upon each other and insulated, so as to multiply the effect of the current enfeebled by its transmission through the long conductor.

But Henry, in 1832, had done much more than this. He had actually constructed and operated an electro-magnetic signaling apparatus which was as truly an electric telegraph as that of to-day. Not only was it a telegraph, but it was essentially what now goes by the name of the "Morse" telegraph. Professor Henry describes his apparatus of 1832 as follows:

> I arranged around one of the upper rooms in the Albany Academy a wire of more than a mile in length, through which I was enabled to make signals by sounding a bell. The mechanical arrangement for effecting this object was simply a steel bar permanently magnetized, of about ten inches in length, supported on a pivot, and placed with its north end between the two arms of a horse-shoe magnet. When the latter was excited by the current, the end of the bar thus placed was attracted by one arm of the horse-shoe and repelled by the other, and was thus caused to move in a horizontal plane and its farther extremity to strike a bell suitably adjusted.

This apparatus is shown in the accompanying illustration, and was seen in operation by many witnesses. It is therefore certain that Henry was the first actually to magnetize a piece of iron at a distance by electricity and to produce acoustic signals thereby; that he was the first to point out and experimentally demonstrate the relation between the battery, the conductor, and the electro-magnet necessary to develop magnetic power at a distance; and, moreover, he did not omit publicly to call attention to the fact of the applicability of this experiment to an electric telegraph.*

The statement of Professor Gale clearly establishes the fact that the principles laid down by Henry were applied by himself, in 1837, to render Morse's machine effective at a distance. It is therefore certain, that although Morse had recorded signals by means of his Sturgeon magnet through a few feet of wire, yet, for any



HENRY'S SIGNAL TELEGRAPH OF 1832.

* In the words of Professor A. M. Mayer: "This was the first electro-magnetic telegraph which had worked through so great a length of wire; it was the first telegraph in which an electro-magnet had worked successfully; it was the first sounding electric telegraph."

TELEGRAPHIC WRITING BY MORSE'S FIRST INSTRUMENT. (FROM ORIGINAL IN ARCHIVES OF NEW JERSEY HISTORICAL SOCIETY.)

telegraphic purpose, his previous experiments had been utterly unavailing.

It is also important to remember that the code of conventional signals which had been devised by Morse, and which, in connection with his machine, he proposed to use for the transmission of intelligence, were *numerical* and not *alphabetical*. According to his scheme a specially prepared dictionary was required, in which every word in the English language was represented by an arbitrary number. A separate type represented each numeral, having a corresponding number of projections or teeth. We reproduce a specimen of telegraphic writing by this numerical code. The numbers refer to words in the telegraphic dictionary. They are translated by counting the points at the bottom of the line, and then, by referring to the dictionary, the corresponding words are found and the communication translated.

The construction of the machines referred to by Mr. Baxter was begun early in September, 1837, immediately after the partnership between Morse and Vail had been determined upon. Meanwhile, Morse remained in New York, engaged in the preparation of his caveat. This document was subscribed by him on the third day of October, 1837, and from it we may learn precisely of what his invention then consisted. He enumerates the essential parts of his apparatus as follows:

First, a *system of signs*, by which numbers, and consequently words and sentences, are signified; second, a *set of type*, adapted to regulate and communicate the signs, with rules in which to set up the type; third, an *apparatus called the port-rule*, for regulating the movement of the type-rules, which rules, by means of the type, in their turn regulate the times and intervals of the passage of electricity; fourth, a *register*, which records the signs permanently; fifth, a *dictionary*, or vocabulary of words, numbered and adapted to this system of telegraph; sixth, *modes of laying conductors* to preserve them from injury. This, then, was Morse's telegraph, as it existed in October, 1837. It was the first apparatus to *record* simple numerical signs at a distance by electricity. Writing as late as 1867, and giving what may be regarded as his own mature opinion of his work, Morse claims, and with justice, to be the first inventor of a *recording or printing telegraph*, as distinguished from a *semaphore*, giving only evanescent signs, either visual, as in the apparatus of Schilling and others, or acoustic, as in the apparatus of Henry. He inquires:

> What else was necessary to be added to the catalogue of facts known in 1832 to construct a telegraph? One other fact only was wanting, and that was a system of signs adapted to the capabilities of the mechanism for printing at a distance; and this system of signs I invented in 1832, and adding to it the inventory of known facts *successfully combined* them to produce the telegraph.

But, as we shall hereafter see, the telegraph invented by Morse in 1832, and described in his caveat of 1837, has nothing in common with the *essentials* of the modern system of telegraphy which is known in the United States as Morse's; nor is the code of alphabetical signs now universally used in telegraphy throughout the world the same, either in principle or in construction, as that of the caveat.

As soon as the caveat had been safely lodged in the Patent Office, Morse began the preparation of a dictionary. October 24, he writes to Vail:

> The dictionary is at last done. You cannot conceive how much labor there has been, but it is accomplished, and we can now talk or write anything by numbers. . . .
>
> The spark passes freely as yet three and a half miles, and magnetizes well at that distance, though evidently with diminished strength, which would seem to indicate that there is a limit somewhere. We have just heard that Professor Wheatstone had tried an experiment with his method — twenty miles — with success; we have, therefore, nothing to fear.

On the 29th, Morse went to Speedwell for a few days, partly to observe the progress of the new machinery, and partly with the intention of painting the portraits of the members of Judge Vail's household, in fulfillment of a commission which had been given him as a delicate and considerate manner of relieving his pressing pecuniary necessities. After his return to New York, he wrote to Vail, November 13:

> You will be gratified and agreeably surprised when I inform you that the result now is, that, with a little addition of wire to the coil of the small magnet which I had all along used, the power was as great apparently through *ten* as through three miles. The result has surprised us; and yet there is no mistake, and, I conceive, settles the whole matter.

Meanwhile Alfred Vail and his young assistant, William Baxter, were engaged night and day in pushing forward the construction of the new machinery. Writing of this period, Mr. Baxter says:

> Alfred was singularly modest and unassuming, while Professor Morse was very much inclined to insist on the superiority of his own plans and methods — if for no other reason, *because* they were his own. As we all looked upon him with the respect due to a professor, we were at first quite willing to defer submissively to his dicta. It resulted from this, that the

first machine which was constructed at Speedwell was substantially a copy of the original model, although constructed of metal, in a more symmetrical and practical form.

As we became acquainted with Morse it became evident to us that his mechanical knowledge and skill were limited, and his ideas in matters relating to construction of little value. As the weak points in the apparatus were one after another developed, Alfred began to draw upon the resources of his own wonderful power of invention in substituting practical and commercially valuable mechanical combinations for the more or less impracticable designs of Morse.

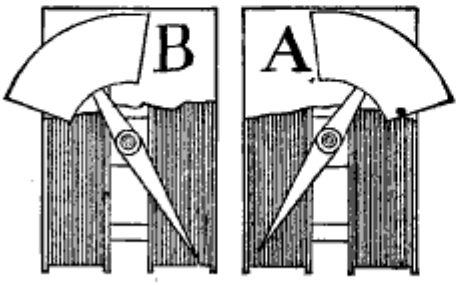
We found, for example, that the pencil of the recording apparatus frequently required repointing, and that when freshly sharpened it made a different mark from that made by a worn point, which tended to render the record obscure and difficult to decipher. Alfred contrived a fountain-pen that made a uniform line. This device, however, was not satisfactory to him, as it threw the ink in all directions when jerked by the sudden action of the magnet, and he spent some time in diligent study in the endeavor to devise a remedy.

He was a mechanical draughtsman of surpassing skill, as is fully attested by some of his work still in possession of his family.* He brought to me one day, after working for an hour at his drawing-table, a sketch of a new marking device, in which a vertical motion was given to the lever instead of the transverse movement which had hitherto been employed. We constructed the new lever, and thus for the first time produced a register capable of making *dots*, *dashes*, and *spaces*.

Alfred's brain was at this time working at high pressure, and evolving new ideas every day. He saw in these new characters the elements of an alphabetical code by which language could be telegraphically transmitted in actual words and sentences, and he instantly set himself at work to construct such a code. His general plan was to employ the simplest and shortest combinations to represent the most frequently recurring letters of the English alphabet, and the remainder for the more infrequent ones. For instance, he found upon investigation that the letter *e* occurs much more frequently than any other letter, and accordingly he assigned to it the shortest symbol, a single dot (·). On the other hand, *j*, which occurs infrequently, is expressed by dash-dot-dash-dot (—·—·). After going through a computation, in order to ascertain the relative frequency of the occurrence of different letters in the English alphabet, Alfred was seized with sudden inspiration, and visited the office of the Morristown local newspaper, where he found the whole problem worked out for him in the type-cases of the compositors.

In this statement I have given the true origin of the misnamed "Morse" alphabet, the very foundation and corner-stone of a new system, which has since become the universal telegraphic language of the world.

* As an illustration of Vail's skill as a draughtsman, we give a fac-simile of his drawing of one of his original conceptions, embodying the principle of the modern electric annunciator. This was probably made in 1845.



FAC-SIMILE OF VAIL'S DRAWING OF ELECTRIC ANNUNCIATOR.

The construction of the apparatus, and the accompanying experiments, were carried forward as rapidly as possible during the last three months of 1837. Meantime, Professor Gale, in New York, was engaged in planning the batteries, which were of the Cruikshank, or trough pattern, having sixty pairs of plates each. By November 13, as we have seen, Gale had transmitted signals through ten miles of wire with the old experimental instrument. At length, on January 6, 1838, the new instruments were set up in a vacant room at Speedwell; and on the 10th and 11th of the same month they were publicly exhibited to the people of Morristown, in operation through three miles of wire.

Writing of this period in the progress of the work, Mr. Baxter says:

The path to this land of promise was not by any means strewn with roses. It could hardly have been expected that the Judge, who was the actual financial supporter of the enterprise, would go on for months making a constant outlay without seeing any result. It was too large a sum of money to be to all appearances thrown away on an invention the practical use of which was little understood or appreciated, and the ultimate success of which was, to say the least, problematical. The superior wisdom of his neighbors and the sarcastic remarks of the villagers irritated and discouraged him, so that by degrees he grew morose and ill-tempered, and at length utterly refused to look at the machinery or to assist in its construction, thus leaving us to find our own way out of the accumulating difficulties as best we could.

It was a trying ordeal, for we were convinced that if a favorable result were not reached at an early day the Judge would order the experiment discontinued. During the last days of 1837 the crisis seemed so close at hand that Morse and Alfred carefully avoided meeting the Judge, for fear of precipitating the *dénouement*. We confined ourselves closely to the room and worked assiduously at the apparently endless task, determined, if possible, to accomplish it before our opportunity for doing so was withdrawn. Each succeeding day, at noon, I was directed to watch and report when the Judge left the works to go to his dinner, whereupon Morse and Vail would steal out and dine at the house of Dr. Cutler,—a brother-in-law of Alfred's who lived near by,—and hurry back to the room before the Judge returned.

It was a time of extreme anxiety for us, as well as a critical point in the history of the telegraph. We well knew that unless a satisfactory result were soon reached the work must stop, never to be resumed by us, and we felt that at any moment the fate of a great invention might be decided for all time.

But time and patience conquer all, and at length we had the unutterable satisfaction of knowing that the machine was at last in working condition. . . .

I recall vividly, even after the lapse of so many years, the proud moment when Alfred said to me: "William, go up to the house and invite Father to come down and see the telegraph machine work."

I did not stop to don my coat, although it was the 6th of January, but ran in my shop-clothes as fast as I possibly could. It was just after dinner when I knocked at the door of the house and was ushered into

the sitting-room. The Judge had on his broad-brimmed hat and surtout, as if prepared to go out, but he sat before the broad fire-place, leaning his head on his cane, apparently absorbed in deep meditation. As I entered the room he looked up, and said, "Well, William?" and I answered, "Mr. Alfred and Mr. Morse sent me to invite you to come down to the room and see the telegraph machine work." He started up as if the importance of the message impressed him deeply, and in a few minutes we were standing in the experimental room. After a short explanation, he called for a piece of paper, and writing upon it these words, "*A patient waiter is no loser*," he handed it to Alfred, saying, "If you can send this, and Mr. Morse can read it at the other end, I shall be convinced." He knew that Morse could not possibly be cognizant of the contents of the message, and hence that there could be no collusion between the experimenters, and in any event he had perfect faith in both; so that when the message was translated from the machine by Morse and handed to him, the duplicate in every word of his own dispatch, he knew that the invention was a demonstrated success, and he then, perhaps for the first time, fully realized its actual importance. The unexpected result of the experiment overcame his usual equanimity, and he gave way in an instant, apparently wholly overcome by his emotions.

He had scarcely seen or spoken to Alfred for six weeks, and the meeting under such auspicious circumstances was a most joyous one. In the exuberance of his happiness the Judge proposed to go at once to Washington and urge upon Congress the establishment of a Government telegraph. He was perhaps the most influential adherent, in his portion of the country, of the Van Buren administration, then in power, and hence apprehended but little difficulty in effecting the desired result. But the event proved that the assistance of Congress was not so easily to be procured.

It was at once determined that an exhibition should be first given in New York, and that Morse and Vail should then take the apparatus to Washington, for exhibition before Congress. The instruments were accordingly transported to New York and set up in the University, in the same room where the early experiments had been made. A letter from Alfred to his brother, written January 23, 1838, says:

Yesterday I wrote by stage informing you of our intention to exhibit to-day. We have done so with perfect success, through ten miles, to hundreds of ladies and gentlemen. To-morrow is our last day. I shall box up, and it is decided we make a stop in Philadelphia for a few days. We are now going on very well. Our audiences were astonished and delighted.

At the conclusion of the exhibition in New York, Morse and Vail proceeded to Philadelphia and submitted the apparatus in operation to a committee of the Franklin Institute. This committee in their report expressed their high gratification with the performance of the apparatus and their hope that the Government would furnish the means to make a test on an extensive scale. This indorsement produced a most encouraging effect, and Judge Vail at once authorized papers to be prepared for securing foreign patents. After a stay of a few days at Philadelphia, Morse and Vail set out, with high hopes and anticipations, for Washington.

The report of the Secretary of the Treasury to the House, heretofore referred to, had been made on December 6 of the preceding year, and was accompanied by the most promising of the various replies to the circular which had been received. The Secretary said:

From these communications, and such other investigations as the pressure of business has enabled me to make, I am satisfied that the establishment of a system of telegraphs for the United States would be useful to commerce as well as the Government. It might most properly be made appurtenant to the Post Office Department, and, during war, would prove a most essential aid to the military operations of the country.

The letter of Morse in reply to this circular was written September 27, 1837, immediately after the contract with Vail had been concluded, and, together with the report, had been referred to the House Committee of Commerce. Immediately upon arriving at Washington, Morse had applied to the chairman, Hon. Francis O. J. Smith of Maine, to be heard by the committee in explanation of his plan. This permission was readily granted, together with the use of the committee room in the Capitol for the exhibition of the apparatus. At the next meeting of the committee, when the somewhat unprepossessing apparatus was first seen, the members evinced general incredulity as to the merits of the invention; but, fortunately, Mr. Smith had in the mean time become deeply interested, and had made himself acquainted with the principles and mode of operation of the apparatus. With such effect did he intreat his associates to promise attendance at a special meeting to listen to the explanations and to witness the manipulations of the partners, that the time appointed found every member present. Morse and Vail, inspired with new hope by the favorable attitude of Smith, spared no effort to make the exhibition successful. The demonstration was conclusive, and, the chairman was instructed to report a bill appropriating thirty thousand dollars to construct an experimental line between Washington and Baltimore.

The following interesting letter from Alfred Vail to his father, written on February 17, 1838, gives a graphic impression of the sensation produced by the invention, as it appeared to the hopeful and enthusiastic writer:

The labors of the week have closed, and with the most unexpected success. Hundreds have witnessed the operation of the machine and its almost incredible powers. I do not represent to you the full effect which our exhibition has had upon the minds of those who have witnessed it,— for you would scarcely believe,— but I can assure you, I feel as though some strange thing had happened when I see members of Congress eager to witness the powers of the machine, and, after having seen them, utter exclamations of won-

HON. FRANCIS O. J. SMITH.
(FAC-SIMILE OF ORIGINAL PENCIL-SKETCH BY MORSE.)

der and amazement. Some say, "The world is coming to an end." Others, "What would Jefferson think should he rise up and witness what we have just seen?" "Where will improvements and discoveries stop?" "Time and space are now annihilated." "It is the most wonderful discovery ever made." Others say that "it must belong to Government," etc., etc. Some members, after having seen it themselves, go out and bring in half a dozen more, and they come again and again. Mr. Calhoun, after he had seen it, which was the day after he made his speech, sent down a dozen other senators to witness it; and so we go. The President and Cabinet have signified their intention to visit it, and you may imagine the interest they feel from the fact that it will be the first visit the President will have made to the Capitol since Congress has been in session this winter. I believe they are more desirous to have an experiment tried 200 miles than 100, but we wish to try it 100. The battery which we use has 40 plates more than we need; the fluid passes the whole circuit of 10 miles, even when it is not in action — that is, only from the moisture on the plates. Dr. Patterson has made a *very* favorable report of our exhibition at Philadelphia to the Secretary of the Treasury, which will be or has been sent to the House. Professor M. has been requested by the chairman of the Committee on Commerce to make out a full report and proposition. The committee are very much pleased and will *undoubtedly* report favorably to the House. Professor M. tells me that Ellsworth* and others inform him that it will meet with approbation by Congress, and that members frequently ask him what is his opinion. I state to you things as they are. Mr. Ellsworth said that nothing had ever been in Washington that has produced such a noise.

In the letters written by Alfred Vail at this time to his family and friends there is apparent an undercurrent of dissatisfaction in respect to the personal relations between Morse and himself. As we have seen, Vail, in accordance with the terms of the contract, had not only become a full partner in the ownership of the invention, but had supplied the entire resources and facilities for obtaining patents and for constructing the apparatus for exhibition at Washington; and, more than this, he had introduced essential improvements not only in the mechanism, but in the fundamental principles of the telegraph. In the correspondence of this period there is evidence that, notwithstanding his many admirable traits of character, Morse seems to have possessed so high an appreciation of his own abilities that he was scarcely able to do justice to the work of his coadjutors, or even fully to comprehend its essential value to him. This was particularly the case in respect to the services of his enthusiastic and faithful associate Vail. From the time when the apparatus was first exhibited in New York to the last day of his life, Morse appears to have evinced a certain disinclination to acknowledge the full proportion of credit to which, as time has shown, his associate was entitled. We find him repeatedly referring to Vail as his "mechanical assistant," rather than his associate and partner, and in terms calculated to convey the impression that the latter, instead of being a liberally educated young man, of more than ordinary ability, was but an ordinary mechanic who had been employed to put the matured conceptions of the inventor into substantial form. The sensitive spirit of Vail chafed under this ungenerous treatment. His private letters contain occasional references to this grievance. On January 22, 1838, the day before the exhibition in New York, he writes to his brother:

> Since my arrival here I have been so engaged with the telegraph that I have had no time to inform you of our progress. I however have now the pleasure to inform you of its complete success through the ten miles, after some little trouble and solicitude. We received the machine on Thursday morning and in an hour we made the first trial, which did not succeed, nor did it with perfect success until Saturday — all which time Professor M. was rather *unwell*. Tomorrow we shall make our first exhibition, and continue it until Wednesday, when we must again box up. Professor M. has received a letter from Mr. Patterson inviting us to exhibit at Philadelphia, and has answered it, but has said nothing to *me* about his intentions. He is altogether inclined to operate in his own name; so much so, that he has had printed five hundred blank invitations in his own name, at your expense. . . . Professor Silliman has seen the machine in operation, and says it exceeds his expectations.

Again writing from Washington, to his brother George, February 20, 1838, in reference to the execution of a formal conveyance of their stipulated interest in the invention, which for a long time he had been urging Morse to make, Vail says:

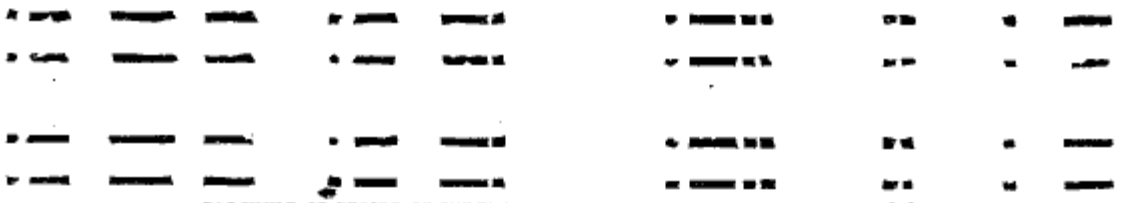
> He has agreed to give us one-fourth, so you perceive the thing is settled. In regard to Professor M. calling me his "assistant," this is also settled, and he has said as much as to apologize for using the term. . . .

* Hon. Henry L. Ellsworth of Connecticut, then Commissioner of Patents.

I cannot take your advice that one should allow himself to be called all sorts of names if he can only get the "ready."

After the exhibition before the Congressional committee at Washington, the chairman, Mr. Smith, whose acute perceptions fully appreciated the vast prospective importance of the telegraph as well as its enormous pecuniary value, proposed to be admitted as a partner in the invention. Further negotiations resulted in an agreement by which Smith was to become the owner of one-fourth of the invention, to be contributed in equal shares by Vail and Morse. He was to resign his seat in Congress and become the legal adviser of the partners, and was also to accompany Morse to Europe, bearing his expenses while abroad, and providing means and adopting measures for securing European patents.

The immediate object of their visit to Washington having been accomplished, Morse and Vail returned early in March — Morse with the intention of proceeding to Europe at an early day in company with Smith, while Vail went to Speedwell to prepare apparatus for exhibition in Europe. He immediately began



FAC-SIMILE OF RECORD BY MULTIPLE FOUNTAIN-PEN INSTRUMENT OF APRIL, 1838.

two new instruments, on a plan radically different from that exhibited in Washington. The pencil hitherto used in registering was replaced by a multiple fountain-pen. This was attached to the armature-lever, making dots and lines upon a continuous ribbon of paper, which by clock-work was made to pass beneath the pens. This improved register had been completed by Vail and was in successful operation when first seen by Morse on a visit to Speedwell, April 11, 1838.

On May 16, 1838, Morse and Smith embarked for Europe, where they arrived in June. Smith returned in November, and threw himself into the political arena. Morse remained abroad until April of the following year, endeavoring, without avail, to induce the European governments to adopt the invention, but at length returned to New York. By this time the apathy and indifference of Congress towards the invention had filled its promoters with discouragement. As we have seen, Alfred Vail, supported by his father and brother, had performed every obligation placed upon him by the partnership agreement. He had defrayed the cost of patent protection; he had constructed the machinery, adding essential improvements, the work of his own hands and brain; he had borne the expense of exhibiting the apparatus in New York, Philadelphia, and Washington, demonstrations attended with such success that a report of the most eulogistic character had been made to Congress by the committee having the matter in charge; and finally, to secure the coöperation of the ex-chairman of the Congressional committee as a partner in the enterprise, he had given up one-half his original interest. Not only had he thus more than performed his part of the labor, but a large sum of money had been expended without tangible result. Under these circumstances it is not surprising that Judge Vail had become somewhat disheartened. There was no immediate prospect that a dollar could be realized from the invention either in America or in Europe. Meanwhile a cloud of financial embarrassment enveloped the country and cast its gloomy shadow over every industrial enterprise. The Speedwell works were not exempt from the effects of the general depression. It was with the utmost difficulty that its proprietors could meet their current obligations, and the condition of affairs was such that they were utterly unable to furnish Morse with further pecuniary aid.

This was a period of discouragement and depression for the proprietors of the telegraph, scarcely relieved by a ray of light from any source. At the time, there seemed little hope that Congress would ever grant the desired appropriation. The session of 1839–40 was on the eve of the most exciting and disgraceful presidential campaign that the country had ever known, and, as in later days, the members were far too much interested in legislation which would give them some imaginary advantage over their political opponents to pay attention to measures affecting the real welfare of their constituents and of the country. In December, 1842, Morse was persuaded to make one more application to Congress. The Committee on Commerce again recommended an appropriation of thirty thousand dollars in aid of the enterprise. The bill passed the House by a close vote, and only after a discussion, which, as reported in the "Congressional

Globe," reflects scant credit upon the patriotism, to say nothing of the intelligence, of some of the participants. In the last hour of the session, March 3, 1843, the bill passed the Senate, and was signed by the President. Morse, writing to a friend in after years, says:

> This was the turning point in the history of the telegraph. My personal funds were reduced to the fraction of a dollar; and had the passage of the bill failed from any cause, there would have been little prospect of another attempt on my part to introduce to the world my new invention.

On March 4 Morse wrote to Vail the most hopeful letter he had penned in many years:

> You will be glad to learn, doubtless, that my bill has passed the Senate without a division, and without opposition, so that now the telegraphic enterprise begins to look bright. I shall want to see you in New York after my return, which will probably be the latter part of next week. I have other letters to write, so excuse the shortness of this, which, if short, is sweet at least. My kind regards to your father, mother, brothers, sisters, and wife. The whole delegation of your State, without exception, deserve the highest gratitude of us all.

On March 31 Morse tendered Vail an appointment as assistant and superintendent of the machinery department of the telegraph to be constructed between Washington and Baltimore under the Government appropriation, which was at once accepted, Vail immediately entering upon his duties with characteristic energy and industry. From this time forward the condition of the work is minutely detailed in his diary, and from this we gather much information of interest in respect to the subsequent progress of the work. On April 13 he suggested to Morse the trial of two or more circuits from one battery. The experiment was successful, and the result proved to be of the utmost importance when the telegraphic system became more widely extended. Afterward we find him experimenting with wires in pipes, winding coils for receiving magnets, and experimenting with Morse in a trial of six wires with a common return circuit. About this time he was also making working drawings for a new registering apparatus, and a new "correspondent," a machine which had been devised by Morse while in Europe as a substitute for the port-rule and type. Vail's inventive and experimental turn of mind found full scope while engaged in this congenial work. Among other discoveries which he made at this time was the self-interrupting circuit-breaker, now universally employed for ringing electric bells, and the axial-magnet, so useful in electric arc lighting, in the first of which devices, however, he had been, as afterward appeared, anticipated by Dr. C. G. Page. The operation of the axial-magnet suggested to his fertile brain the idea of utilizing the principle in the construction of a gauge for ascertaining the power of a battery — the modern ampere-meter, of which he made working drawings. Meanwhile the work of constructing the correspondents, registers, and receiving magnets had been going forward in New York. Smith was endeavoring to devise a machine to lay the underground pipe and inclosed electrical conductors between Washington and Baltimore, which he had contracted with Morse to do at the rate of one hundred dollars per mile. Ezra Cornell, afterward the founder of Cornell University, had been engaged in selling a patent plow; and, chancing to fall in with Smith in Portland, undertook, at his suggestion, to construct a pipe-laying machine. This was completed in August, 1843, on which occasion Morse went to Portland, participated in a successful experimental trial of the machine, and returned home in high spirits. At Smith's urgent solicitation, Cornell went to Baltimore, and in October began laying the wires, which had previously been prepared by Morse's assistant, Dr. Fisher. As each length was laid, Vail tested and united the conductors. Ten miles of the underground line had been laid, when the insulation, which had been gradually failing, disappeared altogether. The minds of those engaged in the enterprise were filled with consternation. Cornell dexterously managed to break the pipe-laying machine, that the apparent accident might furnish a plausible excuse to the newspapers and the public for the temporary suspension of the work. Professors Morse and Gale, Dr. Fisher, and Mr. Smith spent days in secret session at the Relay House discussing the cause of the failure and endeavoring to devise a remedy. The consultations were protracted and painful. A disastrous termination of the enterprise seemed certain. Of the Congressional appropriation $23,000 had been expended, and Smith claimed $4000 of the remaining $7000 under his contract for laying the pipe from Baltimore to Washington. He announced that he was ready to perform his obligation, and insisted upon his legal right to be paid whether the pipe was laid or not, in order to reimburse himself for the expenditure which he had incurred during the fruitless expedition of Morse and himself to Europe in 1838. Smith had for the time wholly lost his faith in the enterprise, and the spirit manifested by him put an end to all friendly relations between himself and Morse. Their differences ultimately grew into an open and bitter quarrel which ended only with the death of the participants. From this time until April another period of the deepest gloom and despondency ensued. It seemed certain that the expense of re-insulating the

This sentence was written from Washington by me at the Baltimore Terminus at 8.h 45 min. A.M. on Friday May 24.th 1844, being the first ever transmitted from Washington to Baltimore, by Telegraph and was indited by my much loved friend Annie G. Ellsworth.

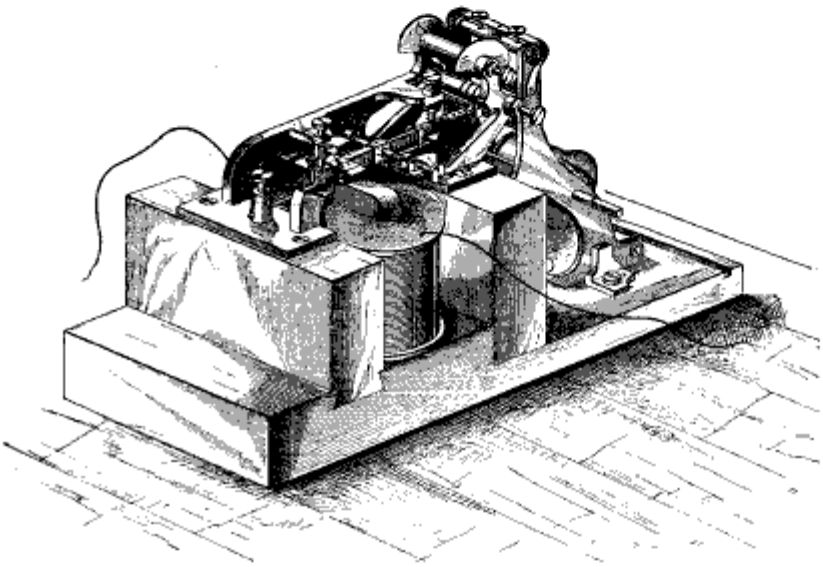
Sam.l F. B. Morse. Superintendent of Elec. Mag. Telegraphs.—

wires and completing the work would more than absorb the funds remaining on hand, and that work must inevitably be suspended to await another appropriation, any attempt to obtain which Smith openly threatened to defeat. The services of Gale and Fisher were dispensed with by way of reducing expenses. Cornell was appointed mechanical assistant, and directed to remove the wires from the pipes and re-insulate them. The dismal prospect of failure, the hostility between Morse and Smith, and the feelings of jealousy among some of the assistants rendered this period a most trying one to all concerned. Vail, though much dispirited, nevertheless labored assiduously at his experiments, and diligently studied Faraday's "Experimental Researches," determined, if possible, to find a way out of the mist of discouragement which enveloped himself and his associates. The quarrel between Morse and Smith distressed him exceedingly, especially as the latter evinced a most unfriendly spirit towards himself. January 8, 1844, he writes in his diary:

> The mode of conducting the business of the telegraph I cannot concur in. I doubt if the experiment is ever tried, and am at a loss to decide whether or not to remain in the employ of the Government. There is much inefficiency in the chief superintendence of it, much indecision, and economy ill-devised. Mr. Smith, I understand, carries his case to the Senate to-morrow. I fear if the appropriation is spent without a trial that utter disgrace will follow all concerned; so far, I can conscientiously say, I am not in any way implicated.

In February it was decided to place the conductors on poles, and accordingly Vail and Cornell were employed in the basement of the Patent Office during March in joining the ends of the wires and making them ready for the poles. On the 1st of April the stringing of the wires was begun at Washington, under the direction of Cornell. One set of apparatus was placed in the Capitol and manipulated by Morse, while Vail transported the other set from place to place along the route of the line, and corresponded with him as occasion offered. On April 12 the wires were worked successfully for twelve miles. On April 23 Vail substituted the earth for part of the metallic circuit between Bladensburg and the Capitol with satisfactory results. On April 30 the line was in operation between Annapolis Junction and Washington. While this work was going on, Smith continued to manifest undisguised hostility towards the enterprise, as appears from an entry in Vail's diary on May 6, as follows:

Professor Morse is again low spirited. He says that Smith will permit nothing to be done by Congress in reference to a further appropriation. Professor Morse's plan is to desist from further progress, to let the patent expire, and then if Government will use it and remunerate him, he will not let Professor Gale and myself want. He will not give Smith a cent; this he told me in the Capitol this morning.

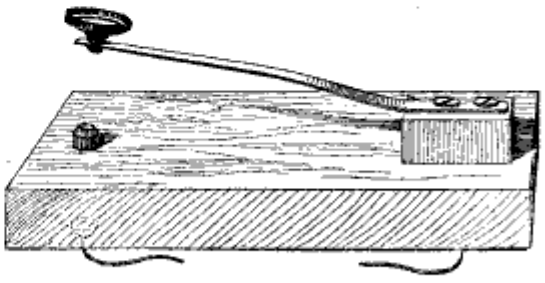


THE BALTIMORE RECORDING INSTRUMENT OF 1844, NOW IN THE NATIONAL MUSEUM.

The work went steadily forward. On May 23 the wires reached the Mount Clare depot in Baltimore, and the instruments were set up and operated with gratifying success, through forty miles of line. On May 24 the historic message, "What hath God wrought!" which had been dictated by Miss Annie Ellsworth, was transmitted from Washington by Morse and received by Vail at Mount Clare, and in the afternoon the instrument was transferred to the lower depot in Baltimore, in readiness for the regular operation of the line.*

The apparatus constructed for the experimental line, although efficient in its operation, would now be regarded as unnecessarily bulky and heavy. The receiving relay weighed 185 pounds, and it was a task for two strong men to handle it. At the present day an equally efficient receiving magnet need not weigh more than four ounces, and might be carried in the vest pocket. The register, which had been constructed by Stokell from working drawings made by Vail, embodied for the first time the beautiful mechanical conception of recording by the indentation of a steel-embossing point upon the paper, working in combination with a grooved roller. One of these instruments was used by Vail at Baltimore, and at his death was bequeathed by him to his eldest son, Stephen Vail, by whom it has been loaned to the National Museum at Washington. In removing this instrument from the place it had occupied for many years, for the purpose of exhibiting it at the Morse memorial celebration at the Academy of Music in New York, on the 10th of June, 1871, a member of Mr. Vail's family discovered a written document folded and attached to the base. A corner of the paper was unfortunately torn off before its importance was discovered. This paper reads as follows, the missing portions being supplied in italics:

This lever and roller were in*vented by me in* the sixth story of the New York O*bserver office,* in 1844, before we put up the teleg*raph line* between Washington and Baltimore, and the *same* has been always used in

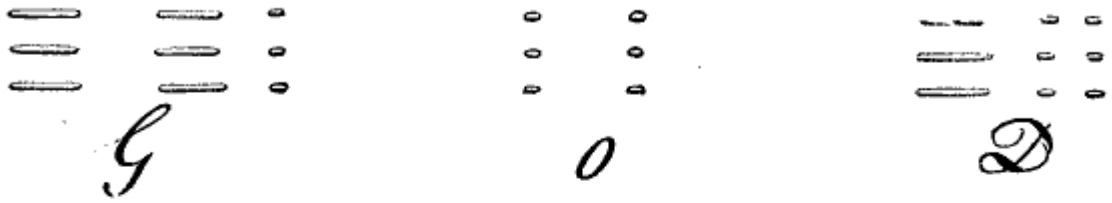


VAIL'S ORIGINAL FINGER KEY OF 1844.
(IN THE CABINET OF THE WESTERN UNION TELEGRAPH CO.)

* WASHINGTON, May 30, 1844.

DEAR VAIL: Little time to say anything. Things worked grandly yesterday. "What hath God wrought," truly. The enthusiasm here for telegraph is beyond your conception. Take courage then, and all will come right for us all. I was excessively fatigued last night, and so doubtless were you. Good-bye.

S. F. B. M.

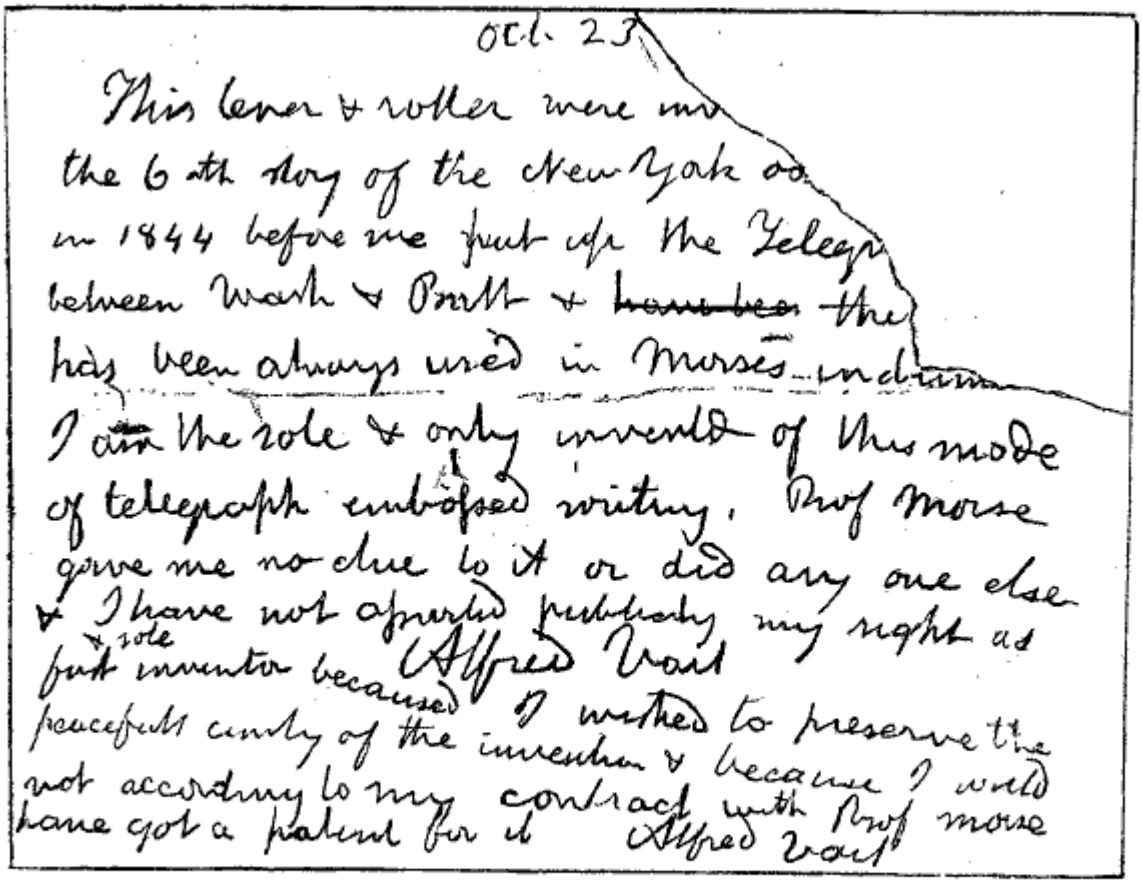


Morse's instrument. I am the sole and only inventor of this mode of telegraph embossed writing. Professor Morse gave me no clue to it, or did any one else, and I have not asserted publicly my right as first and sole inventor, because I wished to preserve the peaceful unity of the invention, and because I could not, according to my contract with Professor Morse, have got a patent for it.

(Signed) ALFRED VAIL.

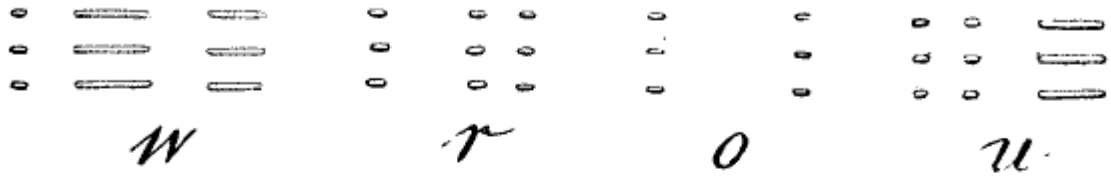
While Vail was at work along the experimental line between Baltimore and Washington, in April, 1844, he was accustomed to dispense with the mechanical correspondent, which had always been regarded by Morse as absolutely necessary for the transmission of signals, and to manipulate the apparatus by dipping the end of the conducting wire into a mercury cup. This plan had suggested itself to him before he left Speedwell, and now he found that his mental conception of the division of time, heightened by his practice and skill as a musician, served his purpose admirably — so admirably, in fact, that ere long the elaborately constructed correspondent, along with the port-rule and other crude mechanism of earlier days, was relegated to the scrap-heap. Immediately after the opening of the line to Baltimore, Vail constructed a simple circuit-closer in the form of a spring finger-key, by which the signals could conveniently be formed by hand. This he soon replaced by a more accurately constructed device, which was substantially that now used.

For some years after the introduction of the telegraph as an established means of communication, the instruments used, in all their essentials, were similar to those originally designed by Alfred Vail. The finger-key and the register indeed retained nearly the form which he had given them; and even the receiving magnet underwent but little change, except in its diminished size. The ponderous coils


Oct. 23

This lever & roller were use
the 6th story of the New York co
in 1844 before me first use the Telegr
between Wash & Balt & ~~how been~~ the
has been always used in Morses ~~inst~~
I am the sole & only inventor of this mode
of telegraph embossed writing. Prof Morse
gave me no clue to it or did any one else
& I have not asserted publicly my right as
first sole inventor because I Alfred Vail
peaceful unity of the invention & because I could
not according to my contract with Prof Morse
have got a patent for it Alfred Vail

FAC-SIMILE OF VAIL'S MEMORANDUM ATTACHED TO BALTIMORE INSTRUMENT.



first used were soon replaced by smaller ones, which Morse had discovered in Paris in 1845. The more expert of the telegraphic operators soon discovered that it was possible to interpret the telegraphic signals by the sound of the armature-lever. In vain did the proprietors and managers of the telegraph lines strive to prohibit this unauthorized method of receiving communications. Even threats of instant dismissal were unavailing to prevent the practice from being carried on whenever it could be done without detection. Morse himself, who had from the beginning regarded the production of a permanent record as the corner-stone of his invention, was most uncompromising in his opposition to the acoustic method, but the objectionable practice nevertheless continued to extend itself. Experience ultimately demonstrated the economy and the accuracy resulting from this unauthorized innovation; the recording instruments passed into disuse on one line after another, and were replaced by the modern sounder, a device consisting simply of an electro-magnet, a vibrating armature, and a retracting spring. At the present day the register is seldom seen except in the hands of inexperienced operators, who have not yet learned to interpret, with the facility that comes only from long practice, the unwritten language of the sounder.

The crucible of time alone has the power to separate the permanent and the essential from the transient and the non-essential. The law of the survival of the fittest is nowhere more clearly exemplified than in the history of the arts and inventions which form an essential part of modern civilization. Half a century has passed since the day when Morse first exhibited his recording telegraph to a circle of admiring friends gathered within the walls of the University. Within that period the electric telegraph has been spread over the globe. It has been extended across every continent and under every sea. Innumerable modifications of the original invention have been made; ingenious and beautiful systems have been invented by which communications may be printed in Roman letters, and even reproduced in a fac-simile of the handwriting of the author. Nevertheless, it is as certain as any future event can be, that one simple essential type of telegraphic apparatus is destined to supplant all its competitors, and to become universal throughout the world. This is the acoustic semaphore, or sounder, invented by Mr. Vail, which is used almost to the exclusion of everything else in North America and in India, and is rapidly making its way in every part of the civilized world. Although this system is everywhere known and recognized as the "Morse telegraph," careful analysis discloses the fact that it retains but little, if anything, which can in strict justice be said to be the offspring of the genius of its accredited inventor.

The accompanying diagram will serve to illustrate the organization of apparatus which constitutes the essential and typical electric telegraph of to-day. E represents the battery, K the finger-key at the transmitting station, and M the electro-magnet of the receiving instrument. A wire, 1, unites the negative terminal of the battery, E, with the ground plate, C. A wire, 2, extends from the other terminal of the battery to the finger-key, K, from whence proceeds the line wire, 3, the latter being continuous with the insulated coils around the legs of the electro-magnet, M, at the receiving station, and through these coils with the wire, 4, which extends to another ground-plate, G. We have, therefore, a circuit of electric conductors made up of the wires, the coils of the electro-magnet, and the earth, going out from the positive end of the battery marked + and returning to the negative end marked —, which is continuous, with the exception of the interruption at the key, K. When this key is depressed, the circuit is completed and is instantaneously traversed throughout by the electric current from the battery. The soft iron of the magnet, M, becomes magnetic, and the armature, L, is attracted, brought forcibly against

DIAGRAM ILLUSTRATING THE PRINCIPLE OF THE MODERN TELEGRAPH.

the stop, s, and retained by the influence of the magnet until released by the interruption of the current at the key, K. The magnetism now instantly disappears, the armature is released, and being raised by the spring, T, strikes against the upper stop, *s*. Hence the movements of the armature to and fro between the stops are a faithful reproduction of the movements given to the key, K, by the finger of the operator. So nearly simultaneous are these two movements that the ear is unable to separate them, even when both instruments are placed upon the same table and electrically united through a thousand miles of intervening wire.

This simple apparatus comprises all that is essential in the commercial operation of the electric telegraph. Other attachments are added for convenience, especially the relay and combined circuit for increasing the volume of sound from the receiving instrument; but this feature is in no wise indispensable, and is often omitted. The elementary mechanism illustrated on the previous page, and the alphabetical code of Vail, based on the immutable principle of the division of time and space, are essentials; all else is in a greater or less degree superfluous.

If we examine more closely this elementary apparatus, we find it almost identical with that employed by Henry in 1832. The battery, the circuit of wires, the electro-magnet, the lever, and the device which produces sounds when struck by the lever under the attractive impulse of the electro-magnet, differ in no material respect from the devices of Henry. His crude transmitting apparatus, a wire dipped in mercury, is replaced by Vail's spring finger-key. The adjustable stops between which the armature lever vibrates, originally devised by Page, were also incorporated into the telegraph by Vail.

It is self-evident, therefore, that not a single feature of the original invention of Morse, as formulated in his caveat and repeated in his original patent, is to be found among the essential constituents of the modern apparatus. Prior to 1837, it embodied the work of Morse and of Henry alone. From 1837 to 1844, it was a combination of the inventions of Morse, Henry, and Vail; but, as we have seen, the elements contributed by Morse have gradually fallen into desuetude, so that the essential telegraph of to-day, and the universal telegraph of the future, comprises solely the work of Joseph Henry and Alfred Vail. The grandeur of Vail's conception of an alphabetical code, based on the elements of time and space, has never met with the appreciation which it deserves. Its utility is not confined to electric telegraphy. It is used to signal, by intermittent flashes of light, between far distant signal stations of the Coast Survey, and between the different vessels of a fleet; it is sounded upon whistles and bells to convey intelligence to and from steamers cautiously feeling their way through the obscurity of fogs; and in fact nearly every day brings to notice some new field of usefulness for this universal symbolic language. It appeals to almost every one of our senses, for it may be interpreted with almost equal facility by the sight, the touch, the taste, and the hearing. Indeed, with a charged electrical conductor and a knowledge of Vail's alphabetical code, even the transmitting and receiving instruments of the electric telegraph may be dispensed with in emergencies.

In the minds of those who have followed the history of the invention of the telegraph, as related in the foregoing pages, the question will naturally arise why Vail did not during his lifetime publicly claim the credit for the share in the invention which was justly his. In reply to this, it may be said of him, that while we now recognize that he was an inventor of exceptional ability, yet, at the time of making his improvements, it did not occur to him that they were anything more than modifications of the invention of Morse; and he further appears to have considered that under his contract with Morse he was debarred from taking patents in his own name, even for the independent creations of his own brain — an erroneous impression, which at least one of his associates apparently took no pains to dispel. Another and perhaps controlling reason for his course is to be found in the fact, that, no sooner had the commercial value of the telegraph been demonstrated by its extension to the principal cities of the United States than rival and infringing enterprises sprung up on every hand. The ablest legal talent of the country, sustained by ample capital, was employed for years in a series of gigantic legal contests, with the avowed object of overthrowing the patents of Morse, and thus leaving the invention open to the world. The position of Vail, not only as a confidential associate of Morse, but as co-proprietor in the

patents, forbade him, both as a matter of policy and of justice, to set up a claim which might have been used with telling effect against the validity of Morse's patent. But, while Vail remained silent, so far as the public was concerned, because, in his own words, he "wished to preserve the peaceful unity of the invention," yet, his correspondence with his associates contains ample evidence that he never hesitated to assert to them his rightful claims, so far as he himself understood and appreciated them. When personal friends, familiar with the work which he had done, urged him to insist upon a recognition of his rights, he replied, "I am confident that Professor Morse will do me justice." But before the expiration of the patents, the death of Mr. Vail occurred, and from this time forward his claims received but scant consideration, although the reasons which had previously rendered this course apparently desirable and necessary no longer existed. Ten years after Vail had passed from earth, a magnificent reception and banquet was tendered to Professor Morse by the principal citizens of New York, at which Chief-Justice Chase presided. Professor Morse, referring to his invention, said:

> In 1835, according to the concurrent testimony of many witnesses, it lisped its first accents, and automatically recorded them, a few blocks only distant from the spot from which I now address you. It was a feeble child indeed, ungainly in its dress, stammering in its speech; but it had then all the distinctive features and characteristics of its present manhood. It found a friend, an efficient friend, in Mr. Alfred Vail of New Jersey, who with his father and brother furnished the means to give the child a decent dress preparatory to its visit to the seat of Government.

One cannot but feel a certain surprise that this was all that Professor Morse, in the evening of his days and in the zenith of his fame, could find to say in recognition of the earnest, self-sacrificing, and life-long labors of his deceased associate.

The writer has no wish to detract from the credit which is justly due Morse for his great work, the conception and the reduction to practice of the recording telegraph. His indebtedness to those who had gone before him, whose results he embodied in his own work, and to the assistants who shared his confidence and his labors, diminishes not in the least his own merit as an inventor, although we believe even greater credit is due him for the unwearied industry, patience, and persistence with which he pressed forward, in the face of discouragements from which most men would have recoiled in dismay, until the goal of success was reached. But in the words of the distinguished associate and friend of both, the Hon. Amos Kendall:

> If justice be done, the name of Alfred Vail will forever stand associated with that of Samuel F. B. Morse in the history and introduction into public use of the electro-magnetic telegraph.

Franklin Leonard Pope.

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Author: **FLP - Pope, Franklin Leonard**