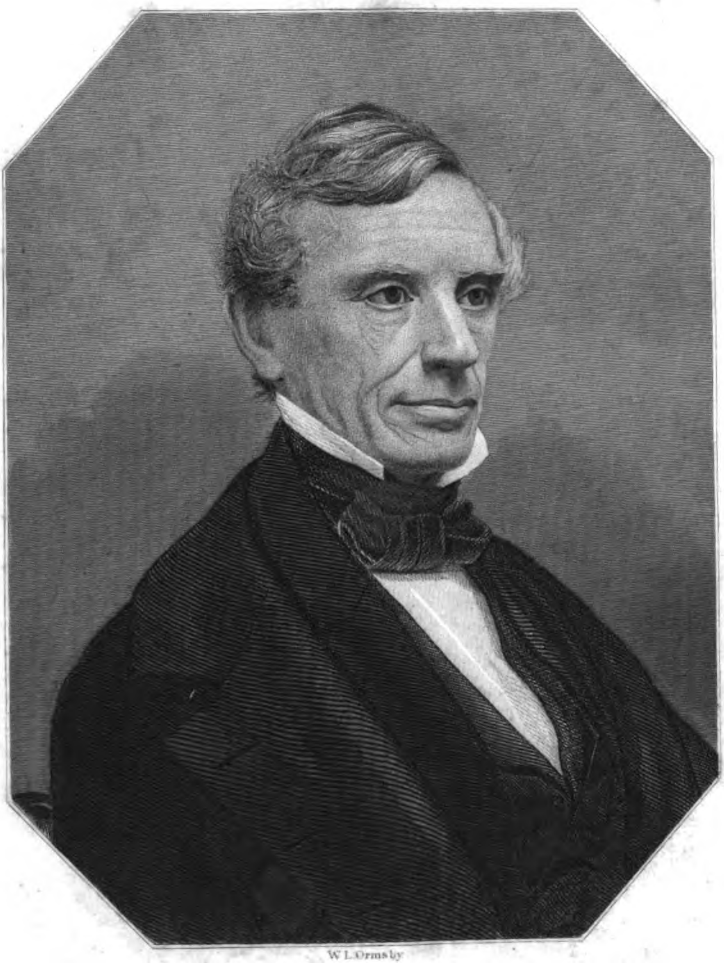
Shaffner's Telegraph Companion

Taliaferro Preston Shaffner



W L Ormsby

With sincere respect & esteem
Y^r friend & Serv^t
Sam^l F. B. Morse

SHAFFNER'S

Telegraph Companion,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

Taliaferro Preston
BY TAL. P. SHAFFNER,
Secretary of the American Telegraph Confederation,
NEW-YORK CITY.

Et non "eripuit cœlo fulmen,"
Fulguri mentem fudit, et orbem lumine cinxit.
Chancellor Pirtle to Prof. Morse.

"Canst thou send lightning, that they may go and say unto thee, Here we are?"—*Job.*

"The names of Franklin and Morse are destined to glide down the declivity of time together—the equals in the renown of inventive achievements."—*F. O. J. Smith.*

"As the inventor of the Electric Telegraph, you, Prof. Morse, stand pre-eminent."—*Arago.*

"The Electro-Magnetic Telegraph—that last and most wondrous birth of this wonder-teeming age."—*Cong. Rep. on Morse's Telegraph.*

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SHAFFNER'S
TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. I. JANUARY, 1854. No. 1.

Art. I.—THE AMERICAN ELECTRO-MAGNETIC TELEGRAPH.

BY HON. AMOS KENDALL.

An Extract from an Argument submitted to the Supreme Court of the United States.

SELDOM, if ever, has a more important case been brought before the Supreme Court of the United States for its decision.

It is important on account of the pecuniary interests involved in it; it is important as involving the fame of a distinguished citizen, and through him, to some extent, the fame of our common country. It is transcendently important in the principles of patent law which it presents for final decision by this tribunal.

It is now to be tested whether Prof. Morse is to share the fate of so many distinguished inventors, who have gone before him; whether individuals or the public, eager to possess the fruits of his mental labor before they rightfully become public property, shall be permitted to gratify their cupidity; whether Prof. Morse, like the inventor of the cotton gin, is to lose the profits of his invention, while thousands of his instruments, the originality of which no man doubts, resound throughout the land, almost in the presence of the tribunal which must decide upon his patents.

It is now to be tested, whether American courts are hereafter to consider patent privileges as the price paid by the Government for the fruits of mental labor, to be held as sacred from piracy, theft, or trespass, as any other species of private property; or whether, like the English courts for a long period, now happily at an end, they are still to confound them with

odious monopolies, of what, before the issue of the special grants, had become the property of the public.

It is now to be tested, whether American courts, as the English courts so long did, are hereafter to look to machinery or instrumentalities as the only objects to be protected by patents, and avail themselves of errors or variances in structure or description, not fatal to the result, for the purpose of annulling patent rights; or whether they shall look through the means to the end, as the real object of protection, and in their decisions secure the results to the inventor, if arrived at by any mode intelligibly described by him, especially if the process be new.

We confidently assert, that if this Court come up to the principles established by the highest courts in England, enough is *admitted* by our adversaries to entitle us to a decree in our favor.

A leading principle decided in England is, that when an inventor has by a new principle, or a new application of a known principle, power or substance, produced a new result, or an improved result, and has intelligibly described the manner in which he uses those means, they being of his own invention, and has patented his means, nobody can deprive him of the exclusive use of his new principle, or new application, or new result, by any improved or different means.

At page 11 of Mr. Chase's printed argument, he asks, "What Morse actually invented?" and he proceeds to reply, "*He invented the first practically useful* MARKING *Telegraph.*" "The evidence in this case," says he, "I freely admit must satisfy the Court, that though his patent and the practical application of his invention, were subsequent in date to some foreign patents and to the actual construction of some foreign telegraphs, still, his was the first practically useful marking telegraph. *For that telegraph, beyond a doubt, he was entitled to a patent.*"

It is also admitted, that Morse invented the means by which this new and useful result was accomplished. "Morse," says the learned counsel, "attached a marker to the armature of the magnet. He brought the paper and its revolving cylinder within the stroke of the marker. He adopted a contrivance for withdrawing the marker from contact with the paper at the instant of the cessation of the magnetic impulse. The combination of these contrivances, with the known means of operation from the distant station, enabled him to produce marks at a distance, &c."

Again: "It occurred to him [Morse] that the motion which previous discoverers and inventors had been able to produce by means of electro-magnetism, might be made to mark dots and horizontal lines. *A simple contrivance sufficed for this.*"

Though we by no means concede, that these admissions cover all of Morse's invention, or any considerable part of it, yet they cover enough to secure to him not only those means, but the new result obtained by their use. Having been the *first* to invent a *practically useful* marking Electro-magnetic Telepraph by *any* contrivances, however simple, which "occurred to him," or were by him invented, and which he has intelligibly described in his patent, he is entitled to the exclusive use of *marking* for telegraphic purposes by any mode in which Electro-Magnetism is the essential agent. There are in fact two distinct grounds on which his general claim rests.

First. He makes a new application of a known power to produce a useful result.

Secondly. He produces a useful result never before produced by any power.

But for one branch of our argument the two may be resolved into one,—*a new result produced by a new application of a known power*,—a result which our adversaries admit to be new, and produced by means of contrivances which they admit to be his.

There are many cases in the English books tending to establish the principle that an inventor, who has produced a new, result or a result in any degree useful by a new application of a known agent, may, by giving to the public an intelligible description of the means he uses, those means being of his own invention, secure to himself, through a patent for the means, an exclusive right to the new application and its result against interference by any other means. The leading case, and the only one it is necessary to present in any detail, is that of Neilson's Patent for what was called *the Hot Air Blast.*

Cold air injected by a bellows had previously been used to produce heat in furnaces employed in the production and manufacture of iron. Neilson perceived that a large portion of the heat generated in the furnace was absorbed in heating the cold air, and he conceived the idea that if the air could be heated before it went into the furnace, the heat of the furnace-fire absorbed in that process would be saved, by which means the furnace could be made much hotter. To carry out his idea, he constructed and patented a clumsy iron box placed between the blower and furnace through which the air must pass, and under the box he put a fire to heat the air in its transit.

His patent was denominated a patent "*for the improved application of air to produce heat in fires, forges, and furnaces where bellows or other blowing apparatus are required*," the only instrumentality described being the iron box with a fire under it between the blower and the furnace.

The discovery proved to be of vast public utility, and his mode of heating the air was greatly improved by various devices, among which was the substitution of iron pipes for his clumsy iron box. The parties who had substituted other modes for heating the air, maintained, as the appellants in this case do, that Neilson's patent was for *his mode of heating the air only*, and as they used different modes, they were not infringers.

Neilson on the other hand maintained, that being the first to conceive the idea, and having rendered it useful by *one* mode of his own invention, he was entitled to the exclusive right of using the hot blast by *all* modes during the existence of his patent. The opposing counsel in that case, as our adversaries do in this, insisted that the patentee was entitled only to the mode described in his patent, that a patent covering all modes would be a patent for a principle; and they were alert, as our adversaries are in this case, to point out how very little the patentee had invented. And little indeed it was in that case. The manufacture of iron was old; the furnace was old; the fuel was old; the blower was old; hot air was old; iron boxes were old;—not a single new thing was used by him—nothing equal to the "simplest contrivance" in Morse's Telegraph. He did nothing whatever in the way of invention, but to put a few old things together, and that not in a very satisfactory manner.

The reported litigation upon this patent occupies upwards of 150 pages in Webster's Reports of Patent Cases. It was contested with all the talents, zeal and perseverance which unlimited means could command: after appearing in various shapes in the English Courts, a case involving its validity and extent went by appeal from the Court of Sessions in Scotland up to the House of Lords.

A long, lucid, and most able charge was given to the jury by the Court below, to which exceptions were taken; and upon those exceptions, the case was taken up. To show distinctly that the House of Lords decided upon the question now at issue, we are obliged to quote somewhat extensively from this charge to the jury. In that address the learned Judge spoke as follows, viz.:

"It is quite true that a patent cannot be taken out solely for an abstract philosophical principle: for instance, for any law of nature, or any property of matter apart from any mode of turning it to account in the practical operations of manufacture, or to the business, and arts, and utilities of life. The mere discovery of such a principle is not an invention, in the patent-law sense of the term. Stating such a principle in a patent may be a promulgation of the principle, but it is no application of the principle to any practical purpose; and without that application of the principle to a practical object and end, and without the

application of it to human industry, or to the purposes of human enjoyment, a person cannot, in the abstract, appropriate a principle to himself. But a patent will be good, though the subject of the patent consists in the discovery of a great, general, and most comprehensive principle in science or law of nature, if that principle is by the specification applied to any special purpose, so as thereby to effectuate a practical result and benefit not previously attained.

"The main merit, the most important part of the invention, may consist in the conception of the original idea—in the discovery of the principle in science, or of the law of nature, stated in the patent, and little or no pains may have been taken in working out the best manner and mode of the application of the principle to the purpose set forth in the patent. But still, if the principle is stated to be applicable to any special purpose, so as to produce any result previously unknown in the way and for the objects described, the patent is good. It is no longer an abstract principle. It comes to be a principle turned to account, to a practical object, and applied to a special result. It becomes then not an abstract principle, which means a principle considered apart from any special purpose or practical operation, but the discovery and statement of a principle for a special purpose, that is, a practical invention, a mode of carrying a principle into effect. That such is the law, if a well-known principle is applied for the first time to produce a practical result for a special purpose, has never been disputed.

"It would be very strange and unjust to refuse the same legal effect, when the inventor has the additional merit of discovering the principle, as well as its application to a practical object. The instant that a principle, although discovered for the first time, is stated, in actual application to, and as the agent of, producing a certain specified effect, it is no longer an abstract principle; it is then clothed with the language of practical application, and receives the impress of tangible direction to the actual business of human life. Is it any objection then, in the next place, to such a patent, that terms descriptive of the application to a certain specified result, include every mode of applying the principle or agent so as to produce that specified result, although one mode may not be described more than another? Although one mode may be infinitely better than another, although much greater benefit would result from the application of the principle by one method, than by another—although one method may be much less expensive than another? Is it, I next inquire, an objection to the patent, that in its application of a new principle to a certain specified result, it includes every variety of mode of applying the principle according to the general state-

ment of the object and benefit to be attained? You will observe that the greater part of the defendant's case is truly directed to this objection. This is a question of law, and I must tell you distinctly, that this generality of claim, that is, for all modes of applying the principle to the purpose specified, according to, or within a general statement of the object to be attained, and of the use to be made of the agent to be so applied, is no objection whatever to the patent. That the application or the use of the agent for the purpose specified, may be carried out in a great variety of ways, only shows the beauty, and simplicity, and comprehensiveness of the invention. But the scientific and general utility of the proposed application of the principle, if directed to a specified purpose, is not an objection to its becoming the subject of a patent.

"That the proposed application may be very generally adopted in a great variety of ways, is the merit of the invention, not a legal objection to the patent."

* * * * * *

"I state to you the law to be, that you may obtain a patent for a mode of carrying a principle into effect; and if you suggest and discover, not only the principle, but suggest and invent how it may be applied to a practical result by mechanical contrivance and apparatus, and show that you are aware that no particular sort, or modification, or form of the apparatus is essential in order to obtain benefit from the principle, then you may take your patent for the mode of carrying it into effect, and are not under the necessity of describing and confining yourself to one form of apparatus. If that were necessary, you see what would be the result. Why that a patent could hardly ever be obtained for any mode of carrying a newly discovered principle into practical results, though the most valuable of all discoveries. For the best form and shape, or modification of apparatus, cannot, in matters of such vast range, and requiring observation on such a great scale, be attained at once; and so the thing would become known, and so the right lost, long before all the various kinds of apparatus could be tried. Hence you may generally claim the mode of carrying the principle into effect by mechanical contrivance, so that any sort of apparatus applied in the way stated, will, more or less, produce the benefit, and you are not tied down to any form."

* * * * * *

"I have to tell you in point of law, that under this patent not claiming any or the best contrivance for heating the air, and at the least expense and trouble, the result which actually followed, viz.: that persons in the trade and acting on the patent, contrived, from time to time, a great variety of contrivances more or less valuable or costly, and at last came to settle generally into

one form as better than others, was exactly the result which might be expected to follow under a patent of this general character, and that if the patent is good in law, then it gives no form of apparatus for heating air, but claims the contrivance generally, of heating the blast for the effect and end of producing heat in the furnace. The only point for you is, will any contrivance which heats the blast, produce that beneficial effect and end?"

The subject was fully discussed by counsel before the House of Lords, and by the Lords themselves, and that august tribunal, so far as appears, without a dissenting voice, decided the law to be as laid down in the foregoing extracts from the charge to the jury.

On that occasion Lord Campbell made the following remarks, viz.:

"The other exceptions, till we come to the 11th, turn upon the construction of the patent. Now in one stage of these proceedings, I certainly did entertain some doubt on that subject. But after the construction put upon it by the learned Judges of the Exchequer, sanctioned by the high authority of my noble and learned friend now upon the woolsack, when presiding in the Court of Chancery, I think the patent must be taken to extend to all machines, of whatever construction, whereby the air is heated intermediately between the blowing apparatus and the blast furnace. That being so, the learned Judge was perfectly justified in telling the jury, that it was unnecessary for them to compare one apparatus with another, because, confessedly, that system of conduit pipes was a mode of heating air by an intermediate vessel between the blowing apparatus and the blast furnace, and therefore it was an infraction of the patent."

Thus it was decided by the Courts of England and Scotland, including the House of Lords, substantially in the language of the exceptions, that the patentee being the discoverer of a new principle, and the inventor of means, however simple and imperfect, by which he has rendered it in *some* degree *useful*, may "*claim or maintain that his patent is one which applies to all varieties in the apparatus which may be employed in heating air while under blast*," and is "*not limited to a particular apparatus described in the specification*"—that it is "*in point of law no objection to the validity of such a patent that it included every mode of applying the principle or agent so as to produce the specified result, although one mode may not be described more than another, although one mode may be infinitely better than another, although much greater benefit would result from the application of the principle by one method, than another; although one method be much less expensive than another, and that this generality of claim, that is, for all modes of applying the principle to the purpose specified, according to, or within*

the general statement of the object to be obtained, and of the use to be made of the agent to be applied, is no objection whatever to the patent."

But it is distinctly laid down in the same case, that the patentee, if he wishes to enjoy his invention thus broadly, must take care in his specification not to confine himself to the single mode described by him; otherwise he will be confined to that mode. *Webster's Patent Cases*, pp. 679, 682, 688, 698, *Ex.* 6.

As well in the facts as in the law, there is a remarkable analogy between Neilson's patent for the hot air blast and Morse's patent for the Electro-Magnetic Telegraph. In Neilson's case, the *ultimate* result was the manufacture of iron which was old.

In Morse's case, the ultimate result was the telegraph communication of ideas from one mind to another, which was old.

In Neilson's case, the furnace, the fuel, the fire, the ore, the hot air, the blower, and iron boxes were old.

In Morse's case, the clockwork, the paper, dots and dashes, galvanic electricity, the battery, the circuit, the electro magnet, and the key were old.

Neilson put the old parts together in such manner as to heat the air in its transit, though he did not claim heating the air, without even a "simple contrivance" of his own invention.

Morse put the old parts together, by a port rule to regulate the pulsations of the electric current so as to make the dots and dashes of any desired length, by a contrivance to regulate the motion of the paper to receive them, by the pen or pencil in the first patent. to delineate them, and the pen-point and grooved roller in his second patent to indent them, and by combined and local circuits.

In Neilson's case, the clumsy iron box in his combination, which was *the only patentable part* of his invention, was immediately abandoned in practice, being superseded by coils of pipe in which the air could be heated to a higher degree of temperature; but in the case of Morse, it is his own invented forms and combinations *now in use* unimproved, which make his Telegraph.

True, his port rule, which forms *a part* of his invention, is not used, because, in common business, the end can be better attained without it; but this constituted a small part of his patentable invention.

Though the *whole* of Neilson's patentable invention was abandoned in practice, yet the British Courts of highest resort sustained his claim to the exclusive use of hot air applied to furnaces: And on what ground? On the ground, that *he was the first to devise and describe the means of applying the hot air*, no matter how bungling or imperfect those means were, if they were such as to make the application *to any degree useful.*

They decided that he was entitled to *the whole principle and effect*, because that was his real invention, and although it was

necessary for him to devise and describe *some* plan by which the object could be attained, when he had described *one* such mode, *it carried with it all modes.* They do indeed lay down one exception to this rule, dependent, however, on the patentee himself. It is where the patentee so frames his specification as to imply that he intends to confine himself to the mode described by him. In that event, he is entitled to nothing beyond that particular mode. Neilson avoided that restriction, by declaring in his specification, that the size and shape of the box in which the air was to be heated, and the manner of heating the air, were immaterial. Morse avoids it by directly declaring, after he has described his machinery, that he does not propose to confine himself to it, but claims all modes wherein the same application of power is employed to attain the same end, both the application and end being new. And the Court will not fail to remark, that such a declaration, or something equivalent to it, was absolutely necessary to bring Morse's invention within the protection of the law as laid down in Neilson's case.

With this exposition, we confidently submit, that, upon the *admissions* of our adversaries, that by a few simple contrivances of Morse's invention, described in his specification, he has produced "the first practically useful Electro-Magnetic *Marking* Telegraph," he is entitled to the protection of this Court against all other Electro-Magnetic *Marking* Telegraphs, whatever may be their form or modes of operation.

But our adversaries, while admitting facts sufficient to entitle us to protection under the law as laid down in Neilson's case, resolutely contest the law itself. They sing us the old song, with all its variations, that *principles*, *effects*, and *results* cannot be patented.

So, in the same sense, *machines* or *means* cannot be patented. An *abstract machine* is no more patentable, than an *abstract principle* or *result.* Go to the Patent Office with the most beautiful machine ever devised, seeming to perform evolutions more wonderful and sublime than those of the heavenly spheres, and tell them you want a patent for it. They will ask you the very commonplace question, "*of what use is your beautiful machine? What* USEFUL RESULT *do you accomplish by it?*" If you reply "I don't know, I have not yet studied that out," they will tell you "you *must* know,—you *must* not only study that out, but you *must give us an intelligible description of it* before we can give you a patent."

Go to the Patent Office, and tell them that you have discovered a *principle*, or achieved a *result*, more important to the wealth, comfort, and happiness of mankind than all discoveries and inventions which have been made from creation down to this day, and ask a patent for it. They will ask you *how you*

apply the principle so as to produce any useful result, or *how* you produce a result so astonishing? If you answer that you do not choose to tell, or have yet to study that out, they will tell you, that you must not only study it out, but give them an intelligible description of it, before they can give you a patent for it.

Every cause has its effect, and every effect its cause. Machines and their results, in the eye of the patent law, cannot be separated. They come into existence together, and march, *pari passu*, hand in hand. They are the body and the soul. Without the soul the body is dead, and protection would be useless; without the body, the soul needs no human protection. It is *body and soul united*, which need the protection of human laws, and it is only body and soul united that such laws are designed to protect.

In the beginning of invention, every *new machine* produced a *new result.* They formed the basis of all subsequent improvements. By the principles of justice as well as patent law, the first inventor was entitled to be protected *both in his machine and his result*, in the one as well as in the other, both being his property, the fruits of his mental and manual labor. The second inventor by *an improved machine* might produce an *improved result*, and would be entitled to protection for his improvement, and for his improvement only. It would be as unjust to let him deprive me of my result because he has improved it, as of my *machine* because he has improved that. He cannot build on my foundation without my leave; but having purchased my machine and results, he adds his improvements, and enjoys the whole together. The first inventor is entitled to the *whole* result; the second to his improvement upon it; so also the third, and so on. But gradations in results are not so easily distinguished as alterations in machinery, and as they both go together, the law attempts to define and protect an improvement in the result, through the improvement of machinery by which it is produced. When it speaks of a new and useful machine, it means a machine which produces a new and useful result; and when it speaks of a new and useful improvement, it means one that produces an improvement in the result. To understand the meaning of the law, we must look upon the machine and its result as *one*,—one in origin, one in object, and one in the eye of the law.

But our adversaries, like multitudes of others, separate machines from their results, and seem to think the former the only objects which the patent laws are designed to protect. We hold, on the contrary, that the ultimate object of the patent laws is, *the protection of results*, and so far as they are applicable to the protection of machines, the object is to *protect the result through*

protection of the machine. Of what use is protection of the machine, if the result be not protected? Of what value is the machine to the patentee, or the public, except for the results it produces?

We need not tell this Court, that patents in England were originally for new results, "new manufactures"—without regard to the manner in which they were produced. No specification of means or machinery was required. The fact that a man produced a useful result, was all that was required; and for the result only the patent was granted. This patent protected him against any person who should produce the same result by any means whatsoever.

What was the object of the specification afterwards required? Not, certainly, to enable others to deprive the patentee of his result by improving upon his means or substituting others; but simply to enable others to understand how he arrived at that result, that the public might have the full benefit of it after the expiration of his exclusive right. The first expedient resorted to for the purpose of enabling the public to avail itself of the invention after the patent had expired, was to require the patentee to instruct a certain number of apprentices in his art and mystery, who might go out and teach it to others. This was made a condition on which the exclusive use was guaranteed by a patent. This gave place to the written specification, which was an improved mode of arriving at the same end.

There is a contract between the inventor and the public. The inventor says, I have accomplished an object never before accomplished, I have produced a result—"a new manufacture" —never before produced, of vast public utility. The government says to him, if you will make known the means by which you attain that end, so that the public will have the benefit of it after your patent expires, we will secure to you all the benefits of your result for fourteen years. The bargain is struck. The inventor reveals his secret; the government gives him a solemn contract of protection; and then, nine times out of ten, suffers him to be plundered, if not ruined, by the uses made of the very secret he discloses!

Morse comes to the government with his ribbon of paper, imprinted with letters Roman, Greek, Hebrew or *Morsaic,* and says, I have produced this new and astounding result instantaneously, standing a thousand miles distant from the printing apparatus, and I ask a patent for it. A patent under the old English law would have given him the exclusive benefit of his result for the patent term; but the government says to him, "You must inform the public how you do this wonderful thing, and then we will give you a patent securing to you the exclusive use of it for fourteen years." Morse says, "If I inform the

public how I do it, you will let others, who perchance get their notions from my description, come in by some improvements, real or pretended, and take from me all the benefits of my invention." The government assures him that the only object and legal effect of his description will be to enable the public to use his art after his patent expires. How far that assurance has been verified is shown by the open use of his invention on thousands of miles of line, in bold defiance of his patented rights.

It takes a long time to change the current of the public mind when it becomes concentrated in one deep channel, however devious from the line of right. You might as well attempt to make the Mississippi run straight by throwing pebbles into its curves, as to think by one or a hundred arguments to overcome unjust prejudices and opinions impressed on the public mind by the precedents of ages. In no portion of human affairs is this fact so conspicuous as in the profession of law, wherein most judges believe it their duty to think just as their predecessors did, and it is the pride of the lawyer that he is able to array a consecutive file of precedents extending back to black-letter age, since which a trifling error then originating, has, by the natural effect of adding precedent, accumulated like the rolling snow-ball, until it has become an enormous wrong.

We need not enter into a history of the English patent laws, which are the ancestors of our own. It is sufficient to say, that the granting of patents for new inventions and for monopolies in trade and manufactures were in ancient times a royal prerogative in England, and there was no recognized distinction between patents for old things and for new. The royal prerogative was so enormously abused as to create a general abhorrence of patents of every sort, and the judges of England sought every pretext for declaring them void. At length they were all swept away, with a few exceptions, by an act of Parliament, and the prerogative of the king was limited to grants of exclusive privileges for limited terms to those only who devised or introduced some new manufacture, useful to trade, and beneficial to the public.

But the current of the judicial mind in England had long been running against all patents, and could not be suddenly changed. It still set against patents for new inventions, as it had done against the old monopolies; and when the specification was introduced, it was immediately perverted from its true object, and used as a means of destroying a right, the protection of which was the sole object of the inventor in making it public. Even now, though a great change has been wrought in the judicial mind of England and America, the odium of the old monopolies in some degree attaches to patents, and something in-

cluded in the specification which ought to have been omitted, or something omitted which ought to have been included, though that instrument enables everybody distinctly to understand the invention, and how to use it, is seized upon as a pretext for annulling the grant altogether.

These are hard cases. The man's invention is his own; the government buys it of him for a price, and on a condition. He complies with the condition as well as he knows how, and under the instructions of officers of the government itself, appointed to advise and correct him if there be anything wrong in his papers. But some error is discovered by an astute lawyer in the specification, an error never thought of by him, nor suspected in the Patent Office, and his patent is declared void. The protection of the government is withdrawn from his invention, but his property is not restored. It is gone for ever, not from any fault of his, but because two public authorities, one in the Patent Office, the other in the courts, differ in opinion upon some point of his specification.

We trust the day is passed when pretexts were sought to get rid of these contracts between government and citizen. Morse comes and exhibits the result of his invention—*the printing of telegraphic characters at any distances.* All he asks is, that protection which the law would give him if no specification of means had ever been required. It is just that, and nothing more, which he has attempted to secure through his specification. It is just that, and nothing less, which his government has promised him. It is protection for *his art*—his *embodied* art, and our adversaries admit that "without doubt" such "an art can be patented,—the statute says so expressly."

Art. II.—GEOGRAPHY OF THE ATLANTIC OCEAN.*

THE WINDS AND THE CURRENTS—TIDES AND THE SEAS—DEPTH OF THE OCEAN—OCEAN TELEGRAPH PRACTICABLE.

THE time is probably not far distant when the popular will, no less than the enlightened good sense of the statesmen of the country, will settle practically how far the government of the Union may be permitted "to provide for the general welfare," by the encouragement of science. Custom in such matters, whence no further usurpations can possibly arise, becomes almost as authoritative as a constitutional sanction; and unless we greatly misapprehend the character of the American people, few will be disposed to blame herein a leaning to the liberal

* From De Bow's Review.

side. The temptation to aid the national genius in the acquisition of those unfading laurels, awarded by universal consent to the successful discoverer of what is truly great and widely useful in these fields, might tempt the most rigid constructionist to relax here his rules, and admit, if possible, an exception to his political creed. The fame of one illustrious philosopher, one of the founders of American independence, is already blended with the history of human thought as well as political enfranchisement; and whether the spirit in which he pursued knowledge, or the magnitude of his additions to the common stock, are considered, it must be admitted that his example still modifies all legitimate inquiry into the august secrets of nature. The era of Franklin was but the dawn of modern science. The laws, the modifications, and the analogies of light, heat, chemical affinities, and electricity, in its Protæan forms, were then just emerging to human ken. The stone tables, on which, as on the leaves of a book, the earth's history are imprinted, were at that time united by unbroken seals. Observation had not yet accumulated a mass of records, nor been sufficiently extended to trace the varying intensities of the great powers of nature over the surface of the earth, and thus create a true philosophic geography. It is worthy of mention, that one of the most important features of our planet was pointed out by the great Franklin, and that he traced that portion of the ocean stream which rushes past our shores, and bestows on Western Europe its genial and temperate climate, its fertilizing showers, and abundant harvests. Since that period there have been travellers like Humboldt and Von Buch, who have measured mountains and gauged streams, watched the fires of the volcano, and explored the causes of those powers that sweep the surface or shake the depths of the earth. Every year the number of observers is increased; the circle of stations at which these investigations are prosecuted is continually widening; while commerce, allured by the promises of greater and more certain gains, bids fair soon to be pressed into the zealous service of science. Physical geography, the most attractive of the departments of the study of Nature, embracing the view and discussion of her phenomena on the widest field that man can grasp, by the aid of all the senses, and presenting subjects at once uniting the enjoyments of the imagination and the reason, and gratifying the passion for knowledge and the desire of profit, is now for the first time possible. The various *meters*, the delicate instruments of modern research, the product and realization in art of scientific progress, are now in the hands of every traveller. He reads off their scales the temperature of the air, the earth, and the ocean, the heights of mountains, the quantity of moisture contained in the air, and many similar relations are by their

means accurately ascertained and measured, at every point whither man can penetrate. Governments have rivalled each other in fitting out expeditions for research and exploration; and if the cultivation of the sciences under the direct patronage of our own, notwithstanding such precedents, be questioned, as on another long vexed subject, we may suppose that the popular voice will incline to advance this cause, whenever it can be done in an incidental way.

The valuable volume of "Sailing Directions, by Lieutenant Maury," is but among the first fruits of what we may reasonably expect from the patriotic and liberal character of the officers of the navy and army. The younger officers are now, as a class, admirably qualified, by their tastes and education, to second any system of scientific observation that may be adopted by the national authority. The Coast Survey and the Naval Observatory were the first steps made in this direction by the government, and they have already well repaid all that has been laid out in their maintenance and prosecution. The equipment and *materiel* of the Washington Observatory may be inferior to the imperial endowments of Pultowa or Greenwich, but the genius and untiring industry of its superintendent have already given it a world-wide celebrity. When the exacting and ceaseless duties of his station are considered, it is astonishing how he should have accomplished so much for the geography of commerce and navigation, as may be inferred from the articles in the "Sailing Directions," or when he found time for the arrangement and tabulation of the observations contained in thousands of log-books, the results of which gigantic labor we find in the same volume. We propose to look at what has been thus accomplished by Lieutenant Maury for commercial geography, under three heads: first, the establishment of a regular system of observation, to be carried out by the various national and commercial marines of the world; second, the contributions already made to science by the materials collected under the direction, and arranged by the author; and third, the practical rules and directions which are therein laid down for the guidance of the navigator, with the results already obtained by following them.

These undertakings have received the sanction of the most distinguished physicists of the age, among them the illustrious Humboldt, who, in writing to a friend, (Dr. Flûgal, U. S. Consul at Leipzic,) says,—

"I beg you to express to Lieut. Maury, the author of the beautiful charts of the winds and currents, prepared with so much care and profound learning, my hearty gratitude and esteem. It is a great undertaking, equally important to the practical navigator, and for the advance of meteorology in general. It has been viewed in this light in Germany, by all

persons who have a taste for physical geography. In an analogous way, anything of isothermal countries (countries of equal annual thermal temperature) has, for the first time, become really fruitful. Since Dove has taught us the isotherms of the several months chiefly on the land—since two-thirds of the atmosphere rest upon the sea—Maury's work is so much the more welcome and valuable; because it includes at the same time the oceanic currents, the course of the winds, and the temperature."

It is comparatively easy to map out the course of rivers over the land, and follow them from the glacier of the mountains to the ocean estuary, through their channels. This is but the visible half of the ceaseless circle which the waters make over the land. A far more difficult task it is to track the viewless winds, and weigh the watery freights they carry from the ocean, and lay down so lowly and gradually in the fog, the dew, the shower, and the noiseless snow; or to pursue the oceanic currents that feed these thefts of the winds, and map out their path—

Parietibus textum cæcis iter.

The solution of the grand problems of physical science connected with navigation do not rest there; they overflow to other branches of human labor and interest. Agriculture, and the health and happiness of mankind, are blended with the course of the winds and the distribution of heat and moisture. The farmer, as well as the mariner, looks up and watches the appearance of the heavens; and plentiful crops and prosperous voyages equally depend on the agencies which set in motion the winds, and uplift the clouds from the ocean. The beauty and impressiveness of these signs, in which Nature addresses Man, render them worthy of the poet. Happy he who can read them aright.

THE LANGUAGE OF NATURE.—"The wind and rain, the vapor and the cloud, the tide, the current, the saltness, and depth, and temperature, and color of the sea, the shade of the sky, the temperature of the air, the tint and shape of the clouds, the height of the tree on the shore, the size of the leaves, the brilliancy of the flowers—each and all may be regarded as the exponent of certain physical combinations, and therefore, as the expression in which Nature chooses to announce her own meaning; or, if we please, as the language in which she writes down the operation of her own laws. To understand that language, and to interpret aright those laws, is the object of the undertaking which those who co-operate with me have in hand. No fact gathered in such a field as this, therefore, can come amiss to those who tread the walks of inductive philosophy; for in the

hand-book of Nature, every such fact is a syllable; and it is by patiently collecting fact after fact, and by joining together syllable after syllable, that we may finally seek to read aright from the great volume, which the mariner at sea, and the philosopher on the mountain, see spread out before them.

Among the friends and collaborators of Lieut. Maury may be mentioned Dr. Buist, a distinguished *savant* of India, who announces in the Transactions of the Bombay Geographical Society, that the Assistant-Secretary, Mr. Macfarlane, "has made considerable progress in the construction of wind and current charts, founded on the information supplied by ships' logs, and on the principle of Lieut. Maury." What has been done for the Indian and the Northern Atlantic Ocean reveals the value of concert of observation among the navigators and meteorologists of the world. In a letter to Lieut. Maury, dated 17th November, 1851, Dr. Buist, after alluding to a vast mass of facts collected by observers in the Indian seas, observes:—

"Three years since, I began to perceive that we had certain classes of storms that occurred periodically, not only all over India, but all over the region to which my information extended, and that these were synchronous, or nearly so. I then began a series of maps, illustrative of the matter."

A system of stations and the co-operation of navigators is naturally suggested by what has already been done. It must be seen that a true science of meteorology is impossible from local observations. We may watch the height of the barometer, and record the amount of moisture in the air, set rain gauges for ever, and yet be merely accumulating facts that in themselves have no significance. The relations of the river, the rain, and the ocean, are not local; they belong to universal geography, and are, literally,

"General, as the casing air,"

the atmosphere which forms the invisible link in the mighty orbit of the waters about the earth. Nature herself seems here to refuse to be evoked by the efforts of the individual mind, and demands for the revelation of her secrets to be everywhere watched.

Towards the end of the year 1851, the idea of a conference between the meteorologists of Russia and those of the United States was suggested by Kupffer, a laborious meteorologist of the former country; and about the same time a proposition was made by the British Government that that of the United States should co-operate in making these observations at certain foreign stations, and according to instructions prepared by General Burgoyne, Inspector-General of Fortifications. This was felt to

be an auspicious moment to secure concert of action among meteorologists on shore, and co-operation among navigators at sea everywhere; and Lieut. Maury then, in reply to the British proposition, suggested that sea and land should be included as the field, and that a general conference of meteorologists and navigators should be held to discuss the plans, draw up the forms, fix the standards, and select the instruments to be employed on this grand field of research.

A UNIVERSAL SYSTEM OF OBSERVATIONS.—The basis originally proposed by the British Government to that of the United States, is contained in the instructions drawn up by order of the Inspector-General of Fortifications, Sir John Burgoyne, the circular letter of Lord Palmerston to British consuls, and that of Lord Glenelg to Colonial Governors. Nineteen principal stations in the colonies of Great Britain were selected as the points of regular record. These were to be supplied with sets of instruments of similar construction. Twenty sets were to be sent to India, by the Board of Directors of the East India Company, and provision made of the same character for observations at Ascension, Rio de Janeiro, Callao and Valparaiso.

The circular addressed to the officers of the government of India, desires them—

"Upon the occurrence of any hurricane, gale, or other storm of more violence than usual, to note accurately the time of its commencement, the direction from which the wind first blows, whether in gusts or regular, and whether accompanied with rain, thunder and lightning, or other phenomena. Also, to note, with as much accuracy as possible, the changes of direction in the wind, and the time of occurrence of each; and lastly, the duration of the gale, and in what quarter the wind is when it ceases. The variations of the thermometer and barometer at each period noticed will also be of importance, if the means are forthcoming of making such observations."

On the transmission of these instructions to the United States government for the purpose of securing its co-operation in the plan, Lieut. Maury brought forward as an amendment a system of universal observation on sea as well as on land, and securing the assistance of the commercial marines of the civilized nations of the earth in carrying out its details. We copy the following from the paper of Lieut. Maury on this subject:—

"The importance of concert among meteorologists all over the world, and of co-operation between the observer on the shore and the navigator at sea, so that any meteorological phenomenon may be traced throughout its cycle both by sea and land, is too obvious for illustration, too palpable to be made plainer by argument; and, therefore, the proposition for a general conference to arrange the details of such a comprehensive

system of observations, addresses itself to every friend of science and lover of the useful in all countries.

"The domain of this science of the atmosphere: its boundaries embrace the land and cover the sea. To comprehend the laws which govern the movements of a machine so vast as it is, requires that its operations should be observed in all its parts and watched from all points at the same time. Its motions are freer and less obstructed over the water, than they are by the land and across the mountains. Indeed, the ocean itself may, in one sense, be regarded as a grand expression of meteorological agencies; therefore the good-will and friendly co-operation of private ship-owners and masters, in all maritime countries, are considered of great importance to the cause in hand."

The proposition for a universal system of observation, as suggested by Lieutenant Maury, was soon after submitted to the Royal Society, and, so far as an extension of these to the sea is concerned, it received a warm approval. The report adopted by the society recommends that instructions similar to those given to American shipmasters, according to the scheme submitted by Lieutenant Maury to the Bureau of Ordnance and Hydrography in 1842, be given "to every ship that sails" from British ports, with a request to transmit the results of them to the Hydrographer's Office of the Admiralty. The labors of the two greatest naval and commercial nations of the world, it is hoped, may be thus united in promoting the interest of navigation.

The additions that have been made to geographical science since American shipmasters have been engaged, under the guidance of Lieutenant Maury, in the business of watching and recording the course of the winds, the clouds, and the currents, have not been few or unimportant. The power of such discoveries in changing the course of trade is well illustrated by the influence of the Gulf Stream on the trade of Charleston. During the colonial times, the course of trade was to make that port the half-way house for vessels bound from England to the northern ports. If driven off the coast during the winter by gales and snow-storms, they returned to Charleston, and there remained until spring. When Dr. Franklin taught the mariner to know when he crossed the banks of this ocean river, by dipping a thermometer into the water, it was, to use the graphic words of the navigators, as if blue and red lines were drawn on the ocean. This discovery shortened the passage to the west from sixty to thirty days. It changed the course of trade. Vessels, instead of running to Charleston to avoid a snow-storm, now stood off for a few hours, thawed out the ship and her crew in the warmth of the Gulf, and were ready for another attempt to make their port.

The view of the general circulation in the atmosphere, as traced by the investigations of Lieutenant Maury, is of the highest interest. The trade winds of the tropical seas have long been known, and form two links in the circuit of the winds around the earth. The ocean scenery of the region of the trades is among the most beautiful to the thoughts and the senses that can be conceived. The machinery of nature aiding so palpably the objects of man, and uniting lands divided so widely by the ocean; the canopy of flying clouds; the fresh and exhilarating breeze blowing day and night in one direction; the charming temperature and the moderate swell of the waves, make it the elysium of the mariner. The gentle spirit of the earth seems to be there bodily present; and the picture of a fleet hanging in the clouds, always an impressive object, becomes exquisitely poetic in its associations, when—

> They on the trading flood,
> Through the wide Ethiopian to the Cape,
> Ply stemming nightly towards the pole.

These trade winds are the great evaporating winds of the ocean; and, as we learn from the investigations of Lieutenant Maury, the belt of the S. E. trades in the South Atlantic is not only more extensive than the N. E. trades in the South Atlantic, but the winds themselves are fresher in the south. The very natural conclusion is, that the increased water thus taken up goes to feed in part the rivers of the northern hemisphere. At the equator these surface winds meet, and form a belt of calms, a node of upward winds, the northeast trade wind becoming a northwest upper current, and the southeast trade a southwest wind in the upper regions of the atmosphere overlying the north torrid zone. At the tropics, two other nodes of calms and of downward currents are met, with the two descending nodes of the orbit of the winds. The prevailing surface winds should now blow in spirals from the southwest towards the north pole, and in similar spirals from the northwest towards the south pole. At the poles the upward current produces another region of calms, whence the wind begins from north and south other revolutions towards the equator. And this system of winds is the source of

THE RAINS.—"To evaporate water enough annually from the ocean to cover the earth, on the average, five feet deep, with rain; to transport it from one zone to another, and to precipitate it in the right places, at suitable times, and in the proportions due, is the office of the grand atmospherical machine. This water is evaporated principally from the torrid zone. Supposing it all to come thence, we shall have, encircling the earth, a belt of ocean 3,000 miles in breadth, from which this atmosphere

evaporates a layer of water annually 16 feet in depth. And to hoist up as high as the clouds, and lower down again, all the water in a lake 16 feet deep, and 3,000 miles broad, and 24,000 long, is the yearly business of this invisible machinery. What a powerful engine is the atmosphere!

"In some parts of the earth the precipitation is greater than the evaporation; thus, the amount of water borne down by every river that runs into the sea may be considered as the excess of the precipitation over the evaporation that takes place in the valley drained by that river. In other parts of the earth the evaporation and precipitation are exactly equal, as in those inland basins such as that in which the city of Mexico, Lake Titicaca, the Caspian Sea, etc., etc., are situated; which basins have no ocean drainage. If more rain fell in the valley of the Caspian than is evaporated from it, that sea would finally get full and overflow the whole of that great basin. If less fell than is evaporated from it again, then that sea, in the course of time, would dry up, and plants and animals would all perish there for the want of water. In the sheets of water which we find distributed over that and every other inhabitable inland basin, we see reservoirs or evaporating surfaces just sufficient for the supply of that degree of moisture which is best adapted to the well-being of the plants and animals that people such basins. In other parts of the earth still, we find places, as the Desert of Sahara, in which neither evaporation nor precipitation takes place, and in which we find neither plant nor animal.

"In contemplating the system of terrestrial adaptations, these researches have taught me to regard the great deserts of the earth as the astronomer does the counterpoises to his telescope —though they be mere dead weights, they are, nevertheless, necessary to make the balance complete, the adjustments of this machine perfect. These counterpoises give ease to the motions, stability to the performance, and accuracy to the workings of the instrument. They are *compensations*."

A strong corroboration of the hypothesis that the south-eastern trades are deflected into the upper regions of the atmosphere, is the fact that the occasional showers of dust to be met with in the Atlantic not far from the belt of calms of Cancer, and in the neighborhood of the Cape de Verd Islands, and sometimes extending to the northern coasts of the Mediterranean, contain the remains of infusoria, whose habitat is not Africa, but South America, and the southeast trade-wind region of South America. These remains cause the red fogs and sea-dust of the North Atlantic, the Cape de Verd Islands, and the dust-winds of Southwestern Europe.

THE EQUATORIAL CLOUD-RING.—The graphic essay on the above subject, by Lieut. Maury, is well known; it forms part of

his theory of the circulation of the atmosphere, and the following is his explanation of its formation:—

"In a clear day at the equator, this cloud-ring having slid to the north or south with the calm belt, the rays of the sun pour down upon the crust of the earth, and raise its temperature to a scorching heat. The atmosphere dances above it, and the air is seen trembling in ascending and descending columns with busy eagerness to conduct the heat off, and deliver it to the regions aloft, where it is required to give momentum to the air in its general channels of circulation. The dry season continues; the sun is vertical; and, finally, the earth becomes parched and dry; the heat accumulates faster than the air can carry it away; the plants begin to wither, and the animals to perish. Then comes the mitigating cloud-ring. The burning rays of the sun are intercepted by it. The place for the absorption and reflection, and the delivery to the atmosphere of the solar heat, is changed; it is transferred from the upper surface of the earth to the upper surface of the clouds.

"Radiation from the land and the sea below the cloud-belt is thus interrupted, and the excess of heat in the earth is delivered to the air, and by absorption carried up to the clouds, and there delivered to their vapors to prevent excess of precipitation.

"In the mean time, the trade-winds north and south are pouring into this cloud-covered receiver, as the calm and rain-belt of the equator may be called, fresh supplies in the shape of ceaseless volumes of heated air loaded to saturation with vapor, which has to rise above and get clear of the clouds before it can commence the process of cooling by radiation. In the mean time, also, the vapors which the trade-winds bring from the north and the south, expanding and growing cooler as they ascend, are being condensed on the lower side of the cloud stratum, and their latent heat is set free to check precipitation and prevent a flood.

"While this process and these operations are going on on the nether side of the cloud-ring, one not less important is going on on the upper side. There, from sunrise to sunset, the rays of the sun are pouring down without intermission. Every day, and all day long, they operate with ceaseless activity upon the upper surface of the cloud stratum. When they become too powerful, and convey more heat to the cloud vapors than the cloud vapors can reflect and give off to the air above them, then, with a beautiful elasticity of character, the clouds absorb the surplus heat. They melt away, become invisible, and retain, in a latent and harmless state, until it is wanted at some other place and on some other occasion, the heat thus imparted."

THE GEOLOGICAL AGENCY OF THE WINDS.—The geological relations between the wind, the land, and the water, are shown

to have an intimate connection with the fertility and habitable quality of each region. The largest portion of the surface swept by the southeastern trades is water; but those regions which lie to the northeast of South America and Africa, in the northern hemisphere, are deserts, and were it not for the inland seas of Europe and Asia, these regions would be still more extensive. In like manner, Australia occupies in the southern hemisphere a position opposite to the continent of Asia, and, being swept by winds borne over a vast extent of land, while in contact with the surface, is found to be mostly a desert. If this contental mass were removed so as to occupy the space in the South Pacific swept by the southeast trades, which blow as southwest winds over the basins of the great rivers and lakes of North America, the channel of the Mississippi would resemble that of the Australian rivers, and present a dry and dusty trough in the midst of a desert, the great lakes would be drained, and Niagara no longer resound with the whirl of its world of waters. If ever there was a time when the Andes and the Continent of South America were submerged, then the ancient winds that fell on the region of Central Asia, and the basins of the Caspian and Aral, were swelled with the waters that now are discharged, in part, by the Amazon and Orinoco into the ocean, and those seas were united, forming a Mediterranean of vast extent, and probably discharging its waters by an estuary more magnificent than the St. Lawrence. According to the circulatory scheme of the atmosphere, the winds that play over the torrid zone of one hemisphere become the surface winds of the temperate zone of the other hemisphere. Fill up the south torrid zone, the region of the southeast trades, with land, and the north temperate zone would become one vast Sahara. Such, in brief, is the aspect of the dry season in the geological cycle, happily not co-existing with man's possession of the planet.

"The Saltness of the Sea" is the title of another of the series of interesting papers contained in the present volume. We are unable to do more than to state that it is to this quality, in connection with the evaporation caused by heat and the passage of the winds over the water, that the currents of the ocean owe their extent and depth. By these agencies, a general circulation of the waters of the sea is maintained; and so complete is it, that the per centage of its salt is found to be nearly the same in every part of the globe.

Following the discussion of a general circulation of the waters through the entire ocean, is the argument so intimately connected with it, and now so deeply interesting both to philanthropy and science, that a permanently open sea exists in the Arctic basin. The study of the currents of the ocean have led Lieut. Maury strongly to the conclusion, that the pole is sur-

rounded by this sea instead of being piled by everlasting barriers of thick-ribbed ice. The report of Lieut. De Haven, the commander of the Grinnell Expedition, the first of the noble enterprises set on foot from the United States to aid in the discovery and rescue of the lost ships of Sir John Franklin, follows; and in the midst of the dangers of the dreary cruise during the long nights of those two polar winters, a ray of hope, faint though it be, hangs over the track of the intrepid Kane, who has dared again the perils of the Arctic Sea, at the joint command of humanity and national glory.

DEEP SEA SOUNDINGS.—To determine the depth of the ocean, and approximately the outline of its abysses and shallows, will furnish data of the utmost value in completing the theory of the tides. We believe that American officers have been the foremost, and, with a few exceptions, the only investigators in this problem. Already they have contributed enough to make out a chart of the bottom of the Atlantic, which gives a general idea of the slopes and hollows of that ocean valley, and its transverse branches, the Caribbean Sea and the Gulf of Mexico. The first cruise of the "Fanny," the schooner dispatched on this service of making these explorations, cleared up all doubts as to the non-existence of certain fancied rocks and shoals which had been long enough bugbears to navigators. The following is the list of rocks found to be purely imaginary during the cruise:

	Latitude North.	Longitude West.
Ashton Rock	33° 50′	71° 40′
False Bermudas	32 30	58 40
Nye's Rock	31 15	55 50
Van Keulen's Vigia	31 40	38 20
Joryna Rock	31 40	23 45
Steen Ground	32 30	21 15
Mary's Rock	19 45	20 45

Lieut. Berryman, in the United States brig "Dolphin," reports, in 1853, that nothing has been found at the places indicated:

	Latitude North.	Longitude West.
Eight Stones	34° 22′	16° 40′
Jean Hammond's Rock	36 56	19 50
Haugault's Rock	40 58	48 40
Daraile's Rock	40 52	54 42
Haugault's Breakers	41 7	49 23
35 Fathom Shoal	42 32	45 17
—— Rock	30 50	27 19

At some of these localities soundings were taken, with depths of from 2,200 to 4,600 fathoms. The greatest depth sounded in the Taney was in latitude 31° 59′ north, long. 58° 43′ west, on the 15th November, 1849, when 5,700 fathoms of wire were let out without reaching the bottom. The form of the deepest portion of the North Atlantic is that of a *y*, lying northwest and southeast,

the two divisions being in the former direction, and stretching from 20° to 40° north latitude, and from 40° to 60° west long. Just on the verge of one of the divisions of the *y*, the Bermudas rise from the sea, forming apparently a peak mostly submerged, of nearly six miles in height. The *y* form is preserved in the next higher shelf of the bottom, only the tail is prolonged, forming a long trough between the two continents of South America and Africa. Two lines of soundings have recently been run across the Atlantic by Lieut. Berryman, in the Dolphin; they confirm the supposition, that the depth of the North Atlantic is nowhere greater than 5,000 fathoms. No little practical difficulty is experienced in sounding these depths, and the best check, in fact it is indispensable, to observe the rate at which the wire or twine is delivered from the reel. Without this precaution, currents and counter-currents may operate on the line long after the plummet is on the bottom. The following is a series of deep sea soundings recently made from the brig Dolphin, Lieut. O. H. Berryman, and extracted from a letter of our author. It will be seen that it exhibits the profile of two lines carried across the North Atlantic.

DEPTHS OF THE OCEAN.

Date.	Lat. N. D. M. S.	Long. W. D. M. S.	Depth in Fathoms.	
Oct. 4, 1852	39 39 00	70 30 00	1,000	no bottom.
" 7, "	41 12 00	62 38 00	2,200	bottom.
" 9, "	41 40 00	59 23 00	2,600	"
" 10, "	41 40 00	56 01 00	2,595	"
" 11, "	40 36 00	54 18 30	3,450	"
" 20, "	41 07 00	49 23 15	4,580	"
" 24, "	43 40 00	42 55 00	2,700	"
" 25, "	44 41 07	40 16 00	1,800	"
" 26, "	33 08 00	16 10 00	2,950	no bottom.
Jan. 3, 1853	34 15 00	16 45 00	2,298	bottom.
" 9, "	36 49 00	19 53 45	2,950	"
" 9, "	36 59 00	19 58 00	2,500	"
" 29, "	30 49 00	27 25 00	2,200	no bottom.
" 30, "	30 45 00	27 31 00	2,480	bottom.
Feb. 3, "	27 05 00	28 20 26	1,700	"
" 4, "	29 21 00	30 48 00	2,580	"
" 5, "	31 17 00	33 08 00	2,400	"
" 6, "	28 55 00	35 49 00	1,800	no bottom.
" 8, "	29 13 30	41 20 50	2,270	bottom.
" 9, "	31 16 00	43 28 00	2,089	"
" 10, "	33 01 00	44 31 00	2,250	"
" 11, "	32 29 00	47 02 00	1,950	no bottom.
" 12, "	32 55 00	47 58 00	6,600	doubtful.
" 13, "	33 03 00	48 36 00	3,550	bottom.
" 15, "	32 47 00	50 00 00	3,240	no bottom.
" 20, "	28 59 00	57 51 00	1,380	bottom.
" 22, "	28 20 00	59 44 00	2,900	doubtful.
" 23, "	28 04 00	61 44 00	3,000	bottom.
" 24, "	28 23 00	64 17 00	2,518	"
" 25, "	27 42 36	66 11 15	1,000	no bottom.
" 26, "	26 49 00	66 54 00	2,720	bottom.
" 28, "	28 16 00	69 24 00	2,950	"

THE CHARTS.—A series of charts has been compiled from the observations made by the numerous intelligent navigators engaged in the scientific enterprise set on foot by Lieut. Maury. The pilot chart is derived from these results. The ocean is divided into square districts, of five degrees in length on each side. The winds for each month in each district are then collated, and it is hence easy, knowing the prevailing set of the winds for each month, to decide upon the probability of finding in each district a favorable wind. The problem then assimilates to that of the engineer who is called on to make detours to avoid mountain masses in fixing on the best line for a road on land.

The thermal charts are of no little scientific import, and from them we learn the office of the ocean in ameliorating the climates of the earth.

The chart of the trade-winds embodies the results of the observations made on these winds. One remarkable discovery has been made, and it is that the southeast trade region is wider than that of the northeastern trade in both oceans. The average line of division is about 9° north of the equator.

OCEAN TELEGRAPH.—The soundings reported in the preeeding table establishes, beyond doubt, the practicability of laying a submarine electric cable on the bottom of the ocean.—ED.

THE ELECTRIC TELEGRAPH.

SPEAK the word and think the thought,
Quick 'tis as with lightning caught,
Over—under—lands or seas,
To the far Antipodes.

Now o'er cities throng'd with men,
Forest now or lonely glen;
Now where busy Commerce broods,
Now in wildest solitudes;
Now where Christian temples stand,
Now afar in Pagan land!

Here again as soon as gone,
Making all the earth as one.
Boston speaks at twelve o'clock,
St. Louis reads ere noon the shock:
Seems it not a feat sublime—
Intellect hath conquer'd Time!
Sing who will of Orphean lyre,
Ours the wonder-working wire!

Art. III.—SUBTERRANEAN TELEGRAPH,

AS COMPARED WITH WIRES IN THE AIR.

Owing to the difficulties experienced in working wires on poles, or in the air, on account of atmospheric electricity, the minds of many are, at present, fixed upon a thousand plans to remedy the evils, and among these diversified speculations is a subterranean telegraph. At present we are disposed to say but little upon the subject, having serious objections to any and all modes proposed; and as to that which is surrounded with the least evil, we are unable to determine, except upon questionable theories.

An English writer thus refers to the subject, although we believe there are some subterranean telegraphs in France:—

"It may be said that much of the alleged damage likely to ensue from the action of natural currents of electricity passing through the atmosphere, would be obviated by the use of wires buried in the earth; but when it is found in the case of even a single line of telegraph in Prussia, that more than one hundred miles of wire which were buried in the earth—owing to their defective insulation, and the difficulty experienced, and the time occupied in detecting the exact position of those defects, and in remedying them when discovered—have been abandoned, and the wires suspended on posts in their stead, the employment of subterranean wires for the sake *merely* of lessening the effects of atmospheric electricity cannot be recommended.

"And again, when we call to mind the great additional expense that must be incurred at the first outset, and the great difficulty and expense that must be encountered afterwards in submerging *additional wires*, when the increasing wants of trade demand such additions, it would appear unwise, in the present unsatisfactory evidence on the subject, to pursue very extensively the plan of burying the wires in the earth, in preference to their suspension in the air, unless money were of little or no importance, and the best possible insulation was demanded, whatever might be the cost."

We may be too fastidious in our views as to the practicability of a subterranean telegraph; but until there is more evidence upon the subject, and the plan thoroughly tested, we cannot refrain from entertaining a doubt as to the general feasibility, unless at a very great expense, and even then its economy is very questionable in America.

Our lines are very lengthy, and extend over lowlands and uplands, mountains and valleys, plains and swamps, spreading over every species of formation common to the earth. Through many sections of America, the expense of a subterranean system would be very great, and in fact so large, that the prospective income of many, if not all the lines, would never be commensurate with the hopes and wants of investing capitalists.

Extend our commerce to the port of Singapore; laden our ships with the natural products of Borneo, Malacca, and other islands of the Eastern Archipelago; admit them free of duty; open for competition the manufacture of gutta percha insulation; and then, and not until then, need we contemplate the beauties of a Telegraph Line, freed from the annoying hindrances of atmospheric electricity, particularly in the South and West, where Autumn is frequent in the production of the most gorgeous aurora borealis. T. P. S.

GALVANIZED IRON.

We have seen, within the last half century, the most surprising changes in the condition of human affairs, brought about by the scientific application of established principles to practical uses. Not but that noble buildings, and beautiful statuary and magnificent bridges, remain as monuments of the past; but it was not for antiquity to invent steamboats, or railways, or the Napier press, or the magnetic telegraph, nor to equal even in architecture some of the splendid edifices which mark the progress of our age.

Magnetism, supposed to have but one power, and that a directive one,—to have but one practical use, that by which the navigator steers his bark in safety,—is now applied in the reduction of ores, and in the lifting of weights, and the writing of words, and by its ready obedience to a newly-discovered law, becomes the trusty amanuensis of the telegraphic conductor.

Galvanism, allied to electricity and magnetism, having the characteristics of both, with effects dissimilar, has also given its aid, under the direction of science, and we have its singular cements flowing through the vats of the laboratory, to form new *metallic combinations*, and to give strength, *durability*, and beauty to fabrics of indispensable necessity. The galvanic battery arms iron not only with the powers of the magnet, but gives it *security from corrosion*, and thus we have rapidly coming into use materials with which, but a short time ago, we were entirely unacquainted.

Art. IV.—THE AMERICAN TELEGRAPH CONFEDERATION,

ORGANIZED AT WASHINGTON, MARCH 5TH, 1853—TO ASSEMBLE ANNUALLY—COMPOSED, BY REPRESENTATION, FROM ALL LINES IN NORTH AMERICA USING THE MORSE AMERICAN ELECTRO-MAGNETIC TELEGRAPH.

THE origin of this Association was the publication of a call, signed by the Presidents and others of a large number of the Telegraph Lines in the United States, inviting every company, using the Morse system, to send one or more representatives to a Convention, to assemble at Washington City, March 5th, 1853. The object of the Convention, as thus promulgated, was to act on such matters as might be of interest to the lines in common, without regard to the special interest of any given line or connection.

The Convention assembled, and embraced a representation from lines, amounting in extent to at least three-fourths of the wires in America. Various proceedings took place, and among them the adoption of a resolution, presented by Mr. Alvord of Missouri, organizing a General Committee on Confederation, to act in the interim of the Convention, with general powers. That committee, at an early day, after the adjournment of the Convention, issued the annexed circular address, which we republish for more general reflection. It embraces some very important facts, worthy of the daily consideration of every telegrapher, which, too, must sooner or later be an integral on the final adoption of a universality of business system. Finding the business proper for this committee to act upon, as contemplated by the Convention, too great to receive the necessary attention, the editor of the *Companion* was selected to act as Secretary, and as soon as possible, resigned his offices in the West to assume the new duties at Washington City, under the official direction of the committee appointed by the Convention as aforesaid.

The circular address of the Secretary, following that of the committee, will evidently startle the minds of every telegraph management throughout the country, and at the same time infuse a cheerful spirit, and new hope for success, in the prospect of realizing the immense saving, so emphatically exhibited by that document. The facts therein promulgated are worthy of immediate attention. The plans proposed ought to be adopted without delay, that the benefits may the earlier be accomplished. [EDITOR.

ADDRESS

To the Presidents of the several Companies using Morse's American Electro-Magnetic Telegraph, in the United States, Mexico, and the British Colonies in North America.

GENTLEMEN:—In obedience to the directions of the Telegraph Convention, recently held in the City of Washington, the undersigned have the honor to transmit a copy of the resolutions adopted by them, and ask the concurrence and future co-operation of your respective companies.

The members of the late Convention, as well from their observation and experience abroad, as by an interchange of views among themselves, were deeply impressed with the necessity of some organization to preserve harmony, and produce uniformity in the mode of doing business by the many companies using Morse's Telegraph. Obviously this can be attained only by laying aside, for the occasion, all animosities and jealousies, which may have grown out of competition, or the violation of exclusive privileges, real or supposed, and waiving for that purpose only, but without abandoning, all conflicting claims. Acting upon these principles, the recent Convention was distinguished by the harmony and good feeling which characterized its sittings, giving promise of good to be derived from the annual recurrence of such assemblages.

It is, perhaps, a public misfortune, that all the principal telegraph lines of the country are not subject to one control, governed by one set of rules, and presenting in all cases an undivided responsibility.

As such an arrangement is obviously impracticable, it becomes important to the companies, and to the public, to secure by other arrangements, as far as practicable, the advantages which would result from a controlling power. Many evils have already shown themselves as incident to the present system, among which are the following, viz.:—

1. The adoption of different abbreviations and signals on different lines, rendering their language measurably unintelligible to each other. On some lines it has even been proposed to change the elements of which some of the letters of Morse's Alphabet are composed. It requires no argument to prove that the tendency of these practices is to produce utter confusion in the business of telegraphing; and if allowed to proceed, those engaged in it will become as unintelligible to each other, as were the builders of Babel after the confusion of tongues. This mischief cannot be obviated otherwise than by a concert of ac-

tion among the companies, and the adoption of one general system, setting their faces against any alteration therein, unless it be by common consent. As a basis for all future action, we earnestly recommend the adoption of the seventh and eighth resolutions, herewith transmitted.

2. Perhaps the greatest evil existing under the present system, is the absence of due responsibility on account of messages sent over the lines of two or more companies, which are unreasonably delayed, or never delivered at all. We all know that perfect certainty of prompt delivery is not attainable in the present condition of the telegraph lines generally; but it is not difficult to adopt and enforce such regulations, as will greatly lessen the disappointment and irritation so prevalent among the customers of the telegraph, in consequence of the failure of their messages to reach their destination, or their inability to procure information as to what has become of them.

The idea so prevalent among operators, that it is an injury to their line to let connecting lines know when they are down, is fatally erroneous. They receive messages and retain them, awaiting the repair of their line; and when the station whence the messages came inquires after them, too frequently no answer is returned. The customer becomes impatient and irritated, and demands the refunding of his money, which is refused; whereupon he curses the telegraph, and ceases to use it. None of us, it is confidently believed, have duly appreciated the injury done to all the telegraph lines by such short-sighted policy.

All this can be readily obviated. Let each line, when down, promptly inform every connecting line of the fact. If there be any other line by which messages appropriately belonging to the line thus down, can be promptly sent, let them be silently received and so forwarded; if not, let the customer be frankly told that a connecting line over which his messages must pass is down, and that it is uncertain when his message will reach its destination. If, thus informed, he chooses to leave his message, he cannot complain of fraud or imposition.

The undersigned are perfectly satisfied, that incomparably more harm arises from the omission to give information in such cases, than from the failures themselves; and that multitudes abandon the use of the telegraph not because their messages have been delayed or lost, but because they can obtain no satisfactory explanation of the cause.

Intimately connected with these practices is the subject of refunding. Customers are put to great inconvenience in obtaining evidence that their messages have been delayed, mutilated, or lost, when the telegraph ought to know all about it. That the station from which the message is sent, is not in possession of the facts when messages are delayed or lost, is the fault of

other stations or connecting lines, in withholding information which ought to be given.

These evils the Convention hope to mitigate by the rules laid down in their second, third, fourth, and fifth resolutions, which are earnestly recommended to the adoption of your respective companies.

To give greater efficiency to the principles therein laid down, the committee recommend that the following explicit instructions be given to the chief operator at the terminal station of every line, viz.:—

1. That when any line ceases to operate in whole or in part, for the space of one hour during ordinary business hours, notice thereof shall be given to all connecting lines, specifying what part of the line, if any, is still in operation; and that when the line again commences to operate, notice thereof be also given immediately to all connecting lines.

2. That operators of connecting lines, receiving such notices, shall immediately send them along their respective lines.

3. That when from any cause a message from another line or station cannot be forwarded, or, if it has reached its destination, cannot be delivered the same day, notice thereof shall be given to the station whence it came.

A strict observance of these rules would remove many causes of irritation which now beset the telegraph business, and would obviate much trouble now experienced in the matter of refunding.

The second resolution purports to regulate the principles on which moneys refunded shall be charged upon the several companies concerned. In the discharge of the duties imposed on the committee by the fourteenth resolution, they recommend the following rules for giving effect to the second resolution, viz.:—

1. Where refunding is required by reason of an error of the telegraph, the whole amount shall be chargeable to the company on whose line the error was committed.

2. Where refunding is required by reason of delay in the transmission of a message, the whole amount shall be chargeable to the company on whose line the delay occurred, unless said company shall show that it was occasioned by providential or uncontrollable circumstances, of which the connecting lines were duly informed.

3. Where refunding is required by reason of neglect to deliver a message when received, the whole amount shall be chargeable to the company at whose station the neglect occurred.

4. In all cases where refunding is required, the manager of the station where money was paid in the first instance shall be sole judge of the justice of the demand; and if any dispute

arises as to what line is chargeable with the amount refunded, or any part of it, the question shall be referred to the Presidents or Principal Managers of the lines concerned; and if they disagree, the subject shall be referred by them to the Corresponding Committee, whose decision shall be final. *Provided*, that when any line refuses or omits to give information as prescribed in the third and fourth resolutions, the whole sum refunded shall be charged to such line.

The other resolutions adopted by the Convention do not appear to need any explanation. That uniformity may at once be introduced and preserved, it is recommended that they be all adopted, though they may in some particulars be considered objectionable, and that any desirable modifications be reserved for the next annual Telegraph Convention.

The Committee trust that all Telegraph Companies in North America, using Morse's system, will cause themselves to be represented in the next Annual Convention, by delegates formally chosen and furnished with credentials, and that they be authorized to pledge the faith of their respective companies to carry into effect the resolves of the Convention, so far as they may relate to the mode of doing business, their intercourse and responsibilities among themselves. It is only by receiving the vote of the Convention as authoritative, that it can become permanently useful.

In conclusion, we beg that, as soon as practicable, you will submit the resolutions of the late Convention, together with the recommendations of this Address, to your Company or Board of Directors, and communicate the result of their action thereon to our Chairman, that we may notify each Company of their adoption or rejection by the rest.

B. B. FRENCH,
AMOS KENDALL,
J. D. CATON,
J. K. MOREHEAD,
WM. M. SWAIN.

CIRCULAR ADDRESS

TO ALL ELECTRIC TELEGRAPH COMPANIES IN NORTH AMERICA.

At the late American Telegraph Convention, in Washington City, the following resolution, among many others, was adopted, viz.:

"That it shall be the duty of the Corresponding Committee to encourage the establishment, at some central point, of manufactories or dépôts of all the necessary materials, such as acids,

instruments, stationery used and consumed in the conduct and management of telegraph lines."

Not being able themselves to attend to the details necessary to the efficient execution of this and other resolutions adopted by the Convention, the Corresponding Committee, deeming this matter particularly of great importance, appointed the undersigned their Secretary, with the understanding that he was to attend to the details which the Convention had imposed upon them.

Thus authorized by the Committee, the undersigned has given special attention to the subject of the foregoing resolution, which he interprets as follows, viz.:

1st. The organization of a system, by which all the lines in the country can procure the materials needed in the successful management of the Telegraph, *unadulterated* with baser substances.

2d. That the articles purchased might be obtained at the lowest price possible, resulting from a general wholesale arrangement.

3d. That a general uniformity might result therefrom, dispelling the necessity for continual experiments, originating from a scarcity of material in any section of the country, whereby the management necessarily resorts to supposed equivalents.

Considering the objects of the resolution to be as just recited, the Secretary has proceeded to make complete arrangements for carrying the same into immediate operation. He has visited the various cities in the East, and procured the prices from many firms, offering to supply the lines throughout the country with the materials consumed. The prices submitted are greatly under the amounts now paid in all parts of the country, and the proposals accepted are at least twenty-five per cent. less than the lowest price paid by any line heretofore. The multiplication of commissions by the dealers greatly increased the cost of the article, and with a view to save that increase of expenditure, the Secretary has, in every instance, sought proposals from the manufacturers. The great saving will be readily seen by an examination of the figures presented hereinafter. Not only is the price reduced, but the pure article is obtained, unadulterated and free from mixture with inferior qualities.

It must be remembered, too, that the great saving accruing under this arrangement, as well as the perfection of the materials purchased, contemplates the concentration of purchase through the arrangement of the American Telegraph Confederation. Some of the companies will not realize much saving, because their consumption is small. Every line throughout the country greatly needs the economy proposed, though ever so little. The benefits will be mutually enjoyed; none are excluded. The

arrangements contemplate, that every company or every line throughout the United States, Canada, Nova Scotia or Mexico, can partake in the advantages proposed. It is the interest of all to unite; the larger the purchase, the less will be the sum to be paid; thus all will partake alike in the economy. The invitation is to all, and the earlier commenced the better. Many lines have, very probably, a supply on hand sufficient for the season, but when new orders are given it is hoped the proposals beneath submitted will be accepted. The prices embraced in the schedule may not be much less than now paid by some lines, but much less than paid by other lines; besides, a good article is procured for the same amount paid for an inferior. Some lines are paying three hundred per cent. more than proposed in the schedule, and the consumption very large; to these lines the saving will be extraordinary. An examination of the prices will prove to be one-fourth, in the aggregate, less than the lowest price paid by any line in America. This may seem to be a bold assertion, but nevertheless it is true. The prices paid by the various lines have been procured, and there can be no mistake as to the correctness of the statements submitted.

It is proper to add here, that a moderate commission is added to the price specified in the schedule, to be appropriated by the General Committee to defray the expenses necessary in carrying out the directions of the Annual Conventions. If the revenue thus accruing exceed the necessities of the Committee, a reduction will of course be promptly made. The Committee, under the resolutions of the Convention, will manage or direct the course of procedure in all matters, and will not fail to do all that may be possible for the general prosperity. The companies can safely repose confidence in the arrangements presented, as there are those intrusted with the charge, who will realize the advantages of the economy as shareholders in the respective lines, and not otherwise. The Committee is elected annually, and the Convention can adopt such rules and regulations as to its powers as may be deemed requisite and necessary. The prosperity of the cause is the aim in view. That the subject may the better be understood, a short review of the cost now paid and as proposed will doubtless suffice.

NITRIC ACID.

This article is one of the most costly in telegraph consumption, and none more impure as in general use; it is one of the important elements connected with the enterprise, and should be carefully considered, that the very best quality may be obtained for the objects in view. There are but few gentlemen connected with telegraphing who are expert chemists, and in consequence of which, the most base and adulterated ingredients

have been mixed with acids and used in batteries instead of the quality required in the generation of effective electrical action. In fact, the most injurious effects have resulted from the use of mixed acids. Nitric acid is often diluted with muriatic and sulphuric acids, or, as commercially known, oil of vitriol. These baser acids reduce the cost of nitric in proportion to the ratio of mixture, and its utility is reduced upon the same scale. Muriatic acid acts powerfully upon zinc and platinum. According to the best authorities, it is much employed for making many metallic solutions; and in combination with nitric acid, it forms the *aqua regia* of the alchemists, so called from its property of dissolving gold, &c.

The mixture of acids does not only impose upon the lines a higher price for an inferior quality, but it brings into use agents powerful in decomposing the metals, and consequently shortens their duration in usefulness. The chemical action of the battery is a hundred-fold greater than the electrical. It should only be commensurate therewith. Science has settled the fact, that muriatic acid is not an auxiliary in the Grove battery. No one seeks it, but it is often forced upon the lines without their knowledge of the fact. Relative to the mixture of sulphuric acid, or oil of vitriol, with nitric acid, it may be said that there is no harm done, or that the two acids are used in the Grove series. That is true, but look at the relative value. Sulphuric is worth only one-fourth the value of nitric. Why then pay the price of the former for the latter? If they have to be mixed, let it be done at the offices, and let each kind be purchased at its proper value.

During the investigation of the quality of acids, by the Secretary, gentlemen proposed to furnish acids at most any price. In the West and South, the scale of acid mostly used was No. 44, and anything under that was deemed worthless. In the East nearly as erroneous ideas prevailed. In fact, there are as many views entertained as to the kind or quality of acids as there are persons in the management of telegraph lines.

In procuring bids to furnish the acids, under this arrangement, the question proposed was, "At what price will you furnish nitric acid 44° Baumee's Hydrometer?" A druggist responded, "Nine cents." The question was then asked, "Are you willing to submit that acid to an expert chemist for examination?" He answered, "No," but was willing to test it with the acid used by nearly all the telegraph lines in the country, and it should be equal in quality.

He said that the lines generally required an acid that would act readily on the zincs; and a mixture of muriatic acid was the best means of accommodating the managers, as they pronounced it the quality required. A mixture with sulphuric acid or oil of

vitriol elevates the scale of specific gravity, and therefore its measurement need not be feared by the dealer. Such are the means resorted to, by commercial trade, to gratify the singular ideas advanced by communities not expert in the science of chemistry. At least three-fourths of the acids heretofore used in the United States by the telegraph lines, are adulterated at least ten per cent., and thus the injury may be estimated proportionate with the scale of base mixture.

Consultation with practical telegraphers, and calculations based upon reliable data, show the quantity of nitric acid used in America to be about 32 carboys of 120 lbs. per week. The prices paid range from 9 to 15 cts. per lb., the average being 12 cts. per lb. This would make an estimated annual cost for nitric acid $23,961 60. The Secretary can have the quality of acid used by the lines unadulterated for 8½ cts. per lb., which would amount to an annual outlay, based upon the quantity estimated above, of $15,972 80. This makes a saving of $6,988 80 per annum! The saving will greatly exceed this, because several hundred offices have been and are now paying as high as 30 cts. per lb. for an inferior article to that offered now for 8½ cts.

The carboys are to be well made, strong, and capable of standing the hardships of transportation. They will be marked, and known as telegraph acids. The world generally entertains a great fear of the combustion of *aqua fortis* in transportation, and shippers manifest great indifference as to forwarding it. The acid will be shipped under an independent name.

SULPHURIC ACID.

The telegraph lines do not use the proportionate quantity of sulphuric acid contemplated by science and the early projectors of telegraphing. The cause of this inequality is owing to mistaken views entertained, mostly by young gentlemen, who have not a thorough knowledge of the necessary ingredients in the proper composition of a battery. Many use nitric acid diluted with water, in which to immerse the zincs, rather than be troubled with pouring out acids from separate carboys. By this process an acid costing 8½ cts. is used instead of one costing 2 cts.; in this, economy will be promoted by its abolition, and the restoration of principles settled by science and practice for years. Some gentlemen do not use any acid diluted with water, and claim it as a grand discovery in economy. Experience has taught that in such cases, the battery has to be enlarged, and it is inactive for more than an hour after its construction. Time has to be allowed for the acid to ooze through the porous cups, and a chemical action on the zincs is produced. A battery thus constructed will always be black, and more or less covered with a thick coating of the oxide of zinc. Sulphuric acid cleanses the

zincs, and an opportunity is given for an even and steady action of the nitric acid upon the metal.

Science has devised the construction of the Grove battery. Experience has demonstrated its correctness. There should be two liquids, and two metals—one liquid to be nitric acid, and the other dilute sulphuric acid; and the metals platinum and amalgamated zinc. The plates of platinum are immersed in the nitric acid, and the zinc in the dilute sulphuric acid.

Rain water is the best with which to dilute sulphuric acid.

The quantity of sulphuric acid that should be used in America, for batteries as estimated under the head of Nitric Acid, would be about 50,000 lbs. per annum, which, at 2 cts. per lb., would amount to $1,000; the equivalents now used costing from 4 cts. to 10 cts. per lb., amounting to at least $2,500 per annum. In this, the result of arrangements made by the Secretary, the lines will make a saving of at least $1,500.

ZINCS.

To relate the many tricks resorted to in the manufacture of telegraph zincs, would require many pages. The impositions exceed those related of acids. Thousands of zincs used by the telegraph lines are composed of zinc, lead, tin-solder, and even iron, and every kind of base alloy. The commercial rates of zinc at present, in New-York, are quoted at 7½ to 8 cts. per lb. On examination of the rates quoted in different cities, it cannot be bought for less. How, then, can lines purchase a pure article for a less sum, after the expenses of moulding? There is no possibility for such to be the case; if bought for less, it must be alloyed. It is true that zinc rates very high at present, and the price is expected to be less in a few months. A proposal has been presented and accepted to supply zinc cups, warranted free from alloy, at 8 cts. per lb. This very favorable offer contemplates, like all other proposals, the patronage of the entire enterprise.

A few estimates will show the necessity of care in the purchase of zinc.

The quantity in daily use is about 1,100. These zincs, moulded of proper weight, will last, on an average, about two months. The locals will wear out in less time. The main battery, if properly amalgamated, will serve longer. According to this basis of calculation, the quantity consumed per annum will be 6,600, which, at 8 cts. per lb., would amount to $1,320. The lines have been paying all prices, ranging as high as 15 cts. per lb. At this price, full 8,000 miles of lines are paying at this time, and purchasing with them at least 20 per cent. of alloy. Estimating the average price paid to be 12 cents per lb., the cost, as per quantity consumed, would be for 16,500 lbs. = $1,980, or $660 net gain. These items are less than the calculations of others who have been consulted upon the subject. They are fully

sustained by the reports of the various companies. At the price proposed, a pure metal is obtained, having passed through the analytical examination of a competent chemist. There will be no compounding of base metals, causing a torpid battery, but the pure and unalloyed material will be procured. The great result will not only be in saving of original outlay, but in securing a battery promoting the ends in view.

QUICKSILVER.

When Mr. Sturgeon and Mr. Kemp discovered the application of mercury by rubbing it on the zincs, causing them to last much longer, and the flow of electricity during the action of the battery to be more constant and regular, the scientific world rejoiced in the prospect of economy. Unfortunately, this saving is totally disregarded by many offices. This is, doubtless, the result of indifference and want of proper energy. The great benefits resulting from the amalgamation of zincs, ought to stimulate every operator to give the batteries the greatest attention in its fulfilment. The cost of the quicksilver is greatly less than the waste of zinc and acids by its non-use. It equalizes the chemical and electrical actions. The two harmonize, and the result is most effective. There is as much fraud or imposition in the sale of quicksilver as there is connected with the other items heretofore mentioned, and the telegraph lines seem to suffer the most. That which has been used by many lines is alloyed with lead, tin-foil, &c. Lead is worth 5 cts. per lb., and its mixture with quicksilver will enable the vendor to sell the lead at the rate of $1 per lb., that being the average price paid throughout the country. Those who have any doubt as to the correctness of this statement, can easily test its truthfulness by immersing a thin piece of lead or tin-foil in some quicksilver, and in a few moments the lead or tin will be dissolved, and appear as legitimate mercury. The alloy can exceed twenty per cent. and pass as genuine with many purchasers. Our lines have been cheated out of thousands of dollars by the mixture of these baser metals with quicksilver. The price paid heretofore, has been from 75 cts. to $2 per lb., mostly exceeding $1 per lb. The quantity used in America per annum, including mercury connections, is about 3,000 lbs., which, at $1 per lb., would be $3,000, and at 65 cts. $1,950, or a saving of $1,050.

It will be seen from these figures that there will not only be a great saving in procuring a pure article, but also in the cost of purchase.

POROUS CUPS.

This article can be supplied to the lines at 62 cts. per dozen, made from the best New-Jersey clay. This clay is con-

sidered the best for porous cups that has been discovered in America, and an inferior quality will not answer as well. The best is the cheapest in the end. An inferior article made from brick clay can be purchased at 50 cts. per dozen. No arrangement has been made for purchasing such an article, they being deemed injurious to the proper construction of a battery.

TUMBLERS.

Various are the kinds of tumblers in use. Some thick and some thin, some costing $1,65 and some $2,50 per dozen. Some are so thin that they can scarcely bear the weight of the zinc and acids. In cold weather they easily break, thus causing a great expense. Tumblers can be furnished the lines at $2,00 per dozen, made of the best glass, and sufficiently strong for substantial use, and economical management. An inferior quality can be purchased at $1,60. No arrangement has been made for purchasing an inferior quality. The tumblers, zincs, and porous cups are all made to suit as pairs, and the full force of the battery will be brought into action by such an arrangement. A large zinc in a small tumbler occasions the use of a small quantity of dilute sulphuric acid, and its renewal must be more frequent. These questions will be carefully considered.

PLATINUM.

A line once supplied with a good article of platina, will not be required to renew the supply. If alloyed with inferior metal, it will not endure the nitric acid. If rolled into thin slips, the breakage is very great. If long and thick, the wear will be longer. There are various views entertained as to the utility of the thin or thick strip. Orders will be complied with. If thin be desired, it should be stated. If not specified, the plates will be rolled to the most approved thickness.

The very best imported platinum can be procured at $8,00 per oz., in plates rolled the required thickness. A quality inferior can be obtained, but the best imported cannot be had for less.

MESSAGE HEADS.

This item of consumption is one of no ordinary consideration. The great quantity used necessarily occasions a large expenditure. The amount employed by the Morse lines of America exceed 10,000,000 per annum, of which New-York City uses about 1,000,000. These estimates may appear large, but they are much less than the calculations of several gentlemen engaged in the active duties of telegraphing. Message heads are purchased by offices, and sometimes by the officers of the companies.

The prices paid range from $1,67 per 1,000 to $5,00 per 1,000. Several million are bought at $4,50 per 1,000. Estimating the average cost to be $2,50 per 1,000, the annual cost will be $25,000.

This large outlay ought not to be made without reflection, and the opportunity is now presented for making a very great saving. The Secretary can supply message heads, printed on good paper, equal to that used by any line in America, at $1,20 per 1,000. If all the lines would use the same paper as the Magnetic Company, the message heads could be furnished at $1,10 per 1,000. The proposals are arranged to meet the diversified opinions of companies.

The reduction in the cost of message heads, from the prices named to $1,20 per 1,000, will occasion a gain to the enterprise of a startling amount. The price paid now as an average is $2,50 per 1,000 on 10,000,000=$25,000; the price proposed $1,20 per 1,000 for 10,000,000=$12,000. Net gain, $13,000!

ENVELOPES.

The quantity of envelopes used is not as great as that of message heads; the amount will be considered 6,000,000. Of this, there are about 4,000,000 white and 2,000,000 buff. The cost of the white will average $2,50 per 1,000. The cost of the buff will average $1,70 per 1,000. The cost of buff has ranged from $1,37 to $2,50 per 1,000. These estimates are upon white embossed, and printed buff envelopes. The annual cost, at the above prices, would be for white embossed $10,000; for buff and printed, at $1,70 per 1,000, would be $3,400; making an aggregate of $13,400.

The Secretary is now prepared to furnish white envelopes embossed, equally as good as the best now used by any line in the United States, at $1,60 per 1,000, and the buff printed at $1,20 per 1,000. If the buff are embossed, the price will be $1,10 per 1,000. The aggregate estimate upon these prices will be for the white envelopes $6,400; for the buff envelopes $2,400; making a total of $8,800. Net gain, $4,600.

The prices now proposed are greatly under former rates. The proposal contemplates the supply of all the lines, and hence the reduced rates.

CLOCKS.

Arrangements have been made for procurimg a superior quality of clock, from one of the most extensive manufactories in Connecticut. The face is about twelve inches in diameter, gilt frame, having the time of the hour, minute, second, and day of the month, all represented on its face, and to run eight days.

Made to run lying on the table, hanging on the wall, or in course of transportation. The manufacturer says, he "will warrant them to keep the time correct, as to *day of month*, *hour*, *minute*, *and second*, and that he will start them with genuine Connecticut time, and tumble them over railroads, wagons, steamboats, drays, and by hand, and land them in Halifax, or St. Louis, still running with the correct dial time of New-England. He will mark the moment of shipment, and its time of delivery will indicate how long the clock has been wandering to its new home." The price is $10 each. The stamp *American Telegraph* will be on the face of each one, and all will be warranted.

PENCILS.

The prices paid for pencils have been from 50 cents to $1,00 per dozen, and often a very inferior quality purchased. The number used per year exceeds 50,000. Supposing the average cost to be 60 cents per dozen, the total will be $2,500. The Se cretary can furnish the best pencil made at 22 cents per dozen for Nos. 1, 2, 3, and 4. At this price, the cost in the aggregate will be $916,66. Net gain, $1,583 34. The pencils are to be well made, capable of making the finest point, without waste. They will be manufactured in Germany.

PENS.

There are millions of pens bought by the various lines. No one consulted places the aggregate less than 4,000 gross. Price paid from 60 cents to $1,25 per gross, average about 90 cents, total $3,600. These pens can be purchased for the lines at 30 cts. per gross. For the same quality, form, and stamp, manufactured by the same firm in Birmingham, England, I paid in Louisville, St. Louis, &c., $1,25 per gross. It will be seen that on this small item the net gain will be large. Thus, cost at 30 cents=$1,200. Net gain, $2,400. They will be stamped in England, *American Telegraph Pens.*

BLACK INK.

The lines use a very large quantity of black ink, being about 4,000 quart bottles per annum. The best quality is retailed in New-York at 75 cents per bottle. In the West and South it is sold at $1,00 to $1,25. Put the average at 80 cents and the total will be $3,200. The same ink thus sold, the Secretary will furnish at 28 cents per quart bottle, well corked, sealed, and labelled. At this price the total will be $1,120, making net gain $2,080. The ink will be labelled *American Telegraph Ink.*

The Secretary is not prepared to submit estimates of the cost of the many other kinds of materials required by the lines, such as red ink, inkstands, files, screw-drivers, battery brushes, instru-

ment oil, magnet springs, screw-nuts, register paper, foolscap and letter paper, copper wire, plyers, solder, soldering-lamps, registers, magnets, keys, catgut, circuit breakers, lightning-protectors, repeaters, circuit-shifters, message-files, paper clips, &c., &c., embracing everything used in the management of the telegraph. The subject has been sufficiently investigated to warrant the assertion, that in the purchase of every article a saving can be realized.

REGISTERS AND MAGNETS.

Relative to registers, magnets, keys, and other parts of the machinery, there will be vast improvements submitted. Not by the introduction of fanciful ideas or the application of new principles, but by the proper construction of machines, calculated to make them last, and prove serviceable, totally disregarding all freaks of fancy in the peculiar scroll, harp, fiddle, or banjo construction of the instrument. There is no reason why a machine should not wear twenty years, as certainly as the varieties of machinery common in mechanics. The re-supplying of lines every few years is a heavy tax. To re-supply the offices of America with machines will cost at least $75,000. The breakage of an instrument has frequently occasioned more loss than the price of a dozen, and generally this loss is occasioned by the application of fanciful ideas, without regard to utility. The enterprise throughout the country may depend upon this subject receiving from the Committee the most careful consideration.

AGGREGATE ANNUAL EXPENSE.

Having considered the cost of the various materials common in the telegraph service, the annexed summary is presented, as being worthy of the most candid reflection.

Materials.	Present Cost.	Proposed Cost.	Net Gain.
Nitric Acid	23,961 60	16,972 80	6,988 80
Sulphuric Acid	2,500 00	1,000 00	1,500 00
Zincs	1,980 00	1,320 00	660 00
Quicksilver	3,000 00	1,950 00	1,050 00
Message Heads	25,000 00	12,000 00	13,000 00
Black Ink	3,200 00	1,120 00	2,080 00
Envelopes	13,400 00	8,800 00	4,600 00
Pens	3,600 00	1,200 00	2,400 00
Pencils	2,500 00	916 66	1,583 34
Totals	$79,141 60	$45,279 46	$33,862 14

Net gain, $33,862,14!! What argument could be more commanding? Look at this immense saving, and then who can doubt the general utility of a concentration of the purchase by the lines? Not only is the gain in money as presented, but the

pure and unadulterated material is procured, and more efficient service obtained. Some of these estimates will appear large, but they are based upon an average scale, procured from reports of various lines. The lowest estimates have been taken in all cases where there was a difference of opinion, and experience will, beyond all doubt, establish the fact that the table of costs is really below the true sums now paid.

In procuring the articles from the Secretary, there will be no nitric acid mixed with oil of vitriol to increase its scale of degrees, and at the same time rated as equal in value to the pure article. No sulphuric acid with false gauging, and mixed with exhausted acid. No zincs, alloyed with lead, tin-solder, and iron. No quicksilver alloyed with 20 per cent. of lead, tin, or other base metals, destroying its usefulness and durability. No porous cups made of brick-dirt or clay, of density preventing a flow of nitric. No tumblers, almost as thin as wafers, causing breakage of 50 per cent. per annum. No platinum alloyed with metals of half value, thereby preventing durability. No message heads at enormous rates and waste of revenue. No envelopes at double prices for inferior quality, and of every species of paper. No pencils of inferior lead, causing a great waste in pointing.

Such are the views entertained by the Secretary, in the fulfilment of the important resolutions submitted to the American Telegraph Convention, as hereinbefore recited.

PRICES PROPOSED.

The following are the prices now proposed, and upon which the lines may depend in every particular, viz.:

Nitric Acid, per lb	8½cts.
Sulphuric Acid, "	2
Zincs, "	8
Quicksilver, "	65
Message Heads, per 1,000	$1 20
Envelopes, Embossed, per 1,000, White	1 60
" " " Straw-colored, extra	1 60
" Printed " Buff	1 20
Pencils, per dozen	22
Tumblers "	2 00
Porous Cups "	62
Black Ink, quart bottles	28
Platinum, per oz.	8 00
Pens, per gross	30
Clocks, each	10 00

The straw-color envelope is a very superior article. The die will emboss that color of envelope better than the white. If generally adopted, the manufacturers contract to place water-marks in the paper, indicating it as the telegraph paper, and granting the lines its exclusive monopoly. The same idea will be proposed as to message-head paper.

CASH PRINCIPLES.

The Secretary has no power to contract debts without being individually responsible. The rates proposed are cash prices. No proposals were sought on the credit system, because no means could be devised to meet the case. The cash principle is the only plan to insure success.

The lines can estimate their supplies for the coming quarter, or year, and the whole shipped under one invoice. This will be a point in economy. The arrangements are such, that an order for all the materials, and for any quantity, and even for a million of message heads, can be placed in transportation within twenty-four hours after the time of its reception by the Secretary.

All orders must be addressed to the Secretary, at *Washington City*, and any requiring the action of the Committee thereon, will be promptly submitted.

That there may be increased confidence in the arrangements herein proposed, the Secretary will give such bonds as may be deemed necessary by the Committee.

The cost of the dies for embossing the envelopes will be $5 each. The cost of electrotypes to print the envelopes will be $1 to $2 each. The cost of electrotypes for printing message heads will be $1 to $2 each, and for duplicates 50 cents each. These expenses will be extra, and they will remain as the property of the Company.

Before closing, the Secretary would state that he is now wholly employed under the directions of the Committee, appointed by the late American Telegraph Convention, in carrying out the actions of that body. Their counsel will form his course of duty, and his energies will be untiring in the service of the enterprise. He feels too much interest in the general prosperity, to allow any part of his duty to remain unperformed. His determinations are, to render all service possible calculated to elevate the Telegraph, and the accomplishment of deeds tending to promote the general and universal weal.

Respectfully submitted.

TAL. P. SHAFFNER,

Secretary.

Editorial.

INTRODUCTORY.—The TELEGRAPH COMPANION, as now issued, is an improvement on the old series, or original issue. The quarto form was inconvenient.

The doctrines promulgated through this work will be relative to the Science and Art of Telegraphing. Many years' connection with the Morse American Electro-Magnetic Telegraph,—a participator in the struggles in its extension over thousands of miles of territory, even along the borders of, and before the doors of the red man's home, and an attentive student in the various legal investigations in the courts of the country, have infused into our mind a firm conviction of its superiority and originality over all other Electric Telegraphs of the present age.

Our teachings will be, to sustain this conviction, being in accordance with the decrees of many of the most learned jurists of the land, and the sanction of the American people.

In promoting the ends in view, we do not desire to discuss them in a manner calculated to cast any disrespect upon other systems of Electric Telegraphs, but at the same time, a candid discussion of the merits and relative rights of the diversified systems must be expected. We speak thus frankly, that none may be deceived in the policy pursued.

The whole range of Telegraphing will be considered, embracing the manner of management, working and general policy, the construction and repair of lines, the various departments of operation, and quantities of materials consumed, and everything requisite to elucidate the manual of Telegraphing.

We invite a fair consideration for the COMPANION, and a liberal encouragement. With these remarks, we submit the first number.

TAL. P. SHAFFNER.

TERMS AND TIME OF PUBLICATION.—The Companion will be published monthly, 48 pages in each number, octavo, making over 600 pages per annum. Terms—$2,00 per year, payable in advance.

The Companion, proper, will be wholly letter-press writings, and will embrace one number of the Compound Tariff Scale. The Tariff Scale will be a separate publication. The works will issue on the first of each month.

THE COMPOUND TARIFF SCALE will contain 32 octavo pages, and be devoted entirely to Tariff affairs, being 30 pages of rule and figure work, and two pages of explanatory notes relative thereto.

Terms—$2,00 per year. It will be issued monthly, with all the corrections of Tariffs, and new offices established by the new lines built.

COMPANION AND TARIFF SCALE.—The Companion will be sent to subscribers for $2,00 per year. The Tariff Scale will be forwarded at $2,00 per year. Both publications will be sent to one address for $3,00 per annum. We hope every Operator, and every Officer of the different Companies, will give us the necessary material aid in the publication of these important works. Merchants would find the Tariff a very useful book in the counting-room. Stockholders would find the Companion a useful book in obtaining a proper understanding of the art of Telegraphing. We hope to have the co-operation of all in accomplishing the grand desideratum.

OUR PUBLICATIONS AGAIN.—We desire it to be distinctly understood, that in the publication of these works we do not expect gain. They will cost more than the subscription. Already there has been expended nearly one thousand dollars, and the most unanimous subscription will not meet the outlay. We hope, however, the Companies will give all the aid possible. If the works pay expenses of printing, it is all we desire. Our labor and responsibility will be gratuitous in the premises.

OLD SUBSCRIBERS.—The subscribers to the Companion during the last year can have their choice in taking either of the works for the coming year at the same price. We will send to the Company subscribers the Tariff, knowing the object of their subscription to be for it. To the Operators we will send the Companion. If any change is desired, we will cheerfully comply.

DELAY OF PUBLICATION.—The delay has not been intentional, or for want of energy, but as a question of policy. The change of place of publication from Louisville to New-York, and the change of position from the Presidency of the St. Louis and New-Orleans line, to the Secretaryship of the General Confederation, require a change in the order of things, to meet the necessities of the future. It is our purpose to publish the work, let the subscription be large or small.

THE AMERICAN TELEGRAPH CONFEDERATION will hold the next annual meeting in Washington City, on the 6th day of March, 1854. A representation from every Morse line in the United States, Canadas, Mexico, Nova Scotia, or in other words, every line in North America, is expected to be represented there. We have already heard of the appointment of many delegates to attend that meeting, and we hope others will promptly act in the matter. Where Presidents or Superintendents have authority to represent their lines, it is hoped they will not fail to attend.

We would call attention to the official circulars in the present number, as involving important facts for the consideration of every Company.

ATMOSPHERIC TELEGRAPH.—During our recent trip to Boston, we visited the rooms of the Atmospheric Dispatch Company, No. 24 Merchants' Exchange, State Street.

We had but little confidence in the practicability of the enterprise, prior

to an examination of the machine and witnessing its operation. The tubes were made of lead, about two inches in diameter, and about twenty feet long. The feasibility of the invention for the uses designed was demonstrated by various experiments. Although the operation seemed to be perfect, yet we entertained doubts as to the ultimate success of a long line; but Mr. I. S. Richardson, the talented inventor, readily presented arguments, based upon fixed laws in philosophy, dispelling all fears. Important results will characterize this invention, though many difficulties will occur in its early progress. After fruition is attained, there will be hundreds claiming to be the original inventor. Like the history of Morse, men who were slumbering in ignorance for years later than his invention, have come forward and claimed to be *the* sole progenitor of the great art, conceived by Morse, and brought to perfection by the toil of years.

The Atmospheric Dispatch Company contemplate constructing a line from Boston to Worcester, as the first section of a line to New-York. The shares are $100 each, payable in calls of ten per cent., commencing on the 1st of February, 1854. Total capital stock, $500,000. The tube to be two feet in diameter, for conveying letters and packages to and from the said cities and intermediate places, allowing fifteen minutes to each transit.

Although we feel confident of successful results from the art invented, yet we cannot believe in the realization of all the hopes entertained by the worthy and ingenious inventor. If it accomplishes one half, the triumph will be great. The achievement will rival in brilliancy the brightest star of this progressive age. It will be one of the most marvellous and resplendent gems that bedeck the illustrious escutcheon of American ingenuity.

Telegraph Magazine.—It has been announced that the Companion, published heretofore at Louisville, was to be united with the Telegraph Magazine, published in New-York. Such was the design of the proprietors of the two publications, but circumstances have occurred rendering the union inexpedient.

A Baby Battery.—While on a visit to Boston, not long since, we called on Messrs. Palmer & Hall, Telegraph Instrument Manufacturers, and were shown a baby battery, composed of zinc and copper, and dilute sulphuric acid. The plates were one-eighth of an inch square, and as thin as a common wafer. The action of the battery was sufficient to work the largest Relay Magnet. It was a beautiful exhibition, and its minuteness gave it no ordinary degree of novelty.

Alarm Telegraph.—Houses are now being built, in cities, with telegraphs connecting each window and door with the bed-chamber; so that in case of the entry of burglars at night, an alarm-bell is sounded, waking up the residents, and advising a sudden retreat of the nocturnal invader. This is an important improvement, worthy of general use.

A New Battery.—We had the pleasure of examining a new galvanic bat-

tery, invented by Mr. Moses G. Farmer, Superintendent of the Electric Telegraph of the Boston Fire Department. Gallon jars, large porous cups, and amalgamated zinc are used, differently constructed from Grove battery. The mode of application secures a constant battery for some thirty days without renewal. We hope to have a detailed account of the invention of Mr. Farmer, and if it proves more economical, and attains an electric current equal to the Grove battery, it will deserve the immediate consideration of the various Telegraph Companies.

Balize Telegraph Line.—This line extends from Algiers, opposite New-Orleans, to the Balize, at the mouth of the Mississippi River. It is owned by the Union Tow-Boat Company, and is well managed. The length is 120 miles. To commerce it proves to be of infinite value.

The Telegraphs in Canada.—In no section of America are there more lines in progress of construction than in the Canadas. We hear of some three thousand miles now being built. These lines will greatly aid the general system, and advance the prosperity of existing lines. As soon as we can collect proper material, we will give more definite news as to their extent.

Atlantic and Ohio Telegraph Line.—This Company has two wires from Philadelphia, through Harrisburg and other towns, to Pittsburg. A leased wire from the Magnetic Telegraph Company between Philadelphia and New-York is worked by this Company, as a more direct connection with the latter city. Mr. David Brooks has lately been elected Superintendent of the lines of this Company. Mr. Brooks is a gentleman well qualified for the station, and a thorough telegrapher. He is familiar with all the various departments, and his acts are characterized by excellent judgment. He labors for success by an economical and judicious management, laying aside all freaks of fancy, and adopting the useful. We most certainly wish him success, and that the prosperity of the line may be triumphant.

The Magnetic Telegraph Company.—This is the oldest Electro-Magnetic Telegraph Company in the world. It extends from Washington, through Baltimore and Philadelphia, to New-York. It has seven wires. The management of this line is somewhat peculiar, but well suited to its necessities. In a future number, a detailed account of the system will be given, believing that other lines can be benefited by the adoption of equivalent plans of operation. Wm. M. Swain, Esq., is the indefatigable and talented President.

Boston and Portland Line.—For many years the line between these two cities has been owned and managed by the Hon. F. O. J. Smith. Recently he sold the entire line, 120 miles, to the Maine Telegraph Company, which gives it a continuous wire from Boston to Calais, Me. The steamers' news is now sent direct from Halifax to Boston. We ardently hope that this line will realize a handsome revenue; but we cannot comprehend the neces-

sity of connecting with an adversary in Boston. Morse lines ought to connect with each other. The policy adopted by Mr. Smith, a few years ago, refusing business from illegitimate lines, was universally condemned. We can see but little difference in the policy now adopted by Mr. Eddy, the Superintendent, in his separation from the Morse lines in Boston and connecting with the House line. The largest patronage received from other lines is from the Morse Companies. The return business is sent back, by Mr. Eddy, through a different line, and one, too, limited in extent, connecting but few towns in the United States. The consummation of prosperity is only attained by an unbroken connection.

New Magnetic Battery.—A short time since we visited Providence, R. I., to witness the operation of a new battery in course of construction, designed to propel boats, or used as a motive power in mechanics generally, and to be applied to Telegraph lines. Mr. Calvin Carpenter, the inventor, has displayed a great deal of zeal and genius in the construction of the work. A patent has recently been granted him for the invention. We saw various experiments performed, and they were really wonderful. A small wire was placed in the circuit and instantly burnt into pieces. The power was great, and the current of electricity seemed to be even, and attaining what some gentlemen style quantity and intensity as verified by the diversified tests. The large battery, Mr. Carpenter estimates, is equal in strength to 100,000 pounds. In a future number we will give a minute description of the machine. To Mr. F. O. Gilbert, Manager of the Telegraph Office, and to Gov. Jackson, we are indebted for much information derived while at Providence.

Iron Wire.—In the construction of Telegraph lines, a good quality of iron wire is more important than any other portion of material used. For the same reasons that required the copper wire to be taken down from the early lines, demand the use of the very best iron wire that can be procured. We have seen all qualities used. Some worthless, and some very superior. Messrs. Dewey & Co., at Wheeling, Va., have probably manufactured the best wire employed for Telegraph lines west of the mountains. The wire was made from the Missouri Iron Mountain ore, which is doubtless superior to any other iron of America. We think so, because the wire manufactured from that ore has proved the most substantial.

Recently we were shown some specimens of wire from the extensive manufactory of Mr. Henry S. Washburn, at Worcester, Mass. It excelled all other wire that we have witnessed. The testings were startling and almost beyond belief. We have never seen wire of equal quality used by any line in America, though we understand that Messrs. Smith & Ward—who are very worthy and energetic gentlemen—have purchased a lot of the same wire for some new lines being constructed by them in Texas.

The question as to quality of wire will be presented to the General Committee, at Washington City, and we indulge the hope that some means will be adopted to aid Telegraph builders in procuring the very best wire in the construction or repairing of lines.

THE ST. LOUIS AND NEW-ORLEANS TELEGRAPH.—This line extends from St. Louis, Mo., to Nashville, Tenn., via Cairo, Ill., and Paducah, Ky. Length, about 400 miles. River crossings have greatly retarded the prosperity of this line. During the past summer, submarine cables have been laid across the various streams, and now the Company work successfully through cables across the Ohio, Mississippi, Tennessee and Merrimac rivers, making the most extensive submarine line in America. A reliable connection south of Nashville with New-Orleans, will enable the line to pay a handsome dividend at an early day. Col. Wm. Tanner is President.

NEW-ORLEANS AND OHIO TELEGRAPH.—The line of this Company extends from New-Orleans, via Vicksburg, Nashville, Louisville, Maysville, Cincinnati, Wheeling, to Pittsburg, connecting with the lines running to New-York, giving a direct intercourse thereto from New-Orleans. This Company has two wires from Louisville to New-Orleans, which make not less than two wires from Boston to New-Orleans. The revenue of this Company is nearly $200,000 per annum, and is rapidly increasing. Col. Wm. Tanner is President. While the Company has the services of one in whom confidence can be so implicitly placed, as can be with Col. Tanner, there need be no fears of the property of the Company being wasted away, by wild and extravagant schemes, such as have marked the career of some other lines in America.

RAIL-ROAD TELEGRAPHS.— Since it has been established that Telegraph lines greatly benefit the Rail-road routes by economy in running, and safety of lives, nearly all the leading roads in the country are securing lines along their routes, and appropriating liberal sums for their use. The day is not far distant, when every rail-road throughout the land will be compelled to adopt the use of the Telegraph in the running of their trains. We will discuss this question in future.

PITTSBURG, CINCINNATI, AND LOUISVILLE LINE.—The Company extends from Pittsburg, via Cincinnati, to Louisville. Two wires the entire distance. This line is one of the best in the United States, having business connections with several long ranges. Mr. Jackson Duncan is Superintendent, and is actively engaged in the management of the line. Mr. Duncan is a practical man, well qualified for the office, and ere many months the Company will realize the advantage of having a Superintendent who studies the economy as well as the theory of operation. The men that can go out on the line, and partake with the men in the hardships of repairs, like Mr. Duncan, Mr. Brooks, Mr. Woods, and a host of others like them, are the men for Superintendents.

TELEGRAPH INCIDENT.—Early in November last, the wires of the Montreal Telegraph Line, near Northfield, Vt., was by some means caught by the locomotive of a train of cars, on the Vermont Central Rail-road, and stripped from the poles for a distance of fifteen miles. This demonstrates two facts: 1st, that the wire was good; and 2d, that the poles were totally worthless.

BOSTON TELEGRAPH OFFICES.—The lines running into Boston have, nearly all, offices of their own, which necessarily occasion great inconvenience, and increased expense.

The Boston and New-York line has an office in building 76 State-street, up stairs. Bain line to Portland, in same office.

The Northern line to Montreal is in same building, first floor in rear.

The Vermont and Boston line has an office in same building, up stairs.

The Maine Telegraph line has an office on first floor, Traveller Building, 31 State-street.

Marine Telegraph line is in the Merchants' Exchange Reading Room.

The Boston, Lowell, Troy, House line, is in 77 State-street.

The New-York and Boston, House line, is in Traveller Building, 31 State-street.

The offices are very accessible; but the people must be well informed in telegraphing to know what route to patronize.

NEW-YORK AND BOSTON LINE.—This Company is styled. "The New-England Union Telegraph Company." It has five wires, with many lateral branches. The wires embrace all of the Morse and Bain lines. The latter system has been totally abolished, and the Morse machines substituted.

This is one of the most important lines in the United States, connecting two of the largest cities in the Union. Unfortunately, it has been allowed to go to wreck, and nearly the whole requires rebuilding. The insulation is mixed. Every kind, and nearly the very worst ever devised, is in use. It is astonishing to see such a state of affairs on an important line like this. It has not worked successfully for some time past, and never will until thoroughly repaired. Mr. Charles F. Wood, late of the Magnetic office, in New-York, has been elected Superintendent. He has been for some time engaged in repairing. Mr. Wood is a finished telegrapher. He knows his duty, and he is nobly performing it. His perseverance is equal to the necessities of the task, and his fine judgment, brought to use in the execution of his office, will produce results, crowning his efforts with the most cheering and triumphant success.

WADE TELEGRAPH LINES.—These lines are those built and managed by J. H. Wade, Esq., of Ohio. One embraces the Cincinnati, Columbus, and Cleveland line; another, the Cincinnati and St. Louis line, and in addition, several branch lines and rail-road routes. Mr. Wade is building an extensive range of lines along the rail-roads in Ohio and Indiana. If there is a telegraph man in the United States deserving of credit for energy and good management, it is Mr. Wade. He has conducted his lines upon a liberal, yet economical scale. He does not falter in expending a dollar where ten-fold will result therefrom. Some managers of lines hold on to the dollar, and allow the line to go to wreck; others, again, spend every dollar for fancy and extravagant show. Not so with Mr. Wade. He is a saving man, energetic and just, possessing abilities equal to his position. Success has

crowned his efforts, and his career as a telegrapher has been marked as conservative, and equal in skill to that of any other gentleman engaged in the enterprise.

NEW-YORK, WASHINGTON, AND NEW-ORLEANS LINE.—This Company is one of the pioneer lines in the United States. It was built by Mr. John J. Haley. The line extends from Washington City, via Richmond, Va., Raleigh, N. C., Columbia, S. C., Macon, Ga., Mobile, Al., to New-Orleans. A leased wire, belonging to the Magnetic Telegraph Company, connecting the line of the Company at Washington, direct with Philadelphia and New-York, is also under the management of that line. The office in New-York greatly increases the revenue of the line. Its income is very large. S. Mowrey, Jr., is President, and although new in the business, we have unlimited confidence in his superior judgment in the management of the line. It is one of the longest in the United States, and the difficulties of working are many. The most patient and energetic man will have times of sorrow; but we think Mr. Mowrey will never allow *fail* to enter his mind. He meets a liberal and hearty encouragement from the many gentlemen employed on the line, and his success may be considered as beyond doubt.

TEXAS TELEGRAPH LINE.—While Texas existed as a Republic, Prof. Morse presented his Patented Telegraph to the nation as a token of respect and esteem. He receives no consideration for lines constructed in the State of Texas.

We understand that Messrs. Smith & Ward are pushing forward the construction of many miles of lines in Texas. They have had to contend with many difficulties, but we are rejoiced to hear of their success. Their perseverance entitles them to great praise, and liberal realization of material relief.

WESTERN TELEGRAPH LINE.—This line extends from Baltimore, via Frederick, Harper's Ferry, and Cumberland, to Wheeling, with a branch from Brownsville to Pittsburg. It is about 360 miles long. The Company, last summer, made a contract to run a wire along the Baltimore and Ohio Rail-road. The line will be completed on or before January, 1854. This Company is paying a dividend, and the prospects for the future are very encouraging. Geo. R. Dodge, Esq., is President.

BAIN LINE FROM LOWELL TO GARDNER.—A line of Telegraph has been erected from Lowell to Gardner, Mass., via Fitchburg, on which the Bain system was designed to be worked. The revenue not being sufficient to sustain it, the property has been sold, and operations suspended. Some of the wire has been taken down. Small routes, or lines, having many offices, can only succeed with the use of the Morse system. Transferring work from one office to another, at will, is one of the principal elements of success.

INDIANA AND ILLINOIS LINE.—This range of lines is very extensive, running from Cincinnati to Dayton, Indianapolis, Terre Haute, Detroit, Chicago,

&c., being in length over 700 miles. During the past year, it was leased for a term of years, to Mr. Ezra Cornell, who is one of the oldest telegraphers in America. He was on the first line built, and his experience and ingenuity enable him to surmount many difficulties that ordinary men would fail in their efforts to overcome. Mr. C., like many of the old telegraphers, has braved the storms and tempests, and we do hope the remainder of his career in the telegraph will be as brilliant and cheering as his pathway in the past has been rugged and gloomy.

Yellow Fever in the South.—This fatal disease has, during the past summer, swept over the Southern country with disastrous results. Towns and cities suffered badly. In the midst of the epidemic, the telegraph lines were not excepted; many of the operators were the victims of the fever. Mr. B. P. Crane, Mr. Achilles Herbert, and others of the National lines in New-Orleans, fortunately recovered. Not so blessed were H. F. Watkins, chief operator at New-Orleans, W. H. Grogan, and T. S. Titcomb, formerly of the same office, and also W. Clayton, chief operator of the Mobile office, of the Washington line. They were victims of the fell destroyer. They were faithful and efficient officers. We record their early departure from among us, with pensive feelings, that useful men like those should be so early borne "from whence no traveller returns."

Maysville Submarine Cable.—We regret to learn that the electric cable, constructed for the Maysville, Ky., crossing, proved worthless, after applying the greatest energy to secure success. Cause of failure was over-heating the gutta percha, destroying its insulation, and thereby connecting the electric wires. Cables constructed on the same principle can be made effective by proper care and the use of suitable machinery. The reels were too small, and the twist proved fatal.

New-York, Albany and Buffalo Line.—We are rejoiced to hear of the prospects of this line. The Company has several wires on its main line, and also a number of branch lines as feeders. Mr. F. H. Palmer, of New-York, is the Superintendent of the line from New-York to Utica, and Mr. O. E. Wood, Superintendent from Utica to Buffalo. These gentlemen are practical managers, and well versed in the art of telegraphing. If the line cannot succeed under the management of such gentlemen, there can be but little hope in the future. They are actively engaged in making repairs, and, ere long, the line to Buffalo from New-York can be relied upon as one of the most efficient and reliable in the United States. Mr. John Butterfield, of Utica, is President.

Newfoundland Telegraph Line.—We understand that this Company has suspended further work in the construction of the submarine line to Cape Race, from Halifax, until spring. They are confident of success. The steamers to run in connection with this line, between Galway and America, are in course of construction. Unparalleled speed is expected in the running of these steamers.

House Lines.—The line of this system running from New-York to Washington is doing a very fine business. Mr. Henry J. Rogers is the Superintendent. He is one of the oldest telegraphers in the United States, having been associated with Prof. Morse in the management of the first line in America, and is well versed in the science of electric telegraphs. Various improvements have been invented by him, and his diversified talents are equal to any emergency. We regretted that Mr. Rogers found it to be his interest to leave the "art that has worked so well" amid storm and tempest.

The line from New-York, via Albany, Buffalo, Cleveland and Cincinnati, to Louisville, is under the superintendence of Mr. Anson Stager, of Buffalo. It is a long range of lines, and the difficulties of management must be very great. Fortunately, however, for the Company, Mr. Stager is well qualified for the position. He is a thorough telegrapher, understanding the working of lines as well as any other gentleman engaged in the business. His zeal and qualifications entitle him to richer rewards than are usually attained in the telegraph enterprise.

The business of the line from New-York to Louisville is very large, and rapidly increasing.

Damage by Sleet.—The recent storms in the North greatly damaged the Telegraphs. The New-York, Albany and Buffalo suffered very much, but the line from Orwell, Vt., to Whitehall, N. Y., and thence to Rutland, Vt., was totally destroyed. The wire was broken between nearly every pole. The damage was so great that fears are entertained that the repairs will not be completed before spring.

Telegraph Controversies.—We have received a communication, with a request for publication, from a friend, which reviews very critically the management of one of the lines in the United States. We would gladly publish it if we thought good would be the result. We desire to be cautious in meddling with the private affairs of Companies. We prefer to point out remedies for evils, without being too particular in noticing the localities of existing wrongs. Where an evil affects the general system of telegraphing, we will not fail to condemn, hoping to promote prosperity, and not foster contentions.

Correspondents.—We respectfully invite letters from telegraphers of all positions, relative to the mode of telegraphing, and all news pertaining to lines, and business thereon. Any question of the science is a matter of interest. Let everybody write.

A Model Battery.—There is nothing about the telegraph business more essential in successful management, than care in the battery series. We always visit the batteries wherever an opportunity offers. Among those of the most beautiful and best arranged in the United States, is that in the New-York office of the New-England Union Company, under the management of Mr. Charles T. Smith. He has had as much experience in batteries as any other gentleman in the country, and he adheres to the settled

doctrines of the Grove series. Experience of many years has demonstrated its superiority, and he delights in witnessing its perfection. It must afford the early projectors of electric telegraphs great pleasure, to find the old veterans in practical telegraphing, like Mr. Smith, dispel all the new doubtful schemes, and hold to that which has proved to be profitable and wholly such cessful for many years.

CUBA TELEGRAPH LINES.—We see announced, through the press, the suspension of the further erection of the telegraph lines in Cuba, by the Government.

WESTERN TELEGRAPH.—The stockholders of the Texas and Red River Telegraph Company assembled at Shreveport, and organized by electing the following officers:

President—D. S. Welder. *Secretary*—J. G. Battle. *Directors*—B. P. Crane, D. F. Roysden, J. W. Morris, of Shreveport; L. R. Walmesly, T. H. Aives, of Natchitoches; H. Lynch, M. Ryan, T. C. H. Smith, of Alexandria.

The stock was very fully represented, and the best spirit prevailed. No doubt is entertained of the completion of the line at an early day. The yellow fever has greatly hindered the builders in its construction, but their energies are equal to the most extraordinary difficulties. The line is built by Messrs. Smith & Ward.

WILLIAM TANNER, ESQ.—We had hitherto neglected to mention the fact, that this gentleman, who has been so long and favorably known to the public as an editor and telegraph proprietor, has recently been elected President of the St. Louis and New-Orleans Telegraph Company, to fill the vacancy occasioned by the resignation of Tal. P. Shaffner, Esq., who goes to Washington City, as Secretary of the American Telegraph Confederation. Two better men for the posts they have been called to fill, could not be found; and we congratulate them both, upon their *upward tendency.—Pad. Penant.*

SUBMARINE TELEGRAPH CABLES.—We shall, in future numbers of the *Companion*, discuss the various modes of crossing rivers. From sad experience, we are convinced that masts are not the most reliable nor economical. The following notices, from the press, are a few pertaining to the electric cables submerged in the Western waters. The newspapers throughout the country have favorably noticed these cables, and their superior excellence is evidenced from the tests applied. Though they pertain to our own work, yet we hope their republication will not be considered out of place, contemplating, as we do, to give the progressive movements in the entire telegraph enterprise, and the subject of submarine crossings is one of great importance to the prosperity of many lines. Since the construction of the cables, mentioned in the following notices, the same gentlemen have invented very great mprovements thereon. Here are a few notices:

SUBMARINE TELEGRAPH AT PADUCAH.—The great Submarine Telegraph Cable, on the St. Louis and New-Orleans Telegraph Line, was laid across the Ohio River at this place, on Monday last, the 26th inst. We examined this strange piece of mechanism a few days previous to the time it was deposited

in its watery abode, and was not a little astonished at its wonderful strength.

The whole forms a cable of near two inches in diameter, and it is much the largest and most substantial cable of the sort *in the known world.*

We are told that the great cable across the channel from England to France is inferior in size to this, and by no means as well insulated for electrical application; while, in point of strength, it will not compare at all with the one at this place.

This stupendous wire, which now conducts the lightning from shore to shore, beneath the bed of the majestic Ohio, is 4,200 feet in length, and the longest one to be found in the United States. It has been constructed by that amiable and accomplished gentleman, Tal. P. Shaffner, Esq., late President of the Company, and now Secretary of the American Telegraph Confederation, assisted by J. B. Sleeth, mechanical engineer. These gentlemen have made improvements in the construction of cables, both scientific and mechanical, which will entitle them to Letters Patent, and the country may well be proud of them, as men of skill and ability, in whatever they may undertake.

The wires on this line, we understand, have been exceedingly troublesome and expensive to the Company; upwards of $20,000 having been expended in unsuccessful efforts to cross the Ohio River in such a manner as to secure them against accident; but this great effort has accomplished the object, and there can be no future loss sustained, on account of breakage of masts, wires, &c.

We rejoice that the work has been successfully accomplished, and that it has proved fully equal to the most sanguine calculation our friend Shaffner had made of its utility. We had the pleasure of receiving the first dispatch which ever passed under the Ohio, on this mammoth cable, which run as follows:—

"ILLINOIS BOTTOM, *July* 26, 1853.

"COL. PIKE:—I send this through the great cable, successfully laid to-day.

"SHAFFNER."

Success to Shaffner! He may well be styled the "Lightning King," after this! May he live a thousand years, and succeed in everything which he undertakes, as he has in this instance! We regret to learn that he will soon go from amongst us, to engage in his new duties at Washington City; but even from that far-distant point, we shall expect to hear from him occasionally through the medium of electricity, which seems to be his favorite element.

SUBMARINE TELEGRAPH CABLE.—Tal. P. Shaffner, Esq., the former enterprising President of the St. Louis and New-Orleans Telegraph Company, arrived in our city on Tuesday last, and was engaged yesterday in laying the Submarine Telegraph Cable. It was put down about half a mile above here, and was towed over to the other shore of the Mississippi by the steam ferry. Its length is about 3,710 feet.

From the size and great strength of the wire, we have no doubt it will withstand the swift current and snags of the old father of waters for a century to come. May unbounding success attend its projector.

There is another roll of this cable on our wharf, intended for the Merrimac River. We understand it will be laid in a few days.—*Cape Girardeau Eagle.*

SHAFFNER'S LIGHTNING FERRY.—On Monday, the 26th July, Tal. P. Shaffner, Esq., whose pet is lightning, laid across the Ohio River, on the New-Orleans and St. Louis Line, about a mile below town, his great teegraph cable, the longest in America, and the largest in the world. This cable is 4½

inches in circumference, fourteen hundred and forty yards long, and weighs eleven thousand pounds.

Last fall Mr. Shaffner constructed and laid across the Tennessee River his first cable of this kind. During the winter and spring the freshets were greater than usual, and the great cable triumphantly resisted all forces coming in contact. The experiment confirmed the most sanguine hopes of the constructor, and Mr. Shaffner has commenced laying the cables at every crossing on the line. This line has more submarine telegraphing than any other line in the United States. Heretofore the companies have been much annoyed by the inefficacy of their submarine apparatus. Mr. Shaffner has been assisted in the construction of this cable by J. B. Sleeth, mechanical engineer.

The cable between England and France is inferior to this in strength and non-electric incasements.

It would not surprise us if Col. Shaffner should, before long, mount his pet and pass over to Europe, to offer his improvements to the trans-Atlantics. His energetic efforts and improvements in rendering subservient to man the fierce element, merit not only the admiration of the world, but a most fruitful reward.—*Paducah Journal.*

These are a few of the hundreds of notices of the cables crossing the Ohio, Mississippi, Merrimac, and Tennessee rivers. They have proved their efficiency. The torrents of the mighty floods roll over their powerful forms, and never in a single instance have they failed to perform their functions. We have received many letters from telegraphers, asking information upon submarine cables, and it will afford us great pleasure to give any aid in our power, tending to advance the enterprise. For nearly five years, amid storms, tempests, ice, and floods, we tried to conquer these mighty rivers. We feel proud in being able to enjoy the conquest.

Complimentary.—We feel very much gratified in finding the following flattering good feeling entertained towards us, from the gentlemen connected with the St. Louis and New-Orleans Telegraph Line; some of whom have been associated with us for several years past. May richer blessings crown their efforts than have been realized by them in times gone by. Their kind co-operation in the management of one of the most difficult lines in the country, will ever be cherished by us with the warmest affection. By request we insert the correspondence:—

Merited Confidence.—The numerous friends of Tal. P. Shaffner, Esq., the great telegraph man of the West, will read the following complimentary correspondence with pleasure:—*Paducah Journal.*

Louisville, Ky., *August 1st*, 1853.

On leaving the St. Louis and New-Orleans Telegraph Company, I cannot refrain from expressing to you, and the other gentlemanly officers of the line, my profound thanks for your liberal encouragement and energetic co-operation for, and in behalf of the line.

There is no telegraph company in the United States that can boast of a more true and faithful corps of officers than this, and I cannot refrain from expressing to you in this voluntary manner my sincere acknowledgments.

Your zeal, capacity, and moral worth, I trust, will always be respected as

pre-eminent, and equal to the full requirements of your station, and deserving of the same confidence you have so nobly won by your services for this company.

In resigning the Presidency of your company, I give place to one who is worthy of your confidence and esteem. An intimate association of many years with Col. Tanner, my successor, has established in me an abiding assurance of his ability and integrity to serve the interest of the line with the utmost fidelity.

I leave you, gentlemen, to assume new duties in the East, called by the wishes of those deeply interested in the enterprise, though much I regret to part with you, so early after the triumphant re-election as your sole manager by the late meeting of the stockholders.

In the hour of prosperity or adversity, weal or woe, the recollection of our past association in the fulfilment of our official relations, will be pleasant and felicitous.

With sentiments of high esteem for each and all of you,
I respectfully bid you adieu.

TAL. P. SHAFFNER,
Late President of the St. Louis and New-Orleans Telegrayh Co.

August 15*th*, 1853.

TAL. P. SHAFFNER, ESQ. :—Dear Sir:—We have each of us, at our respective stations, received your complimentary letter, announcing your withdrawal from the Presidency of this Company. We thank you kindly for the expression of confidence and regard for us, individually and collectively, as the corps of managers and operators on said line, and we assure you that those feelings of confidence and regard are fully reciprocated by us. Since our connection with this line, over which you have exercised a vigilant supervision, and exerted a most creditable enterprise, our intercourse with you has been one of uninterrupted pleasure. That we regret to part with you, it is unnecessary to add; but in our separation we beg you to rest assured that you have with you our warmest friendship and highest regard, and we shall ever cherish for you a most timely esteem. And with our best wishes for your future prosperity, good health and happiness, we are

Yours, most respectfully,

C. CARVILLE, } *Nashville, Tenn.*
GEO. D. SHELDON, }
J. L. THOMAS, *Clarksville, Tenn.*
J. H. M'KENZIE, *Hopkinsville, Ky.*
E. J. MARSHALL, *Eddyville, Ky.*
SAM. B. HITT, *Smithland, Ky.*
H. B. MARSH, }
G. S. PIDGEON, } *Paducah, Ky.*
J. B. SLEETH, }
W. H. BOLLARD, *Caledonia, Ill.*
M. B. HARRELL, } *Cairo, Ill.*
HENRY CANDEE, }
HOMER PARR, *Cape Girardeau, Mo.*
JOHN M. WEBB, *Ste. Genevieve, Mo.*
F. M. COLBURN, } *St. Louis, Mo.*
T. E. SWEETS, }

HON. AMOS KENDALL.—THE ARBITRATION.—It is known to the public' that recently an arbitration, on telegraph affairs, took place in the city of

Philadelphia. The case was one of difference between the Washington and New-Orleans Telegraph Company and the Morse Patentees, including their energetic agent, Hon. Amos Kendall. With a view of finally settling disputed points in a business affair, as to respective rights, the questions in dispute were amicably referred to three disinterested gentlemen, and their award to be final in the premises. These gentlemen were distinguished lawyers from New-York, Philadelphia and Charleston. The news reporter of Philadelphia was indiscreet enough to promulgate a slanderous news item for the press, charging Mr. Kendall with fraud, &c. The recollection of the base slander must mantle the news-reporter with shame and mortification. How a man can bring himself so low as to wantonly assail another in this wholesale manner, totally reckless of truth, is a question not easily solved. He stands behind a curtain, and is presumed to be just in his message to the world, never permitting a false statement to issue from his position. The flag intrusted to his charge he trailed in the dust, in heralding forth a fabricated statement, relative to this transaction.

With a view to place the matter before the country in its proper garb, we addressed a letter to Mr. Kendall requesting information upon the subject. His letter nobly unfolds the bright page of truth. Here is the answer, viz.:

WASHINGTON, *Nov.* 10*th*, 1853.

TAL. P. SHAFFNER, ESQ.:—Dear Sir:—At your request I proceed to state the practical results of the arbitration, lately held in Philadelphia, in which the Washington and New-Orleans Telegraph Company, Prof. Morse, the Messrs. Vails, and myself, were parties.

It was an amicable proceeding, in which the Company claimed that we had no right to a certain amount of stock acquired through the construction of the line, and we claimed a right to additional stock, in consequence of the putting up of a second wire on a portion of the line, which the Company denied.

Before the arbitrators entered upon the case, I called their attention to a telegraphic message in the *New-York Herald*, which appears to have been sent all over the Union, charging me, by name, with fraud in these matters.

The following is an extract from the award, viz.:

"*It being the opinion of the Referees that* THERE HAS BEEN NO ACTUAL "FRAUD, and that the circumstances of the transaction are not such as to "induce the charging of these expenses on the parties in any other manner, "or to any greater extent, than they will bear them in common with all the "stockholders of the Company."

The author of the libellous message thus finds his malice defeated by his own act, inducing an express acquittal of his charge.

Of the questions submitted, the arbitrators decided the first in favor of the Company, and the second against them. By the first branch of the decision, Messrs. Morse, Vails, and myself are required to refund $20,000 in stock, and $2,200 in dividends; in all $22,200 00

The second branch of the decision will give us additional stock, amounting to about 39,861 12

Balance in our favor $17,661 12

The result in detail is as follows, viz.:

	To refund.	To receive.	Gain.
Prof. Morse,	$9,250 00	$16,608 80	$7,358 80
A. Vail,	1,387 50	2,491 32	1,103 82
G. Vail,	1,387 50	2,491 32	1,103 82
A. Kendall,	10,175 00	18,269 68	8,094 68
	$22,220 00	$39,861 12	$17,661 12

These results will, doubtless, be somewhat varied in the final settlement; but it is quite as likely that the amount accruing to us will be increased, as that it will be diminished.

I had proposed, for the sake of peace, to give up all claim to stock on the second wire, and all additional wires; but my proposition was not acceptable. If the malicious men who got up the difficulty are satisfied with the result, I assure them that I am.

There was the less reason for charging me with fraud in this matter, inasmuch as my accusers knew I was not the author of the arrangement of which they complained; but I look upon it as a compliment, that I was singled out as the object of attack. When a rogue is called a rogue, it creates no sensation; but when an honest man is charged with default, whether rightfully or wrongfully, all hell yells with delight.

With great respect,
Your obedient servant,
Amos Kendall.

Atlantic Ocean Telegraph.—We desire to say much upon this subject, but have not room in the present number. We publish an article on the Ocean-Sounding, as preparatory to a discussion of the question in future. There are several efforts being made for the construction of an electric telegraph cable across the ocean. We believe it can be done. There can be no doubt about it. This boldness we expect to be ridiculed. So were the founders of the telegraph. To our astonishment we find the editor of the *Telegraph Review*, Mr. Reid, indulging in a sneer at the enterprise. This was unexpected, although his good-will towards us has been, for a long time, deemed exceedingly questionable. We seek no controversy, nor will we permit ourselves to be drawn into one. We notice the article in the *Review*, because it is evidently intended to hinder the accomplishment of an enterprise that is destined, ere the revolution of many years, to astound the world by its most triumphant success. Here is the article, viz.:

"We now learn that Mr. Shaffner is in concert with a former employee of an English Submarine Company, in endeavoring to form a Company to put a cable across the Atlantic. This will be a difficult work. Telegraph enterprise in this country has not been made so uniformly remunerative to stockholders, as to induce a connection with a colossal enterprise like this. The single fact of the immense weight of the cable is enough to terrify an ordinary mind from contemplating it. The cable at Paducah weighs at the average of three tons per mile. The shortest stretch across the Atlantic is one thousand five hundred miles. Think of a coil, within the ribs of a vessel, weighing forty-five hundred tons! But great men are born for great necessities."

We understand this article to give the following reasons why a submarine line from America to Europe is impracticable, viz.:

1st. That it will be a difficult work.

2d. That telegraph stock in America has not proved very profitable, and that capitalists will be deterred from investing in a gigantic enterprise like this.

3d. The weight of the cable will be at least forty-five hundred tons.

4th. That no vessel is of sufficient tonnage to carry such a monster cable.

Relative to the first objection, we admit that the proper construction of an electric cable across the Atlantic Ocean will be difficult in the extreme. The crossing of the flooding waters of the inland has been difficult for years past. The same energy that has stretched a web of wire over forty thousand miles in the Western hemisphere, overland, and through its mighty streams, can master the difficulties in crossing the ocean. Tides may ebb and flow—the billows may surge with mighty power—the icebergs may tower their white-mantled form high in the skies, and sink deep in the briny sea—the heavens may let loose the loud-rolling thunder, and the earth heave up its fiery lava; but, just as sure as these elements of nature exist, and worlds revolve, America and Europe will be connected by an electric cord.

To the second objection we have to say, that there is a cause for the unprofitableness of many telegraph lines. Rapidity in building, and recklessness of management, have been the progenitors of ill success. When the lines now constructed work with *fidelity*, the patronage will be sufficient to enable every line in the country to pay handsome dividends. In the construction and management of lines, apply the remedy, and the disease will be cured. Build or repair the lines strong, and insulate them well, and they will all prove profitable. Shun *extravagance* as you would a viper!

The third objection is singular, and we scarcely know how to answer it. We admit it will *weigh* very heavy; but we consider the great weight secures with it great *strength;* therefore this objection occurs to us to be really an argument in favor of success.

The fourth and last objection is marvellous. If there was only one solitary vessel ploughing the mighty deep, then there would be something to reflect upon. After reading the objection, we proceeded forthwith to the harbor of New-York, to see if all the vessels of the world had vanished from the face of the earth. At one view we saw a forest of more than a thousand masts towering from vessels. We then felt relieved, and that all was safe. At the Merchants' Exchange, the marine registers evidenced the existence of thousands at sea, and our joy seemed to be full, that the laying of a cable need not be confined to only one poor vessel.

In the final cabling of the ocean we hope for success. We do not entertain faith in the various schemes blazoned forth in the press, but our arrangements contemplate solidity and reality.

In years gone by, Mr. Reid, with others, partook in the struggles of the telegraph. The electric telegraph was the "wonder of this wonder-teeming age," and but few entertained faith in its ultimate utility. Every person engaged in the business was ridiculed. The ignorance of that age has pass-

ed away. He who was an object of burlesque then, ought not to foster it now. The progressive march of the science ought to receive a cheering smile, and not a scorn. We hope the Review will give the subject a more candid consideration.

EXTENSION OF MORSE'S PATENT.—The subject of the extension of the patents granted to Prof. Morse, by the United States, seems to be gravely considered by a portion of the American press. Of course, no one doubts its importance to the inventor and the people. The following notice, relative to the question, we copy from the *Scientific American*, viz.:—

"EXTENSION OF PATENTS AND PATENT LAW SUITS.—A statement has lately appeared in one of our daily papers, to the effect that a number of interested capitalists, with their seat of operations in the city of Washington, have formed an association, with a capital of $500,000, for the purpose of procuring the further extension of the Woodworth Planing Machine patent, also the Hayward Patent for manufacturing india rubber, and the Telegraph Patent, granted to Prof. Morse, April 11th, 1846. The intention is to accomplish this result by a special act of Congress, during its next session. There must be some error in including the patent of Prof. Morse, inasmuch as it has yet seven years to run, and the extension, if any, should be granted under our general laws. It is possible, however, that the owners of the patent, anticipating its rejection by the Commissioner of Patents, are thus providing in due season to supersede the general law by obtaining a special act. To be fully convinced of this, however, we shall need more light upon the subject, but, from information received from other sources, we are led to believe that large sums of money are being collected to obtain the extension of the two first patents. We are opposed to the further extension of these patents for the following reasons:—1st. Because the applicants for the extension have already amassed enormous amounts of money from these inventions. * * * 2d. We are opposed to the extension of these patents, because they have been so managed by the owners as to injure deeply the interests of inventors, and to cause the public to become dissatisfied with our whole patent system, which is one of the most noble institutions in our country. We have always advocated the interests of inventors, and have defended their just rights; but in opposing the extension of these patents we plant ourselves upon the foundation of the rights of the people, who, as well as inventors, are deeply interested."

The editor of the above paper expresses doubt as to an association of Prof. Morse in this Company, with a capital of $500,000, but proceeds to place him with inventors, whose patents he thinks ought not to be renewed. We deeply regret this species of procedure, upon the part of the editor, to arouse "public sentiment to bear forcibly upon Congress," against the merit of the Morse patent. He ought not to associate parties in an arrangement affecting so seriously the rights of persons, unless the evidence of the fact is complete. We can assure him, that so far as Prof. Morse, or any of his friends, are concerned, there is no truth in the report he has seen fit to indicate in the article quoted above. Nor has there been any grounds for the origination of so base an imputation, other than a wilful misrepresentation by some one, who has probably been foiled in his propensity to plunder from Morse those rights seemingly guaranteed to him by the letters patent.

It occurs to us, and we express our opinon with due respect, that a high

and elevated work, like the paper from which we have quoted, ought to be more careful and discriminating in assailing the reputation and property of citizens. The editor claims to be "the friend of inventors;" but we think his past career has manifested a very different disposition towards Morse. We have been often pained to see his paper joining with a part of the press in assailing the patents for the American Electro-Magnetic Telegraph.

The first objection to the extension of these patents seems to be correct, if *true;* but if not true, then a renewal ought to be granted by the Commissioner. Such is the case of Prof. Morse. He has not "amassed enormous amounts of money." If he has not, the *Scientific American* ought to advocate the renewal of his patent.

The second objection is so sweeping, that we know not how to answer, so far as it may refer to the Morse patentees. We suppose, however, the objection must refer to the other patents, as there has not been any very great mismanagement of the Morse patents, unless an effort upon their part to prevent themselves from being robbed and plundered by reckless and unscrupulous speculators, be mismanagement.

The patent of Prof. Morse, granted in June, 1840, expires June, 1854. That he will apply for a renewal is beyond doubt; but as to his being connected with any combinations, either direct or indirect, to procure a renewal by any corrupt mode, particularly such a base one as indicated above, is wholly untrue. The renewal can safely rest upon its merits. The laws now existing are ample for the case, and no special acts will be needed. So just are his claims, that the Hon. Amos Kendall, his agent, has positively refused to receive any aid even from those who are engaged in the telegraph business. Again we say, we are confident in the belief that no effort has been, or will be made in any manner whatever, upon the part of Prof. Morse and his associates, in procuring any act through Congress relative to his patent, or any law tending to promote a renewal.

We hope the courteous editor of that valuable work on science will correct the misrepresentation made, and in future, not assail the renewal of a patent, unless he knows his first objection is unquestionably verified. *Palmam qui meruit ferat.*

NOTICE.—The *Companion* and the *Tariff Scale* will be published and issued from New-York City by Messrs. PUDNEY & RUSSELL, No. 79 John-street. Subscriptions can be forwarded to them, or to the Editor, at Washington City.

Articles designed for publication in the first thirty-two pages of the *Companion* should be in the hands of the Editor by the 1st of the month preceding that of publication. News designed for the editorial department should be forwarded to the Editor on or before the 10th of the preceding month.

Corrections to be made in the *Tariff Scale* should be given to the Editor on or before the middle of the month preceding its issue.

SHAFFNER'S

TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. I. FEBRUARY, 1854. No. 2.

Art. I.—THE AMERICAN ELECTRO-MAGNETIC TELEGRAPH.

By Hon. Amos Kendall.

Argument submitted to the Supreme Court of the United States. Continued.

OERSTED—SCHWEIGER—ARAGO—STURGEON—HENRY—MORSE. DISCOVERIES RESPECTIVELY. MORSE THE INVENTOR OF THE RECORDING TELEGRAPH.

We propose now to take up the case somewhat in detail, and show the Court by the evidence what it was that Morse invented. First, however, it is necessary to correct some errors of fact contained in the printed argument of the opposite Counsel.

At page 7, Mr. Chase, after giving an account of the invention of the Electro Magnet by Sturgeon in 1825, says, "It was now certain that mechanical results could be produced *at any distance from the operating station* to which the Electric Current could be transmitted." No such fact is established by the evidence, nor was there any such certainty.

Again at page 28, after giving an account of Prof. Henry's experiments made known in 1831, Mr. Chase says "the fact that by the use of Electro Magnetism thus developed, any mechanical effects, capable of being produced by any ordinary motive power of like energy could be wrought *at any distance from the operating Station* to which the Electric Current could be transmitted, was also established." Again says he, "It was also established that the electric current generated by a proper battery, could be sent through a Circuit of indefinite extent *without any sensible diminution of its power to excite an Electro Magnet*, or to deflect a needle placed at the remotest point from the operating Station."

There is no evidence *tending* to establish either of these

alleged facts, other than unwarranted inference from an experiment by Prof. Henry, exhibiting a result not verified by experiment or experience, before or since. Of that we shall say more hereafter.

At page 13, Mr. Chase says, "Morse was unacquainted with electricity and electro magnetism."

It is in evidence that he attended a series of lectures on electricity and electro magnetism delivered by Prof. Dana in 1827 during which one of Sturgeon's Electro Magnets was exhibited. That identical Electro Magnet, as well as the original manuscript of Dana's Lectures, hunted up through Morse's recollection of that science as then explained by the learned Lecturer, were in evidence; but the mysterious fire in the Clerk's Office has disposed of those lectures, though the Electro Magnet is still in Court.*

At page 26 Mr. Chase says the decision of Judges Grier and Kane in Philadelphia amounts to this, that Morse was the "*proprietor of the electric current for telegraphic purposes* and that without discovering any new principle whatever."

There is no warrant for such a broad assertion either in that decision or in Morse's claims. They do not touch Wheatstone's nor any other, except *marking* telegraphs.

Page 43, Mr. Chase says "I pass, barely mentioning it here, Prof. Henry's contrivance for breaking and closing a second circuit *used in* 1833 *or* 1834, which left nothing new in point of principle to be invented by Morse or any body else for extending telegraph circuits." Nobody testifies to such use in 1833 or 1834. Henry himself, so far from testifying to *any use at any time*, is not certain that he explained it to his class before he went to Europe in 1837, and does not say that he ever did it afterwards.

Now let us see what had been done before Morse took up the subject, and in this we shall, in all sincerity, attempt to mete out *exact justice* to every one whom it is necessary to mention.

Electricity, Galvanism, sundry modes of generating them, the circuit, and modes of breaking and closing it, were known.

Oersted in 1819 discovered that the electric current, passing on the Circuit wire, would deflect a magnetic needle brought in proximity to it. This was the discovery of Electro Magnetism; a mechanical effect was then produced.

Schweiger conceived, that if the current could be made to pass several times around the needle, the mechanical effect would be increased. With insulated wire he made a coil of many turns in a shape somewhat elliptical, which he embraced in the Circuit and suspended the Magnetic needle within it. A spe-

* There is another mystery in the non appearance upon the Record of a deposition of Prof. Silliman, touching this matter.

cimen of this contrivance has been exhibited to the Court, and it is called Schweiger's Multiplier. The result was as he expected.

Arago discovered that the Electric Current passing upon a wire would attract iron filings.

Sturgeon conceived, that if a part of the Circuit wire were made to pass several times around a piece of iron, the same influence which moved the needle and iron filings, would produce Magnetism in the iron. He insulated a piece of iron rod, coiled the circuit wire spirally around it, and on applying the current, found that the iron became Magnetic. This was the invention of the Electro Magnet.

It occurred to Prof. Henry, that by applying Schweiger's Multiplier to Sturgeon's iron bar, a much more powerful Magnet might be produced. He tried the experiment and succeeded. By multiplying the turns of wire around the iron, it was found that the Magnetism was increased somewhat in proportion to the number of turns added, so that mechanical effects could be produced at greater distances on the electric circuit than with the Magnet as arranged by Sturgeon.

Henry did not invent the Multiplier, nor the Electro Magnet. His merit so far as the Electro Magnet is concerned, consists in combining together the inventions of two other men, and producing a more powerful mechanical action. He does not in his article published in Silliman's Journal in January, 1831, claim to have discovered any new principle in respect to the Electro Magnet; It is entitled "*On the application of the principle of the galvanic Multiplier to Electro Magnetic apparatus, and also to the development of great Magnetic power in soft iron with a small galvanic element,*" meaning small battery.

The application of known principles in such manner as to produce an improved result, was all he claimed.

If O'Reilly and his associates had an interest in depreciating Prof. Henry's experiments, they could doubtless employ Counsel to say as has been said of Morse's invention, that this combination of Schweiger's Multiplier, with Sturgeon's Electro Magnet was "a very simple contrivance"—one so obvious and natural, that it might have occurred to anybody, and must "inevitably" have soon occurred to somebody. Nevertheless—it was an important accession to the mass of material out of which a telegraph was to be constructed.

But Prof. Henry, as he says himself, was not in pursuit of a Telegraph, or any other particular practical result useful to society. Having made his improvement, he threw it into the mass furnished by Oersted, Schweiger, Arago, Sturgeon &c., to be employed by anybody else who had the inclination to make it useful to his fellow-men. Henry's experiments were made with little more than one-fifth of a mile of wire, and although

they conclusively showed that mechanical action could be produced by means of his improvement at greater distances from the battery than was before possible, they by no means showed that it could be produced at the distance of 100, 20, or even ten miles, and especially *they did not show* that it could be produced with a sufficient force, *to mark or indent paper.*

After what has been said, written and printed, on the other side, it may surprise the Court to learn, that it was not his improvement in the Electro magnet, which Prof. Henry said in his article of 1831 was " directly applicable to Mr. Barlow's project of forming an Electro-Magnetic Telegraph," but it was the result of an experiment to ascertain the effect of currents from batteries of different descriptions, a result apparently inconsistent with all experiment and experience before and since, but in which at the time Prof. Henry seems to have had great confidence.

To place this matter in an unquestionable light, we quote the entire passage which relates to it in Henry's article in the 19th volume of Silliman's Journal, page 403, it being in evidence in this case, viz:

" Experiment 7. The whole length of the wire [over one-fifth of a mile] was attached to a small trough on Mr. Cruikshank's plan, [a battery] consisting of 25 double plates, and presenting exactly the same extent of zinc surface to the action of the acid as the battery used in the last experiment. The weight lifted in this case was 8 oz. When the intervening wire was removed and the trough attached directly to the ends of the wire surrounding the horse shoe, it lifted only 7 oz. From this experiment it appears, that the current from a galvanic trough is capable of producing greater Magnetic effect on soft iron after traversing more than one-fifth of a mile of intervening wire, than when it passes only through the wire surrounding the Magnet. It is possible that the different states of the trough with respect to dryness, may have exerted some influence on this remarkable result, but that the effect of a current from a trough, if not increased, is but slightly diminished in passing through a long wire, is certain. A number of other experiments would have been made to verify this, had not our use of the room been limited, by its being required for public exercises.

" On a little consideration, however, the above result does not appear so extraordinary as at the first sight, since a current from a trough, possesses more projectile force, to use Prof. Hare's expression, and approximates somewhat in intensity to the electricity from the common machine.

" May it not also be a fact that the galvanic fluid, in order to produce the greatest magnetic effect, should move with a small velocity, and that in pasing through one-fifth of a mile, its velo-

city is so retarded as to produce a greater magnetic action? But be this as it may, the fact that the magnetic action of a current from a trough is *at least* not sensibly diminished by passing through a long line directly, is applicable to Mr. Barlow's project of forming an Electro-Magnetic Telegraph, and also of material consequence in the construction of the galvanic coil."

"'From this experiment,' says Prof. Henry, 'it appears that a current from a galvanic trough, is capable of producing *greater magnetic effect on soft iron after traversing more than one-fifth of a mile of intervening wire, than when it passes only through the wire surrounding the magnet.*'"

After attempting to account for a result so extraordinary and apparently so absurd, he adds, "but be this as it may, the fact that the magnetic action of a current from a trough is, *at least*, not sensibly diminished by passing through a long wire, is directly applicable to Mr. Barlow's project of forming an Electro-Magnetic Telegraph, &c."

Had this result been verified by subsequent experiment or experience, it would have saved Prof. Morse the necessity of inventing combined and local circuits, and Receiving magnets with all their delicate adjustments. And it would be a day of joy and rejoicing among Telegraphers throughout the Union, if Prof. Henry were now able to come forward with his Telegraph of a Single Circuit, *the longer the better*, running through their Register magnets, and saving the perpetual adjustment of Receiving magnets arising from the feebleness and variableness of the currents, though great improvements have been made in batteries since 1831; it would form a new era, not less distinguished than that which witnessed the introduction of the more complicated system of Prof. Morse. Unfortunately the result of this experiment turned out to be utterly delusive. The deductions of Barlow and others from previous experiments, that the magnetic force of the current diminishes somewhat in proportion to the increased length of the Circuit, became an established fact, as it is an established law of nature, and Henry's improved Electro magnet, like Sturgeon's original magnet, and the magnetic needles used by other experimenters, came under the dominion of that law, no matter what kind of battery was used, though some kinds are better than others.

These facts and circumstances show, that Prof. Henry's idea of an Electro-Magnetic Telegraph in 1831 was a *telegraph of a single circuit* based on the fallacious conclusion, that he had discovered means by which the magnetic action could be made greater with the same battery on a long Circuit than on a short one, or "*at least*" to use his own *emphasized* expression "*is not sensibly diminished by passing through a long wire.*" If this were a fact, there would be no need of combined circuits to renew the

exhausted power of the electric current. They would be but a worse than useless complication. There is, however, not the shadow of such a combination in Henry's Article of 1831, nor is it probable that then, or for a long time afterwards, his mind was directed to the means of removing an obstacle which he did not suppose to exist, particularly as his object was not to invent a Telegraph but to develope general science.

In another point of view, however, Prof. Henry's experiments were of importance. They confirmed the discovery previously made by Prof. Hare, that a current from "a trough" or from two or more plates, as in his 20th experiment, produces more magnetism in a long circuit, than a current from one plate presenting the same given surface to the acid. That the discovery was not original with Prof. Henry, is shown by his article in Silliman's Journal in which he distinctly concedes it to Prof. Hare, in his account of both his 7th and 20th experiments. Yet, Prof. Henry's experiments confirmed the discovery, and though he did not himself apply it to any useful purpose, he prepared it, so to speak, for practical application by others. It must not be forgotten, however, that this current from this kind of battery, now called a battery of intensity, though it produces more magnetism in long circuits than a battery of one pair of plates now called a battery of quantity, yet both are subject to the same law of reduction of their own magnetic influence, as the length of the circuit is increased.

It must be noted, that when Prof. Henry speaks of "mechanical action" produced by Electro Magnetism, he means any motion however feeble, such as the motion of the magnetic needle and the motion of the bar in Morse's Receiving magnet. Such "mechanical action" is wholly insufficient for Morse's purposes, and was useless to him without means to produce a much greater force.

It must also be noted, that the title "Electro-Magnetic Telegraph" is *a general name*, not confined to Morse's Telegraph, but comprehending Wheatstone's needle Telegraph, and all other Telegraphs of which Electro Magnetism constitutes the principal Agent. A force sufficient to vibrate Wheatstone's needles would be wholly inadequate to give an efficient impulse to Morse's pen. It does not follow, that when Prof. Henry or others speak of "the Electro-Magnetic Telegraph," they mean Morse's *marking* Telegraph. One kind may be practicable by an amount of magnetic force which would be wholly inadequate to give vitality to another. And of all known kinds, Morse's Telegraph requires the greatest magnetic force.

The Counsel on the other side have confounded all kinds of magnetic telegraphs together, by which expedient they give a meaning to some of the testimony which was never intended.

For instance: When Henry says that in 1831 he saw that the Electro-Magnetic Telegraph was possible, he does not mean *marking* telegraphs, which do not appear ever to have been thought of, but *signal* telegraphs which had already attracted the attention of scientific men in Europe.

This, then is the foundation on which Prof. Morse built: the discoveries and inventions of Oersted, Schweiger, Arago, Sturgeon and Henry. It was known that mechanical effects could be produced by Electro Magnetism on a circuit of considerable length, but how long was entirely unknown. Here Prof. Morse commenced his structure.

It is in evidence in the case, that as early as 1832, on board the packet ship Sully returning from France, Prof. Morse conceived the idea of his *marking* Telegraph by the application of Electricity or Electro Magnetism. He had the *result* in his mind, but he could not secure it by patent, because he had not produced it, nor could he describe a process by which it could be produced. A patent then would have been a patent for an abstract principle or result.

One portion of his means, however, was matured on that occasion, though afterwards somewhat modified, and that was his alphabet or system of telegraphic signs. Even Dr. Jackson gives him credit for that. See Jackson's letter of November 7th, 1837.

But neither could he patent that system, because he had not yet devised a plan to make them, and there was no Telegraph in existence to which they could be attached as an improvement. Though *new*, he had not yet made them *useful*. They were, however, drawn out in a sketch book fully identified in this case, but which perished in the fire which destroyed Dana's Lectures. It is in evidence, that Prof. Morse contemplated making these characters by means of an Electro-Chemical process, and that he and Dr. Jackson were jointly to make experiments after their arrival in the United States, to ascertain what solution would best answer the purpose, it being already known that if certain substances were dissolved in some liquid, and a piece of paper saturated with it, the Electric current passing through the paper would leave a visible mark.

It is in evidence, that immediately after his arrival in the United States, Prof. Morse cast certain type, corresponding with the signs or letters he had invented, which, instead of being applied to print them directly, were to be set in a port-rule in a straight line, each type representing the letter or sign intended to be printed at the distant station. These type so arranged, were then made to pass under a metallic point with which each type in its turn came in contact, closing the circuit and keeping it closed a longer or shorter time, as the type re-

presented a dot or a line. The metallic contact being broken as each letter passed, broke the circuit: at the same time the prepared paper at the other end, passing between a stylus and a metallic cylinder, both in the circuit, was to be marked with dots and lines by the chemical action of the current in correspondence with the type which closed the circuit. This contrivance was equally applicable to the making of marks by the Electro-Magnetic process; and though not in use because the operators soon learn how to regulate the requisite duration of the current by holding down the key a longer or shorter time, thereby avoiding the necessity of putting the messages in type, it might yet be employed with advantage in cases where great caution should be used to avoid mistakes.

The contemplated joint experiments of Morse and Jackson were never made, and Morse sought out separately the means of printing his characters at a distance, by means of Electro Magnetism.

In 1835 he constructed a rude machine embodying all the principles and appliances of an Electro-Magnetic Marking Telegraph by means of a single Circuit. It was just such a Telegraph as Prof. Henry supposed to be practicable from the delusive result of his experiment in 1831. But Prof. Morse was not satisfied that he could get power enough to mark at any considerable distance by means of a single Circuit. He, therefore, sought for the means of overcoming this anticipated difficulty, and he found the means in combined circuits, using the mechanical action of the first circuit, to close and break the second, and the second the third, and so on indefinitely.

Now, indeed, an Electro-Magnetic *Marking* Telegraph *was* possible and *not before.* But, let the witness, Professor Gale, tell the story. The following are extracts of his Deposition, pages 142 and 144–5 of the Record, viz:

"That in the month of January, in the year one thousand eight hundred and thirty six, I was a colleague Professor in the University of the City of New York, with Professor Samuel F. B. Morse who had rooms in the University building on Washington Square in said City. That during the said month of January of the year aforesaid, the said Professor Morse invited me into his private room in the said University where I saw for the first time certain apparatus constituting his Electro-Magnetic Telegraph.

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"It was early a question between Professor Morse and myself, where was the limit of the magnetic power to move a lever? I expressed a doubt whether a lever could be moved by this power at a distance of 20 miles, and my settled conviction was, that it could not be done with sufficient force to make characters

on paper at 100 miles distance. To this Prof. Morse was accustomed to reply, "'If I can succeed in working a magnet ten miles I can go round the globe.'" The chief anxiety at this stage of the invention, was to ascertain the utmost limits of distance at which he (Morse) could work or move a lever by magnetic power. He often said to me, "'it matters not how delicate the movement may be, if I can obtain it all, it is all I want.'" Prof. Morse often referred to the number of stations which might be required, and which, he observed, would add to the complication and expense. The said Morse always expressed his confidence of success in propagating magnetic power through any distance of electric conductors which circumstances might render desirable. His plan was thus often explained to me: 'Suppose' said Prof. Morse 'that in experimenting on twenty miles of wire we should find that the power of magnetism is so feeble that it will but move a lever with certainty a hair's breadth; that would be insufficient, it may be, to write or print, yet it would be sufficient to close and break another or a second circuit twenty miles further, and this second circuit would be made, in the same manner, to break and close a third circuit twenty miles further, and so on around the globe.'"

"This general statement of the means to be resorted to now embraced in what is called the '"Receiving Magnet,'" to render practical writing or printing by Telegraph, through long distances, was shown to me more in detail early in the spring of the year 1837, (one thousand eight hundred and thirty seven), and I am enabled to approximate the date very nearly from an accident that occurred to me from falling on the ice formed of late snow in the spring of that year. The accident happened on the occasion of removing to Prof. Morse's rooms in the New York University some pieces of apparatus to prepare a temporary receiving magnet.

"The apparatus was arranged on a plan substantially as indicated in the drawings on sheet 2 accompanying this affidavit. 1 is a battery at one terminus of a line of conductors representing 20 miles in length, from one pole of which the conductor proceeds to the helix of an Electro magnet at the terminus (the helix forming part of the conductor), from thence it returns to the battery end terminating in a mercury cup O from the contiguous mercury cup P, a wire proceeds to the other pole of the battery, when the fork of the lever C unites the two cups of mercury, the circuit is complete, and the magnet B is charged and attracts the armature of the lever A which connects the circuit of battery 2 in the same manner, which again operates in turn [on the] lever E, twenty miles further and so on.

"This I depose and say was the plan then and there revealed and shown to me by the said Prof. Morse, and which, so far as I

know, has constituted an essential part of his Electro-Magnetic Telegraph from that date, till the present time."

"It was early a question," says Prof. Gale, "between Prof. Morse and myself, where was the limit of magnetic power to move a lever." Of course, *it was early in* 1836. Prof. Morse could not tell, but he replied "*If I can succeed in working a magnet ten miles, I can go round the globe*," and he explained his plan to be the use of the first circuit to break and close a second, and so on, now called the combined circuit. And *early in* 1837, *he actually made the combination*—Prof. Morse could not have derived this idea from Prof. Henry, for the following reasons, viz:

First. He did not become acquainted with him, as appears by Henry's evidence, until late in 1837 or early in 1838. We apprehend it was really much later.

Secondly. He did not find a trace of it in Henry's article of 1831. On the contrary, that article, if he had confidence in it, must have tended to convince him that no such expedient was necessary.

Thirdly. It was never a topic of conversation between Morse and Henry, at least prior to 1839, for Henry says in his Deposition, (Record, p. 424) "I heard nothing of the secondary circuit as a part of Morse's plan until after his return from Europe, whither he went in 1838." Although at page 425, he speaks of several visits of Morse to Princeton to confer with him, they were all subsequent to 1837, about the end of which year by his account, their first acquaintance was formed. And it is worthy of remark, that, although Henry says, "I freely gave him all the information I possessed," he nowhere intimates that he had given him the least idea of combined Circuits. The reason why this combination was not spoken of by either, may be, that Henry still had faith, that with Cruikshank's battery, a battery not now in use, a current of electricity might be projected to any distance, if not with an increase "at least without any sensible *diminution*" of its magnetic "influence," and of course, did not think the expedient of combining circuits worth mentioning; while Morse believing the same thing, from Henry's information, also thought his preconceived and perfected plan wholly useless, and never mentioned it. Be that as it may, it is quite evident that the idea was not suggested by either to the other, and was probably original with both.

But an attempt is made to deprive Prof. Morse of the merit, if not the profit, of this part of his invention by a misconstruction of Prof. Henry's testimony. It is asserted that he used this very combination, and explained it to his class in 1833 or 1834. Prof. Henry makes no such statement, nor any statement justifying such an assertion. The following extract from the Re-

cord, page 42, contains all that Prof. Henry says on the subject; viz.

"In February, 1837, I went to Europe, and early in April of that year, Prof. Wheatstone, of London, in the course of a visit to him at King's College, London, with Prof. Bache, now of the Coast Survey, explained to us his plans of an Electro-Magnetic Telegraph, and among other things, exhibited to us his method of bringing into action a second galvanic circuit; this consisted in closing the second circuit by the deflection of a needle, so placed that the two ends projecting upwards, the open circuit would be united by the contact of the end of the needle when deflected, and on opening or breaking the circuit so closed by opening the first circuit and thus interrupting the current, when the needle would resume its ordinary position, under the influence of the magnetism of the earth. I informed him that I had devised another method of producing effects somewhat similar. This consisted in opening the circuit of my large quantity magnet at Princeton when loaded with many hundred pounds weight, by attracting upward a small piece of movable wire, with a small intensity magnet, connected with a long wire circuit. When the circuit of the large battery was thus broken by an action from a distance, the weights would fall, and great mechanical effect could thus be produced, such as the ringing of church bells at the distance of a hundred miles or more, an illustration which I had previously given to my class at Princeton. My impression is strong, that I had explained the precise process to my class before I went to Europe, but testifying now without the opportunity of reference to my notes, I cannot speak positively; I am, however, certain of having mentioned in my lectures every year previously, at Princeton, the project of ringing bells at a distance by the use of the Electric Magnet, and of having frequently illustrated the principle to my class, by causing in some cases a thousand pounds to fall on the floor, by merely lifting a piece of wire from the cups of mercury closing the circuit.

"The object of Prof. Wheatstone, as I understood it, in bringing into action a second circuit, was to provide a remedy for the diminution of force in a long circuit. My object, in the process described by me, was to bring into operation a large quantity magnet connected with a quantity battery in a local circuit, by means of a small intensity magnet, and an intensity battery at a distance."

It will be perceived, that Prof. Henry calls Wheatstone's Telegraph, an "*Electro-Magnetic Telegraph*," though it was a *signal* Telegraph only, which, instead of recording letters like Morse's, pointed at them by means of magnetic needles.

In a preceding part of his Deposition, Prof. Henry, after

giving an account of the results of his experiments upon the single circuit, made public in 1831, goes on to say: (page 421) "In 1832, I was called to the chair of Natural Philosophy in the College of New Jersey, at Princeton; and in my first course of lectures in that Institution in 1833, and in every subsequent year during my connection with that Institution, I mentioned the project of an Electro-Magnetic Telegraph, and explained how the Electro Magnet might be used to produce mechanical effects at a distance."

Now, were all these lectures substantially but repetitions of his article of 1831, or did they embrace the additional idea of combined circuits, as means of effecting these mechanical results? If the latter had been the case, Henry could not so far have forgotten it, as to have any doubt whether he had explained the combined circuits to his class before he went to Europe in 1837. It is in the nature of things impossible, that if, during four years' lectures, he had described this combination of means for accomplishing an end, he should have forgotten those means while he distinctly remembers the end. While he "cannot speak positively" as to ever having explained the combined circuit to his class before he went to Europe in 1837, he says "I am, however, certain of having mentioned in my lectures every year previously at Princeton, the project of ringing bells at a distance by the use of the Electro Magnet, and of having frequently illustrated the principle to my class by causing in some cases a thousand pounds to fall on the floor *by merely lifting a piece* of wire from two cups of mercury closing the circuit." Now, this is the precise mode for closing and breaking the single circuit then used in experiments, and was *not* Henry's mode of bringing into action a secondary circuit. "This" he says "consisted," (not *in a forked wire dipped in two cups of mercury* but) in opening the circuit "*by attracting upward a small piece of movable wire* with a small intensity magnet, connected with a long wire circuit." When, therefore, Prof. Henry says he is certain of having mentioned *every year previously at Princeton*, the project of ringing bells, &c., and illustrated the principle to his class "by *merely* lifting a piece of wire from two cups of mercury closing the circuit," it is as much as to say "the piece of movable wire" was not used in the process.

The solution of this matter is perfectly easy. The short single circuit used by Henry with his improvements in the Electro Magnet, was competent to all the results he *actually exhibited*, and he *used no other*. He does not pretend that he did. His impression is, not that he *used*, but that he merely *explained* the combined circuit to his class. As to results *not* produced by him, such as ringing bells at a distance of one hundred

miles, &c., *he only inferred it* might be done, basing that inference *upon his improvements in the Electro Magnet and his supposed discovery that the magnetic action from a particular kind of battery* "is *at least* not sensibly diminished by passing through a long wire."

He could draw no other inference from this supposed fact, and if it had turned out to be a fact, he could have rung bells by a single circuit not only at a distance of one hundred miles, but of ten thousand miles, and combined circuits would never have been thought of for any practical use.

Prof. Henry does not state when he first conceived the idea of combined circuits, or say positively whether he had it at all before he saw it in operation in England, in 1837. If he explained it to his class, he certainly had it, but he is not positive as to that. If he did not explain it to his class, then it is presumable he did not have it; or considered it of no importance, for he doubtless explained to his class all he knew or thought, which he considered of any importance on the subject. All that Henry proves, therefore, is, that *he had the idea in April* 1837, saw then an actual combination by Wheatstone in London, and suggested a different mode for breaking and closing the secondary circuit. But prior to that time, Morse had not only conceived but completed the combination. It is admitted that Prof. Morse neither invented nor improved the battery. Neither did Prof. Henry.

All he did in that respect was to test the capacity of known batteries in connection with his improved Electro Magnet. Nor is it any real disparagement to him, that being misled by a single experiment, he should reason that it might be "a fact that the galvanic fluid, *in order to produce the greatest magnetic effect, should move with a small velocity*," a supposition long since proved to be the reverse of the fact, as Prof. Henry's Deposition virtually establishes. Since 1831, Danielle's battery, and Grove's battery have been invented, and the latter has nearly superseded all others in the Telegraph Lines. It is composed of *cups* instead of *pairs*, and these cups generally without difference in size, are used both in the main and local circuits, so that practically in the Telegraph, the difference between what Prof. Henry calls a "battery of intensity" and a "battery of quantity" is merely the difference between a *big* battery and a *little* battery, "an *intensity* magnet" being made magnetic by a *big* battery, and a "quantity magnet" by a *little* battery; and a big battery very naturally sends out a swifter current than a little one of the same kind. But the distinctive names found in Prof. Henry's Deposition, do not appear in his article of 1831, and we regret that Science has not clearer ideas on this subject, or more intelligible terms to express them.

We feel as if we have gone into this subject with unnecessary

prolixity; for what, after all, does Henry's testimony amount to in its broadest construction, but that, in common with Oersted, Schweiger, Arago, Sturgeon and others, he has furnished some of the materials used in the Telegraph, without pretending that he produced a Telegraph, or attempted to do so?

He says himself "I left to others what I considered in a scientific view, of subordinate importance—*the application of my discoveries to useful purposes in the arts*," Record, page 424. He further says "I have always considered his [Morse's] merit to consist in combining and applying the discoveries of others in the invention of a particular instrument and process for telegraphic purposes." And if this "particular instrument and process" were the *very first* that gave to the world a *Recording Telegraph*, do they not in law entitle Prof. Morse to as full protection as if he had discovered every principle, devised every combination, and invented every particle of machinery which he employs? Patent law does not accord with the idea, that the production of useful results, is of "subordinate importance." It looks upon mere scientific discoveries as utterly useless until applied to useful purposes in the arts." Let Henry have "the consciousness of advancing science, the pleasure of discovering new truths, and the scientific reputation to which these labors would entitle him," which he says is "the only reward he ever expected,": but do not deny to Morse the reward which his country has promised him for the *more useful* if not more glorious labors, of taking in hand Henry's *barren truths*, dressing them up in the garb of utility, and sending them forth to serve and bless his fellow men.

Art. II.—MORSE'S ELECTRO TELEGRAPH.

By George Gifford, Esq.

Argument Submitted to the Supreme Court of the United States.

THE INVENTED MACHINERY—PROCESS—ART AND ACHIEVEMENT.

May it please the Honorable Court: It has fallen upon me to close the argument on the part of the appellees in this important cause, and in entering upon that duty I find myself laboring under the same embarrassment of want of sufficient time, which has been experienced by all the counsel who have preceded me. And although we thank the court for the allowance of more time for the argument than is fixed by their standing rules, yet we did believe and still believe, and after this initiatory examination of the subject, we think the court must concur with us in the belief, that still more time might have been properly and usefully appropriated to the investigation of

the vast amount of most difficult matter in this case. We are not unmindful of the other important duties of this court, nor of how great is the value of its time to the country; but we cannot avoid remembering also, how small is the value of a few days of the time of this or any other court, compared with the vast amount of time which Morse's Telegraph is daily saving to the country and world. The invention with which we have to deal in this case, is unlike those which have usually been subjects of judicial investigation by the learned members of this court; it is so, both in the agent employed and the result attained.

It employs a subtle, imponderable, invisible agent, and this, not for the manufacture of tangible things, but for the transmission of information.

It is not like the changed and varied combinations of levers, wheels, cams, cylinders, eccentrics, pinions, ratchets, and other visible parts of apparatus and mechanical fixtures, constituting improvements and inventions in the machines and devices employed in the preparation or manufacture and improvement of food, raiment, implements of husbandry, and a variety of other tangible things, by acting upon and changing the form or quality of tangible substances, wherein an occular inspection of illustrative models of wood or metal exhibits the whole essence of the invention. On the contrary, this invention is chiefly constructed of combinations, relations, and conditions far more subtle and refined, and much more difficult to be understood.

The *apparatus* and *machinery* of Morse's Telegraph, subjected here, by the aid of models, to the inspection of the court, ingenious, novel and important as it is, nevertheless presents but an humble appearance to the mind that understands and appreciates the soul of this Telegraph, imparting the mighty energy which its works alone reveal.

Nor is this power and ability a result of chance, but on the contrary it is the legitimate and designed function of a series of combined conditions and intermediate results, sustaining exact and fixed relations to each other, and though intangible, yet wrought, jointed and adjusted with more accuracy, nicety and skill than the smith displays in fitting and connecting the physical parts of his time-piece, and all indispensible to the practical control of this electric messenger, and exhibiting to an investigating mind the most refined, delicate, and effective touches of the conquering genius of the inventor.

The power of the invisible constitution of this invention is known best by its works. The unseen atmosphere in a quiesent state gives little indication of power, but when raging in the hurricane, the *effects* of this invisible agent evince its power. The body of a man gives no indication of the latent power of

reposing passion, and yet passion is the moving power of the race of men, and is known only by its works. The apparatus of Morse's Telegraph is, comparatively, simple and unostentatious; but the conditions and relations which make it a telegraph and the wonder of mankind, are intangible and invisible, and for that reason by a cursory observer, are liable to be stumbled over unappreciated. But when a feeble man, standing near a telegraph in this capitol, and by gentle touches of the finger, and within fifteen minutes, can hold converse with the remote parts of the four quarters of the Rupublic—with Maine, Louisiana, Wisconsin, and the Lakes, then it is that its inherent energies and power are exhibited in its triumphant result of intercepting time and obliterating space; and then it is that we are forced to concede that the visible apparatus is but an inadequate exponent to the Telegraph, and then we realize the necessity of a further investigation in quest of those parts and features of the invention by which, together with the machinery, it performs its gigantic feats. In this I hope to be of some service to the court. This may be thought by some to be too metaphysical, such notions, however, are not realities, but mere apologies to excuse from the labor of investigation.

As has already been stated by my colleague, limitation of time has rendered it necessary to omit comment on any minor points in this case, and for the counsel of the appellees to make a division among them of the main points submitted upon their brief, and for each to confine himself exclusively to the points within his division.

The points, on the printed brief of the appellees, cover all material matters put in issue by the pleadings in the court below, and, therefore, as we suppose, cover all that can properly be controverted here. But the extraordinary course of our learned opponent who opened the argument in behalf of the appellants, in urging his supposed right to originate here, for the first time, other issues—issues not made by the pleadings, nor heard of in the court below, and unknown to the record, and never made at all until recorded in the printed brief of the learned counsel, has given rise to certain other points appertaining to the merits of the case, the importance of presenting or omitting which will depend upon the decision of the court, on the preceding question of practice, that is, whether the appellants have a right to a tranformation of this court into one of original jurisdiction in this case, and to so frame new issues to be here tried for the first time. This question of practice fell within the division of my learned colleague, who we think, without much effort, has successfully maintained the negative of such a proposition.

And although the appellees would have had nothing to fear

from the matters involved in any such new issues, now here made and insisted upon by our learned opponents, had such issues been made in the tribunal where they could have been met by the proper testimony, yet they do protest against the right of the appellants to now and here, for the first time, present new issues involving questions of fact, which in whole or in part can be determined only by testimony; and to do this at a stage of the controversy, and in a court where new testimony cannot be offered; and they protest against this proposition as being without precedent, and contrary to the rules and practice of this court. Still, as we cannot, with entire certainty, anticipate the conclusion of the court on this question of practice, and as evidence taken with reference to other issues can be gathered from the record sufficient to meet and negative even the propositions of our opponents, founded on these new issues, we have resolved to not leave them entirely untouched, but to give them such attention only as may be consistent with a more full consideration of the other issues which were made in the court below, and which we regard as the only questions properly before this court.

Of these new issues it falls to me to consider only those involving questions made upon the re-issuing of Morse's patents, the others fell into more able hands, and have been disposed of by my colleagues.

The questions appertaining to the merits of the case properly before the court, and all, as we submit, with which they will find it necessary to tax their attention, are recorded in our brief, and have been referred to and re-stated by one of my colleagues, and it will be unnecessary for me to recapitulate them here; suffice it for me to remind the court that those falling within my division are:

1st. The patentability of the subject matter of the 1st, 5th and 6th claims of the patent of 1840, as re-issued in 1848.

2d. The patentability of the subject matter of the patent of 1846, as re-issued in 1848, in reference to its relation to and difference from anything included in the patent of 1840.

3d. Infringement.

4th. Disclaimer.

After disposing of those points, then, if time will permit,

5th. To briefly examine the new questions raised by our opponents, as to the validity of the several re-issues of the patents.

The principles of law which these points involve are so well settled, and are so familiar to this learned court, as to require no parade or exhibition of authorities and cases to maintain them. It will be more useful to dwell upon the relation between the facts and the law.

Before taking up these points in their order, and preparatory

to a consideration of them, it will be important to pause and look into the vital parts of the invention of Morse's Telegraph.

No safe conclusion can be arrived at as to whether the claims of a patent for an invention are proper or improper, or whether, and in what there has been an infringement, unless the invention be subjected to an examination sufficiently searching to determine both its *quantity* and *kind* of novelty; for as well might one attempt to decide upon a question of trespass upon land without knowing its boundaries, or how far the title of the claimants extended.

To follow the course of the inventor's mind, and make such an examination of many, and indeed of most inventions, is an easy task, while others require the exercise of the best faculties of the mind, and the most enduring patience.

Many inventions consist only of a single combination, and that too, of tangible parts of apparatus or machinery, where a slight inspection will possess the mind of all there is of it; others consist of many combinations, and are of a compound character, and therefore more difficult to understand; but the combinations of which, still being limited to parts of tangible apparatus or machinery, can easily be understood from a more careful ocular inspection. But, there are still others consisting, not only of many combinations, but of many classes of combinations; one class consisting, perhaps, of combinations in apparatus or machinery; another class of combinations of motions; another class of combinations of intermediate results; another class of intermediate conditions, and finally involving the combination together of the several classes, constituting a complicated whole, in which every element of each class or an equivalent is an efficient and important agent in attaining the ultimate and designed result of that class, and in which also such ultimate result of each class of combinations forms either an indispensable intermediate condition, or effect in attaining the final result of the whole, or an indispensable component part of the whole combination.

Inventions of this last character are, of necessity and from their nature, most difficult to understand—and such, too, bringing out great and useful results, are the ripest fruits of the longest and most indefatigable efforts of the greatest and most enduring genius; and if genius be not absolutely necessary to even understand them after produced, it is certain, that, at least, a careful, patient, and sometimes long and tedious investigation is necessary; and if any one, called to limit the magnitude of such an invention and define the merits and rights of its author, and to find division lines, and to fix the boundaries thereto, content himself with only a cursory inspection of the

visible parts of the clothing of the invention, without a patient examination of the parts which enter so vitally into its life and principle, and give it energy, efficiency and utility, he may be expected to be and remain, where he commences, upon the surface of the thing, unconscious of the grandeur, beauty and order displayed in the superstructure below; and in such case, too often, it would be by mere accident if the response to the inventor's call for protection and justice be more than an unintentional slander upon his merits and his invention. We congratulate the inventor of Morse's Telegraph, that, although the spring and summer of his life have been spent in the philanthropic work of his invention, amid alternate hopes and fears, he has lived to be present and see his invention and cause submitted to this Supreme Tribunal of his country, whose duty and desire to reward merit by justice will overrule every consideration of personal inconvenience and arduous labor, necessary for such full, ample and elaborate examination as will exclude all danger of a misapprehension, or a misunderstanding of the nature, character and extent of his invention.

Morse's telegraph partakes of three distinct classes of patentable subject matter; 1st, *apparatus or machinery;* 2nd, *process;* and 3d, an *art;* each of which, independently of the others, is a fair and perfect subject, within the law, for a patent, and any of which might have been patented without patenting either of the others, but all of which in this case, and properly too, are patented.

It will be found, on attaining familiarity with the details of Morse's invention, that it is not a want or scarcity of novelty which renders it difficult to be understood, and difficult to fix the limits of his right, but that, on the contrary, this results from the greatness of the amount and the diversity of novelty included in it.

If Morse's invention consisted only of novel apparatus, or only of a novel process, or only of a new art, then it would be comparatively easy for the mind to embrace and identify it, and then there would be less danger of injustice to the inventor from any omission or mistake. As it is, however, it is a severe task to become so familiar with the many things about the invention, and the character of the objections raised to Morse's rights, as to avoid error in conclusion. We hear it said by some that Morse is undoubtedly the inventor of his peculiar apparatus or machinery, and *ergo*, not of a process or art; by others that he is unquestionably the inventor of his peculiar process, and *ergo* not of the apparatus or an art; by others, that he is the inventor of a new art, and that it is no matter as to the process or apparatus; by others, that he is evidently the inventor of the process and apparatus, and could not be of an art; by

others, that he must have been the originator of the art and process, and *ergo*, it is of no consequence about the apparatus; by others, that he may have discovered the art, but could have invented nothing but the machinery.

Now, one difficulty appears to be, that all of them are right in part and all wrong in part; they are all right in their premises, as far as they go, but are all wrong in their conclusions; they content themselves with erroneous conclusions, somtimes from inability to comprehend others, and sometimes from a want of patience to investigate, either of which, in the end, exhibits the same error and mischief.

It does not follow, that because Morse's Telegraph contains many points of novelty within one class of patentable subject matter, that it may not, or does not also partake of other distinct classes of patentable matter. The fact is, that Morse's invention contains novelties of each class; that is, in machinery, process, and art; and it were monstrous if the magnitude of the invention were allowed to diminish instead of enhancing acknowledged merit. Nor does it follow that he has no right to *claim* and *patent* the novelties of each class because there are others in other classes, nor because of the still additional novelty of the several classes being combined as a whole.

Under the first point which I am to discuss, I desire here, as a means of developing the magnitude of Morse's invention, and exhibiting the rich treasures of his genius, to present four views in relation to his telegraph.

1st.—Preparatory to a due appreciation of the means, I will briefly notice the nature and character of the specific objects to be attained by it.

2nd.—I will next submit an analytical view of the component parts or elements of the process.

3rd.—I will endeavor to present a like view of the essential character of the machinery, or physical parts of the invention.

4th.—I shall attempt, and, I sincerely believe shall be able, to demonstrate that Morse's Telegraph embraces within it a new and patentable art.

To be continued.

Art. III.—THE ANCIENT AND MODERN TELEGRAPH.*

SENTINEL TELEGRAPH—FIRE PILES—INDIAN RUNNERS—CARRIER PIGEONS—TELESCOPES—CANNON REPORTS—ROCKETS—ELECTRIC—ELECTRO-MAGNETIC.

"Canst thou send lightnings, that they may go, and say unto thee, 'Here we are?'"—*Scripture.*

It is even so. The inquiry has been answered in one grand and magnificent sense. The querist and man of patience little dreamed, when using this grand metaphor to give greater effect to his reproach, and to illustrate the power of Omnipotence, that he was but uttering a eulogy upon science, while he claimed for the Deity but an attribute within the province of mortal triumphs and mortal genius. "Canst thou send lightnings, that they may go, and say unto thee, 'Here we are?'" That restless and ambitious thing, the human mind, undeterred by the subtlety of divine themes, or the awfulness of ethereal problems, has boldly pushed investigation throughout the domain of electrical phenomena, and fettered the hoary potentate of storms on his very throne. Nay, it has torn away the sceptre of the fierce god, sequestered the elements of his realm, and tamed the spirit of tempests to do the weak bidding of man. Science in this has surpassed itself. It has not only accomplished a prodigy, but has worked a miracle—a miracle so vast, so incomprehensible, that the age, much as it has advanced in knowledge and enlightenment, cannot compass the extent of the discovery to which it has given birth. The lightnings have been trained to utter the language of men! Can we conceive of anything more sublime or grand? more thrilling or lofty in the field of imagination? We aspire in our arrogance to count the suns and planets within the visual range; explore the scope of the physical heavens; transfer light and revealed darkness to canvass; imitate the works of the Creator in senseless stone; compress air into dense and powerful bodies; generate a motive agency from water; follow comets and blazing heralds through trackless wastes; and knowledge and science in these pursuits have acquired immortal honors. But what is all this to subjugating the lightnings, the mythological voice of Jehovah, the fearful omnipotence of the clouds, causing them in the fine agony of chained submission to do the offices of a common messenger—to whisper to the four corners of the earth the lordly behests of lordly man!

* From De Bow's Review.

But for the present, we shall treat of only one branch of the subject.

Telegraphs were doubtless invented coeval with the institution of society, or the organization of communities. In primeval days, sentinels stood upon the house-tops, and by gestures and postulary signs, communicated the intelligence with which they were charged. Messages were conveyed long distances by means of trumpeters stationed on contiguous hill-tops, who by minding certain tones from their instruments, could readily and intelligibly convey their tidings from place to place. When intelligence of a peculiar character was desired and expected, piles of combustible matter were prepared on elevated points, and watchmen appointed to guard and light them at the appointed signal. *Clytemnestra*, in the Agamemnon of *Æschylus*, gives us a beautiful description of these journeying telegraphs. The watchman of the tower has nightly scanned the horizon for ten long years, in vain to catch the gleam that is to announce the fall of Ilion. At last it comes:—

A gleam—a gleam from Ida's height,
By the fire-god sent it came;
From watch to watch it leapt, that light,
As a rider rode the flame.
It shot through the startled sky,
And the torch of that blazing glory
Old Lemnos caught on high,
On its holy promontory.

And it sent it on, the jocund sign,
To Athos, mount of Jove divine,
So that the might of the journeying light
Skimmed o'er the back of the gleaming brine;
Faster and farther speeds it on,
Till the watch that keep Macistus steep
See it burst like a blazing sun!
Doth Macistus sleep
On his tower-clad steep?

No! rapid and red doth the wild fire sweep:
It flashes afar on the wayward stream
Of the wild Euripus, the rushing beam!
It rouses the light on Massapion's hight,
And they feed its breath with the withered heath.
But it may not stay,
And away—away—
It bounds in its freshening might, &c., &c.

Another mode of telegraphing was by employing fleet runners, who bore despatches with almost incredible celerity. The monarchs of Mexico were noted for their corps of Indian messengers, who were able by co-operating together, to carry a message a distance of two hundred and fifty leagues in a day. Primitive European nations had legionaries, who, with elevated spears, sent tidings afar; and succeeding generations substituted the telescope, the mirror, the cannon, and the carrier pigeon.

Rockets came later, then the post-boy, and finally the wooden structures, which may yet be found in many parts of Europe, and which, in some respects, bear a close similarity to the windmill edifices against which Don Quixote expended so much fruitless ire and aggressive valor. The post-coach, however, despoiled these inventions of much of their importance and utility. Carrier pigeons were wholly dispensed with; rockets were tossed out of the civil community into the military ranks; the modern colossus, with its ponderous arms, was deemed indispensable only in extraordinary emergencies, or for marine purposes; the telescope was valued only for discerning objects at a great distance, or was turned over to the use of philosophers; by common consent, the mirror was awarded to the ladies, and became, if not their exclusive, their chief source of delight; and whatever other modes of telegraphing remained, if any, were allowed to become obsolete, or were consigned to oblivion. Science had been active in its researches; and discovery led to discovery, until at length the world was "startled from its propriety" by the introduction of the steam engine and the railway, those stupenduous revolutionizers, that are fast linking, in indissoluble ties of fraternity, nation with nation, and interest with interest, until, anon, in this iron embrace, they "shall know war no more."

But science had yet to achieve a greater, may we not truly say its greatest triumph? It has been so since the application of the mind to the investigation of great subjects, that in solving an intricate problem, we find that the secret is also the key to the solution of another; and this progress in mental conquest demonstrates the necessity of new and untried instruments for the hand. On this basis, or by this parity of reasoning, we naturally arrive at this conclusion: that without genius, science would be powerless; without science, ignorance would predominate over knowledge. We are apt to marvel, that in this nineteenth century so many profound truths in philosophy, and secrets in art, have been brought to light, compared with what has been divulged or discerned during the past centuries; but let us not forget, that a fragmentary knowledge of our new electric telegraph had existed in the human mind for hundreds of years; it needed only a master mind to unite the elements; a master hand to forge the mechanical instruments, to show to the wondering world the perfect work. And, as one impediment is overcome, all other obstacles are easily surmounted. The art of expressing thought with types, perhaps, suggested the idea of conveying to the eye images of nature in print from modern blocks. It may be, that the optician, in attempting to improve the focal powers of spectacles for the eye, was moved to conceive the idea of the telescope. But what suggested the spectacles,

if not some previous effort of the mind to unlock the secrets of science, and which mechanical skill turned to permanent and valuable good?

The first telegraph constructed on purely scientific principles, was an instrument closely resembling the common telescope now in use. The author of the invention was Robert Hooke, a philosopher of the seventeenth century. Hooke, however, furnished no system of signals with his instrument, and he died disappointed in finding that his genius had attracted so little attention. But the attempt, abortive, as it had been, to supersede the modes of telegraphing in vogue by some new and untried method, stimulated the philosophers of Germany and France to employ their inventive faculties to the same end. Four years after the death of Hooke, William Amentons, a Frenchmam, of Lisle, brought forward a plan, the details of which he had plagiarized from Hooke; but the principal feature, and that for which he claimed originality, was the table of characters which accompanied it. This table contained the letters of the alphabet, and a key explained to the operator the signs or signals that expressed the sense of the letters, or any combination thereof. Persons stationed at appropriate distances along a line or route, could despatch messages with considerable facility by this invention. But Amentons came to Paris at a wrong period. He laid the result of his labors before the royal court; but it was a time when vice and debauchery held undisputed sway there—when virtue was jeered at from the throne to the peasant, and genius was left to neglect and starvation. Amentons was not more successful than Hooke had been.

But science was not to be deterred from its great purpose, despite the ridicule of royal concubines. Marcel next stepped into the arena of discovery; then Linguet, Dupuis, Edgeworth, Bergstratter, and a host of others of less pretensions. Marcel pined and labored in poverty, and died without reward in obscurity, cherishing his fond project to the last. He aimed to perfect his scheme before he divulged it to the world; but failing to incite confidence, and obtaining no succor with which to prosecute his studies, he burnt his designs, buried his secret, and "wrapping his cloak about him, brooded in silence and despair, until relieved of his burden of life," which event happened soon after. Linguet had little to lose, and everything to gain by a discovery. He was at this time, and had long been, an inmate of the Bastile, and perhaps after all, his pretension was a *ruse* by which to obtain his liberty. He, however, asserted that he had invented a telegraph which would supersede all others, and proposed to exchange the secret for his enlargement. It is not known whether government ever paid any attention to the inventor; at all events, his plan, whatever it was, never enlisted

the encouragement or patronage of any one. Edgeworth put forward greater claims than all his predecessors or contemporaries; but meanwhile the German philosophers had inundated Europe with every variety of plan and design of telegraph, so that it would be difficult to particularize in what Edgeworth had been original, or what he had borrowed without credit from his rivals and competitors.

Claude Chappe, a French theological student, of Angers, "who was," according to a living writer, "so indolent that his parents thought him fit for no other profession than the church," was the originator of the telegraph which still bears his name. His brothers were at a school three leagues distant, and Claude had frequent occasion to communicate with them; but he most heartily detested the journey which he was compelled still to undertake before he could reach them. One day he set about cudgeling his brains how to obviate this difficulty. The result of many experiments was the invention of the upright post, re-revolving beam, and circulating arms—those frightful wayside giants which are still to be seen whirling and striking, and gyrating, and rioting in many parts of the Old World. Chappe was inspired with a new idea at the success of his plan. He cast aside his indolence, and began a series of experiments, the fruits of which have made his name illustrious. As soon as he had improved and systematized his scheme, he repaired to Paris, and explained its principles and operations to the republican assembly. This was in 1792. France was at war with the great powers, and early intelligence was of the first importance to the authorities of the capital. After an official trial, his project was highly approved, and himself dubbed *Ingénieur Télégraphe.* The first message this telegraph conveyed to Paris, was the announcement of the surrender of Conde to the Republic. France then wholly adopted the system, and placed the brothers Chappe in the office of general superintendence.

When we come to consider the necessities of speedy deliveries of intelligence in our present day—the augmentation of commercial and maritime interest—and the increased importance of despatch in every department of political and social intercourse—it seems impossible that we can put too high an estimate on the electro-magnetic telegraph discovery. National and individual interests, half a century since, might not have required the employment of a more active agency than the horse-express, or the post-coach; but the steam vessel and the steam carriage have brought nations together, and consolidated states, and it is as expedient that continents should now be traversed in an hour, as fifty years since the same distance should not consume more than two months.

Electricity—that wondrous power which has succumbed to

the will of man—has two essential properties, both of which have been tried for telegraph purposes; but for a period of two thousand years the skill of man was baffled in determining the distinct nature of these two properties, and in what manner to bring them separately or in combination under control. Thales, the philosopher, and founder of the Ionic sect, discovered, six hundred years before the birth of Christ, that Greek amber, when rubbed, exhibited certain properties of attraction which it did not otherwise possess. Thales, however, was too intent on mathematical problems and astronomical calculations to pay much attention to what may have appeared to him an insignificant phenomenon. Besides, it was an age grossly lax in the pursuit of scientific studies. Science was taught, but it was the science of philosophy, and not of art. It was an age when men reasoned from dogmas and abstractions, not from sound theories and natural objects. Electrical phenomena were not unknown to the scholars that succeeded Thales, either in Greece, in Asia, or the islands of the Mediterranean. But no schools, then established, incorporated the study of this branch of philosophy in their classics, and no attempt was made to inform the understanding on a subject which embraces themes the vastest and profoundest of any explanatory of the physical creation. Plutarch, Pliny, Cæsar, Aristotle, Theophrastus, and others, eminent scholars of antiquity, relate that they have seen electrical phenomena of the most marvelous and unaccountable character, but they have purposely omitted details, owing, without doubt, to their ignorance of the subject; and, indeed, they do not seem to have taken even ordinary pains to master this defect.

It was not until near the close of the sixteenth century that the nature of electrical phenomena began to be understood. A German, by the name of Gilbert, published a work entitled *The Magnet*, in which all the then known properties of electricity are treated together, with some observations on the earth and air. Of course, the wildest conjectures are here put forth as sober axioms, while many since ascertained truths—in fact, the primary principles themselves—are unceremoniously dismissed. Gilbert's work, although an embodiment of errors and absurdities, had the good effect of inducing the philosophers of the age to think. Institutions of learning were springing up everywhere, and rare minds, well stored, were leaving the cloister and academy, prepared to expound and instruct, and to contend for those prizes which the ancients had disdained to touch. Halley was the most prominent of these, who succeeded Gilbert; while Halley in turn was soon to be eclipsed by Otto Guerike, a Prussian, who constructed an electrical machine which consisted of a sulphur globe, made to rotate by means of a winch; and with this simple apparatus, and a cloth pressed

against the globe, he discovered the existence of a controllable electric fluid, and that this electric fluid could be made to pass from one body to another without actual contact. This was a grand and sublime discovery. It was the first real step toward the final establishment of the electro-magnetic telegraph.

MUSINGS OF A TELEGRAPHER.

BY GEO. G. W. MORGAN.

Oh, man! how graciously on thee has Heaven
Bestowed its varied gifts to make thee blest;
Each element of earth to thee is given,
The visible and latent; amongst the rest,
The Telegraph, e'er willingly to pay
Its service—[Sir, we aint at work to-day.]

What hope! what joy! each day to thee is known,
Whilst space, a captive, bound, is at thy door,
Brought from the Frigid or the Torrid zone,
To yield his tribute and increase thy store,
And backward flies the tyrant to his zones—
"[Is any answer here for Mr. Jones?]"

Speedy o'er earth and sea, 'mid frost and cold,
And forests where the untamed brute is free—
No slave of man has ever toiled for gold
With half the zeal that it has toiled for thee—
Asking slight tribute for the service made—
"[To send this South, sir, it must be prepaid.]"

Affection, Friendship, Love, a mighty debt
Owe to this willing, never-failing slave.
"All safe and well—pray, write me; don't forget."
"Father is sick—I fear too sick to save"—
"Wife's got a bouncing boy." All in a breath.
Well, such is life, or rather Life and Death.

Oh, Commerce, thou art blessed; to days gone by—
No power now can hold thee in its chains;
Unfettered hence thine outspread wings may fly,
And at thine ease can coolly count thy gains.
"Please stop my goods, for Buncombe this day failed."
Oh, dear; oh, dear; these Com's must all be mailed.

[Leaf and Fruit of the Gutta Percha Tree.]

Art. IV.—GUTTA PERCHA.

ITS DISCOVERY—NATURE—QUALITIES—COMPARED WITH INDIA RUBBER—CHEMICAL PROPERTIES.

Gutta Percha—the Malayan term given to a concrete juice taken from the Isonandra Gutta Tree—is indigenous to all the Islands of the Indian Archipelago, and especially to the Malayan Peninsula, Borneo, Ceylon, and their neighborhoods,

where are found immense forests of this tree, yielding this product in great abundance. Its fruit contains a concrete edible oil which is used by the natives with their food. The gutta (or juice) circulates between the bark and the wood of the tree, in veins whose course is distinctly marked by black longitudinal lines. The natives were originally in the habit of felling the tree when they required a supply, but have been taught by experience that the juice can be obtained by cutting notches at intervals in the trunk, and save the life of the tree for future tappings, as our maples for successive years yield their sap to the sugar manufacturers. The juice consolidates in a few minutes after it is collected, when it is formed by hand into compact oblong masses of from seven to twelve or eighteen inches in length by four to six inches in thickness, and these when properly dried, are what is known as the Gutta Percha of commerce.

It is only ten years since the knowledge of the existence of this ductile secretion dawned upon the world. Dr. Montgomerie, an assistant surgeon at Singapore, observed in the possession of a native, the handle of a wood-chopper of such singular material that it awakened his attention, and on inquiry and examination he found it to have been made of the juice of this strange tree,—becoming plastic when dipped in hot water, and when cold regaining its original stiffness and rigidity. Within this brief period, the exudations of these dense forests have assumed, more especially in England, innumerable forms. It is singular indeed, that there should circulate in the veins of the primeval forests of Malacca and the neighboring Isles, a sap or juice so long a stranger to the civilized world, possessing such extraordinary virtues, and in the short period of ten years entering so largely and variously into the service of man, and destined to become his servant in a greater variety of forms than any other material yet discovered.

The Gutta Percha of commerce is of a light brown color, exhibiting a fibrous appearance, much like the inner coating of white oak bark, and is without elasticity. When purified of its woody and earthy substance, it becomes hard, like horn, and is extremely tenacious; indeed its tenacity is wonderful. Mr. Burstall, of Birmingham, refering to some experiments testing the strength of tubes composed of this material, says:—"The tubes were 3-4–inch bore, the material 1-8 thick. They were tested by the Water Company's proving pump, with its regular load of 250 pounds to the square inch; afterwards we added weight up to 337 pounds, and I wished to have gone to 500, but the lever of the valve would bear no more weight; we were unable to burst the pipe." Another gentleman, Mr. Andrew Robertson, of Stirling, says:—"I am of opinion that no other material is so well fitted for the above purpose (ex-

tinguishing fires and watering the streets in dry weather,) as Gutta Percha; for, although our pressure is perhaps the greatin the Kingdom, being upwards of 450 feet, not the slightest effect could be discovered on the tube or joints, while the same pressure on our leather hose sends the rivets in all directions."

The application of heat to this crude material makes it soft and plastic, and in a temperature of about 200 degrees it becomes quite ductile, when it is capable of being molded into any desired shape, which it will retain when cool. It can be dissolved by Sulphuret of Carbon, or Chloroform, or if immersed for a time in spirits of turpentine. It is repellant of and completely unaffected by cold water, but is softened and made adhesive by warm water. It is a *non conductor of heat* and electricity; is proof against alkalies and acids, being only affected by the sulphuric or nitric in a highly concentrated state; while the most powerful acetic, hydroflouric or muriatic acids, or chlorine have no perceptible effect upon its structure or capabilities. This gum has qualities entirely differing from the India Rubber. It cannot be worn out. It can be melted and remelted, and repeatedly remolded, without changing its properties for manufacture or losing its virtue. It is lighter than rubber, of finer grain, and possesses certain repellant properties unknown to that material; and is extremely tough. It disregards frost, and displays remarkable acoustic qualities.

In its crude state, Gutta Percha has no resemblance whatever to India Rubber in appearance, nor are its chemical or mechanical properties the same, nor does the tree from which it is taken belong to the same botanical family, or grow in the same latitudes or soil; yet, from the fact that it could be dissolved and wrought into water-proof wares, many have inclined to the belief that the two materials are identically or nearly the same.

Gutta Percha when immersed in boiling water, contracts in bulk.

India Rubber when immersed in boiling water, expands, and increases in bulk.

Gutta Percha juice is of a dark brown color, and consolidates in a few moments after exuding from the tree, when it becomes about as hard as wood.

India Rubber sap is perfectly white, and of about the consistency of thick cream, when it coagulates, it gives from four to six parts water out of ten; it may be kept like milk, and is frequently drank by the natives.

Gutta Percha first treated with water, alcohol, and ether, and then dissolved with spirits of turpentine and precipitated, yields a substance *consistent with the common properties* of Gutta Percha.

India Rubber similarly treated, results in a substance resembling in appearance the Gum Arabic.

Gutta Percha by distillation yields 57 2-3 per cent of volatile matter.

India Rubber by the same process yields 85 3-4 per cent.

Gutta Percha in its crude state, or in combination with other materials, may be heated and reheated to the consistency of thin paste, without injury to its future manufacture.

India Rubber if but once treated in the same manner will be destroyed and unfit for future use.

Gutta Percha is not decomposed by fatty substances; one application of it is for oil vessels.

India Rubber is soon decomposed by coming in contact with fatty substances.

Gutta Percha is a non-conductor of cold, heat and electricity, and, in its natural state, is non elastic, and,with little or no flexibility.

India Rubber is a conductor of heat, cold, and electricity, highly elastic and flexible.

The specific gravity of Gatta Percha is much less than that of India Rubber,—in proportion as 100 of Gutta Percha is to 150 of India Rubber.

Chemists, who have analyzed them, vary a little as to their chemical proportions, but all agree, that the chemical properties and mechanical action of Gutta Percha and India Rubber are so entirely distinct and dissimilar, that they should never be classed under the same head, chemically or mechanically any more than commercially.

M. Arppe, a celebrated German Chemist, says Gutta Percha differs in composition from Caoutchouc, and that the products of dry distillation of Gutta Percha are different from those of Caoutchouc. He considers Gutta Percha to be a mixture of six resins, which have been formed from a Carb-Hydrogen.

Art. V.—ANCIENT AND MODERN HERALDRY.

NUMBER ONE.

EARLY HISTORY—ARMORIALS—GREAT SEAL OF MAINE, NEW JERSEY, VIRGINIA, SOUTH CAROLINA, KENTUCKY, MISSOURI, UNITED STATES—TELEGRAPH CONFEDERATION — KNIGHTS OF THE ROUND TABLE—HOSPITALERS—TEMPLARS—ST. ANDREW'S CROSS—ST. GEORGE'S CROSS—ORDER OF GOLDEN FLEECE.

Many of the Electric Telegraph lines of America have adopted peculiar heraldric seals, dies or stamps, representing their individuality, upon their official envelopes or message-heads. With a view to be in unison with the majority of the lines in this matter, we have gotten up a seal for the general Confederation, and we propose to give an account of the origin of its heraldric symbols, with their meanings.

We had another object in view in having engraved the seal above mentioned, viz.: Many lines were unwilling to believe that arrangements of the Secretary could effect or procure envelopes as well embossed as the respective companies could themselves. The seals of the Confederation excel anything of the kind ever gotten up before, and the impressions, embossed, will doubtless convince the lines, that the Secretary can not only equal pre-existing arrangements of companies in this particular, but excel them. It will be perceived, that the most splendid dies can be made through the arrangements of the Secretary, and the most antique and scientific armorials, known in the science of Heraldry, properly grouped and delineated on the dies. We now proceed to discuss the subject of Heraldry generally.

We learn from the science of law, that it has been a custom from the earliest ages of the world, for the people to have and enjoy various devices, signs, and marks of honor, designed to distinguish the great and noble from the common or ignoble. In Homer, Virgil, Ovid and other ancient authors, we find notices of these customs, and that heroes on the battle-field had figures of different kinds, but, of their own device, represented on their shields, whereby they might be distinguished one from the other, as well as from those of a lower order of warriors. This custom was the origin of using the shield and device thereon in armorial life, and even at this day they are prominent features in heraldric science. From the earliest ages to the present time nations have adopted symbolical signs as marks of distinction, indicating the nation by a flag, on which was illustrated their peculiar symbolic representation. The flag

of the Athenians had on it the figure of an owl, the Goths a bear, the Egyptians an ox, the Romans an eagle, the Franks a lion, and the Saxons a horse. In modern times we see the custom adhered to with equal desire among nations: — thus on Great Britain's flag is represented St. George's and St. Andrew's cross; Mexico, the eagle, the serpent and the cactus; and the United States, the eagle, stripes and stars. These symbols are peculiarities of the respective nations, and the recollection, or sight of them, in the hour of peace or war, infuses into the people a pride and glory for the brilliant renown which may characterize their own dear flag.

Symbolic representation has not been confined to the earliest and modern ages of the civilized world, but we also find it among the customs of the North American Indians. We have seen the otter as the emblem of the Ottaway tribes of Indians, the wolf, the bear, the turtle, and other devices the adopted emblems of the Iroquois and other tribes. They paint them on their bodies, and represent them as a species of idols.

An author supposes, that in Europe the Crusades and tournaments were the cause of methodizing and perfecting into a science the various national, family and individual emblems, to which was given the name of *Heraldry;* a term which embraced originally not only all that pertains to *Coats of Arms*, but also to the marshalling of armies, solemn processions, and all ceremonies of a public nature. Is is also supposed, that the term, *coats of arms*, originated from the circumstance that the ancients embroidered various colored devices on the coats they wore over their armor. Also, those who joined the Crusades, and those who enlisted in the tournaments, had their devices depicted on their arms or armor, as on their shields, banners, etc.; and as colors could not be retained, particular marks were used to represent them.

All coats of arms, formed according to the rules of heraldry, are delineated on shields or escutcheons, which are of various forms—oval, triangular, heptagonal, etc. The parts composing the escutcheon, or represented on it, are tinctures, lines, borders, charges, etc.

By tinctures, we mean the various colors used, the names and marks of which are as follows, viz.: *Or* means gold or yellow, and is represented by dots or points. *Argent* means silver or white, is plain. *Azure*, or blue, is represented by horizontal lines. *Gules*, or red, by perpendicular lines. *Vert*, or green, by diagonal lines from upper right corner to the lower left, or to the lower right as you face the shield. *Purpure*, or purple, from upper left to lower right, being reversed from map rule as to right and left. *Sable*, or black, by horizontal and perpendicular lines crossing each other.

Charges are whatever may be represented on the field of the escutcheon; the principal of which, in addition to natural and celestial figures, are the Chief, the Pale, the Bend, the Fess, the Bar, the Cheveron, the Cross, and the Saltier; each of which, although occupying its appropriate space and position in the escutcheon, and governed by definite rules, admits of a great variety of representations.

The external ornaments of the escutcheon are crowns, coronets, miters, helmets, mantlings, caps, wreaths, crests, scrolls, and supporters. Some escutcheons have none of these ornaments, and others nearly all of them. The supporters are placed on the side of the escutcheon standing on a scroll, and are thus named, because they appear to support or hold up the shield. The great seal of the State of Maine has a shield, supported on the right by a husbandman resting on a scythe, representing agriculture, and on the other is a seaman resting on an anchor, the symbol of commerce and the fisheries. The great seal of the State of New-Jersey has a shield supported by the goddess of *Liberty* on the right with a wand and a cap, those being symbols of independence, because among the ancients the *rod* was used by the magistrates in the ceremony of manumitting slaves, and the cap was worn by the slaves who were soon to be set at liberty, and hence they have been handed down from time immemorial as symbolical of liberty and independence,—they are fit emblems of the United States! Many of the seals of the States are designed to represent some peculiar era in its history, regardless of heraldric science: thus, Virginia, after the struggles of 1776, adopted a seal fitly representing the feeling pervading the hearts of her great and chivalrous people. On one side of the seal the goddess of Virtue, — the genius of the Commonwealth —is represented dressed like an Amazon, resting on a spear with one hand, and holding a sword in the other, and treading on Tyranny, which is represented by a man prostrate, a crown fallen from his head, a broken chain in his left hand, and a scourge in his right. Above the goddess is the name of the State, and underneath the words, *Sic semper tyrannis*—"thus we serve tyrants." While this side of the seal represents exultation over the surrender of Yorktown and the triumph of the American arms, the other side contemplates some reflection as to future glory and happiness. In the centre is the goddess of Liberty, with her wand and cap; on the right hand is Ceres, with the cornucopia in one hand and an ear of wheat in the other, and on her left side is Eternity, holding in one hand the globe, on which rests the Phœnix, the fabulous bird of the ancients, that is said to rise again from its own ashes.

The great seal of South Carolina is another symbolic repre-

sentation of the feelings of the people. The device is a date-tree, or the great palm, emblematical of the State, which is supported by two cross-pieces, to which is attached at the junction or cross a scroll or label. Branches of the palm were worn by the ancients in token of victory, and hence the emblem signifies *superiority*, *victory*, and *triumph*. On the border of the seal is the name of the State and its motto:—*Animis opibusque parati*,—"Ready (to defend) with our lives and property."

The great seal of the State of Kentucky was adopted shortly after the confederation of the thirteen original States, and her people, filled with the good feeling of union and universal good-will and peace with all mankind, adopted a very plain symbol, which has ever proved characteristic of the noble and generous-hearted Kentuckian. It is formed of two men, as friends embracing, with a motto in plain English: "United we stand, divided we fall." Such were the sentiments entertained by the sires of that great State,—renowned for having the names of the greatest men of the world recorded with golden capitals upon her bright and glittering escutcheon.

The great seal of the State of Missouri, being of more modern origin than those heretofore mentioned, is somewhat classical in its arrangement. It is composed of "Arms parted per pale; on the dexter side, gules, the white or grizzly bear of Missouri, passant, guardant, proper; on a chief engrailed, azure, a crescent, argent; on the sinister side, argent, the arms of the United States;—the whole within a band inscribed 'United we stand, divided we fall.'" For the crest, over a helmet full faced, grated with six bars, or a cloud proper, from which ascends a star, argent, and above it a constellation of twenty-three smaller stars, argent, on an azure field, surrounded by a cloud proper. Supporters on each side, a white or grizzly bear of Missouri, rampant, guardant, proper, standing on a scroll inscribed with the motto, *Salus populi, suprema lex esto;* and under the scroll inscribed MDCCCXX., the whole surrounded by a scroll inscribed with the words, "The great seal of the State of Missouri." The following is the recognized explanation to the above: The arms of Missouri are represented on a circular escutcheon, divided by a perpendicular line into two equal portions. On the right side, on a red field, is the white or grizzly bear of Missouri, in its natural color, walking guardedly. Above this device, and separated from it by an engrailed line (indented and waved), is an azure field, on which is represented a white or silver crescent. On the left side of the escutcheon, on a white field, are the arms of the United States. Around the border of the escutcheon are the words, "United we stand, divided we fall." For the crest, over a yellow or golden helmet, full faced, and grated with six bars, is a cloud

in its natural color, from which ascends a silvery star,—representing the State of Missouri—and above it a constellation of twenty-three smaller stars, on a blue field surrounded by a cloud. The twenty-three stars represent the number of States in the Union at the time of the admission of Missouri. For "supporters" on each side of the escutcheon is a grizzly bear in the posture of attack, standing on a scroll inscribed with the motto, *Salus populi, suprema lex esto*,—"The public safety is the supreme law." Under the scroll is the date of the admission into the Union, etc.

We have now devoted more space to the seals of States than at first contemplated, but we have done so with the view of showing the fact of heraldric science being blended in the coats of arms of the States of the Union. Having thus noticed a few of the armorials of the States, we will now notice, briefly, the grand national seal of the United States, which was adopted June 20th, 1782, by Congress.

"ARMS: Paleways of thirteen pieces, argent and gules; a chief azure; the escutcheon on the breast of the American eagle displayed, proper, holding in his dexter talon an olive branch, and in his sinister a bundle of thirteen arrows, all proper, and in his beak a scroll inscribed with this motto, *E pluribus unum.* For the CREST: Over the head of the eagle, which appears above the escutcheon, a glory, or breaking through a cloud, proper, and surrounding thirteen stars forming a constellation, argent, on an azure field."

The paleways of thirteen pieces is symbolic of the original thirteen United States that formed the general confederation of the American Union. The thirteen stars and arrows are representatives of the same fact. The stars are on an azure field, and hence the blue field on the flag of the United States. The stripes of the flag represent the paleways of the escutcheon, being gules or red, and argent or silver colors. Thus the flag is composed. Its heraldry is simple and beautiful, full of language, and expressive of great events. The remembrance of the revolutionary times, when the fathers of the American confederacy fought bravely for the supremacy of the will of the people, infuses into the soul new life and affection for the Declaration or Magna Charta of Freemen's Rights.

The grand seal of the American Telegraph Confederation is composed of the most ancient heraldic devices, beautifully illustrating patriotism, renown and virtue. He who follows through life the index of their morals, will be recognized by the world as the noblest work of God—an honest man.

The grand seal we describe thus: the escutcheon, ornamental border, quartered; the first and fourth, the arms of the United States; the second, armorial of Mexico; the third, armorial of

Great Britain, having reference more particularly to the provinces of the Canadas, New-Brunswick, Nova Scotia, and Prince Edward's Island. The crest, an American eagle, erect with out stretched wings, standing upon a silken wreath, azure, gules and argent. In eagle's beak a scroll, on which is inscribed "*E pluribus unum.*" In rear of eagle, cloud proper, from which issue the orders of cuspidated lightning; in rear of escutcheon, the staffs of two United States flags cross at centre, and the colors unfurling—top the staffs, spears and three tassels. The whole being surmounted with a garter, on which is inscribed, American Telegraph Confederation. In the arrangement of this splendid composition of science and art, we have enjoyed the gratification of having the aid of Prof. H. Hays, formerly of one of the principal Heraldic Colleges of England, who is now extensively engaged in his profession at 341 Broadway, New-York. Prof. Hays has, in the execution of this engraving—and also many others which he has engraved for lines of Telegraph—excelled in talents and genius anything of the kind we have ever before had the pleasure of seeing. As a scholar in Heraldry he is eminently worthy of the highest mark of distinction. We thus speak frankly and voluntarily our indebtedness for the valuable and novel information he has so kindly imparted to us relative to this beautiful and antique science and art.

Having given a description of the seal according to heraldic rule, we shall proceed to give the origin and history of the several devices, grouped in its formation. We will then give their explanation as compounded and their application to the telegraph enterprise, and argue, that by a just fulfilment of their teachings, the system of telegraphing would be that which we all deem essential for success and universal satisfaction.

Nations, societies, and enterprises have, from time immemorial, adopted devices as mottoes to infuse into their followers zeal and love for the cause espoused. To see an army of men, battling with another, each with the most restless determination, one army following a flag with a cross and the other army a crescent, we would readily know they were under different religions,—the former Christians and the latter Mohammedans. The sight of a nation's flag rearing from the battlements of a defeated foe, is one of the most powerful incentives in war. Where can there be found a soul living within the pale of the American Union, whose heart is not filled with pride, chivalry and enthusiasm, on hearing the touching lines written by a bard of Maryland during the late war, when the enemy was not far distant from the commercial metropolis of his native State—his native land? The poet spoke those lines

on the Star-Spangled Banner, as though his soul was enveloped in a sea of glory.

So it is with other nations. The poets seem to be inspired, and the same inspiration spreads from heart to heart, until all feel brimful of joy in the achievements of their arms. Not only nations adopt devices around which the people rally, but also religious sects, societies, &c., have symbols peculiar to the principles which give them birth and existence.

Without further comment as to the practice or custom of the past and present ages, uniting in the use of the science of heraldry, we shall proceed to give an account of the different orders of honor, preparatory to the history of the Garter, which surrounds the escutcheon of the grand seal of the American Telegraph Confederation. In giving the history and legitimate meaning of the Garter, we shall also include the crosses of St. George and St. Andrew, the symbolic flag of the Canadas, New-Brunswick, Nova Scotia, or British Provinces. In considering these subjects, we shall transfer in many instances the language of authorities which we have extensively consulted, in studying the complicated subject.

The grounds and causes of founding societies and knightly orders were several and different, though all terminated in one end. Among the principal objects creating these orders were, a desire or love of *honor*, and therein chiefly to excite and promote *virtue* by suitable rewards. Such was the design of King Arthur, when he formed himself and other martial men into a fellowship, which he styled "Knights of the Round Table." Another cause of the origination of the orders was to redress the incursions and robberies of the Saracens and barbarians, to vindicate the oppressed, redeem the enslaved, and to entertain and relieve pilgrims and strangers, which were a part of the duties of the Knights-Hospitallers and Templars. Another reason for their establishment was to fight in defence of the Christian faith, against pagans and infidels. Lastly, when sovereign princes perceived themselves embroiled in wars or dangerous factions, the erection of orders tended to create a tie, restore peace, quiet all jealousies, unite affections, and secure a lasting friendship and powerful assistance, both for their own and their country's safety. To this end badges of several orders were devised and worn.

With a view to illustrate the further origin of the orders, a few of these will be noticed.

Knights-Templars.—About the year 1117 this order originated. *Baldwin* II. then reigning in Jerusalem, nine gentlemen, of whom two were of noble extraction, *Hugh de Paganes* and *Godfrey de St. Osmer*, came in devotion to the Holy Land. They were called Brothers of the Militia of the Temple, ordina-

rily Knights-Templars, from the habitation assigned them out of a part of the king's own palace, adjoining the temple of Solomon of Jerusalem. Their first undertaking was to guard the most dangerous ways about that city against the violence and robberies of the Saracens, which made them acceptable to all, and for which they had remission of their sins; but for the first nine years they were yet so poor, that they lived upon the alms of others, and wore clothes bestowed in charity upon them. In memory of their primitive poverty, their seal had the impress in *Math. Pans.* A. D. 1127. They had rules assigned them, drawn up by St. Bernard, Abbot of Clairvaux, by the appointment of Pope Honorius II., and Stephen, Patriarch of Jerusalem. They made their vows of obedience, poverty and charity. Their garb was white, to which in the time of Eugenius III. they added the red cross, and of the same form as worn by the Hospitallers. For a long time, in conjunction with the Holy Sepulchre Hospitallers, they defended and supported the kingdom of Jerusalem, but when their riches increased and their revenues augmented, they grew proud, fell from the obedience of the Patriarch to join with the Pope, and at last, 1370, all the Knights of this order in France were in one hour seized and imprisoned by *Philip le Bel*, king of France, with consent of Pope Clement V., being charged with the most infamous and damnable crimes. In England, *Anno* 1. *Ed.* 2, they were also apprehended afterwards, rendered convicts, and all their possessions seized into the king's hands. Two years after, many of these knights were burned in France, and *Jaques de la Maule*, the last Grand Master, suffered the fate of being burnt at the stake in the year 1320. This Grand Master having seen his noble order dissolved forever, as he thought, he cared but little how soon his end might come. Their lands were annexed to the Hospitallers.

Thus fell for a time the noble order of Knights-Templars, no less famous for martial achievements and renown in the East, than their wealth in the West. They held 16,000 lordships in Europe, and their revenue was two millions of francs yearly. There can be no doubt but what their end was the result of ambition in the bosom of Philip, king of France, and no historian attempts to screen that king from accomplishing the wicked act by suborning witnesses to sustain the points of his restless and ill-designed ambition. The order remained dormant for a long time, but there were a few who escaped from the fatal axe, and in a few years they formed associations, continuing in this private manner to retain their existence for many years; they ultimately became blended with the ancient and honorable fraternity of Free Masons, and to this day hold with singular affection to the ancient rites practised hundreds of years ago.

Editorial.

THE COMPANION.—The first number of the COMPANION, New Series, has been sent forth to the patrons of the work, and thus far has met universal approval. We feel gratified at this result, as we are fully aware of the difficulties attending a publication of this character. We cannot commend all, nor can we do justice to many questions of decided merit. Many subscribers did not receive their number timely, owing to the loss of nearly the entire publication by fire, just as it was ready for the mail. It has been reprinted, and we hope for better luck in future. We need all the patronage of the enterprise, and we hope that these losses will induce those who wish to subscribe, to do so at once. Every operator, president, superintendent, director, and agent of a Telegraph Company ought to be a *bona fide* subscriber to the Companion, and besides, render all the aid in their power to make the work useful to the rising generation of telegraphers.

SCIENTIFIC AMERICAN ON PATENTS.—Our remarks in the January number of the COMPANION, relative to the hostility of this publication to the Morse Patents, seemed to have fired up its editor with horrible indignation, and his answer is couched in language neither creditable to the writer, nor respectful to the dignity of the paper.

In the notice of the COMPANION, no disrespect was intended, and the language cannot be interpreted to be otherwise than courteous. We knew his article did do Morse injustice, and the editor of a daily paper in the City of New-York, who, having read the paper charging Morse with being associated with others, to buy his renewal through Congress, as insinuated by the *Scientific American*, stated, that he was inclined to believe it, and suggested, that the best means of a contradiction, would be for Prof. Morse to contradict it through the press. We heard a friend of the *Scientific American*, and an enemy of Morse, rejoicing over the article in question, in a hotel in New-York, referring to the paper for proof of his assertions. There were others who interpreted the article as we did. We may not have sufficient intelligence to comprehend the writings in the above paper, but we are certain of one fact, that is, that we know how to treat and respect the writings of a cotemporary with gentlemanly manners.

REGULATIONS OF COMPANIES.—We have received the rules and regulations of several Telegraph Companies, and for which we thank our friends for placing such valuable information into our hands. We design, in the next number,

to review the rules of the Atlantic and Ohio Telegraph Company, and such others as we may have room for, intending to embrace the regulations of every Company in America ere we are done. We think that it will tend to bring about a uniformity of system.

Batteries.—We have received several articles on galvanic batteries, applicable to the Electro Telegraph, but for want of room they are deferred for the next number. We are always glad to hear from gentlemen on subjects pertaining to the Telegraph.

Size of this Number.—Owing to the delay in business resulting from the late fire, and our own illness, the present number contains only 48 pages.

New-York and Boston Line.—Since our last number went to press, we have had opportunities of witnessing the working of this line. It has been very generally repaired, the old iron insulators removed, and the brimstone insulators banished from the face of the earth. Think of it, gentlemen westward of the Mountains, of a line between two of the principal cities of the United States, having brimstone insulators! Can any one marvel why this line has worked so badly? The wonderful and untiring zeal of Mr. Wood has already redeemed the line from that gloomy mantle that seemed to inclose in its folds the whole line. With Mr. Wood as Superintendent, and Mr. Smith at New-York, and Mr. Richards at Boston, the old pioneer line from Boston to New-York can ere long, if not now, rival in splendor the working of any line in the world. They are competent telegraphers, and capable of mastering any difficulty. Besides these, there are others on the line whose skill and ability are not a shade behind the best corps of operators in the Union

Engravings and New Register.—The number for March will contain some very fine engravings of a new Register, designed for universal use. It will be one of the most complete pieces of machinery ever presented for use on any line. Companies needing new Registers, would do well to wait until they hear fully as to this one. The engravings of the Relay Magnets will be in the next number also, as well as the keys and such other parts as we may deem necessary. We are progressing finely in furnishing supplies for the respective lines, and with a little effort to get all things moving correctly at first, we anticipate much good to result from our arrangements, enabling lines to procure materials at reduced rates.

National Lines.—The range of lines known by the above title is composed of several companies, commencing at No. 23 Wall St., New-York; they run to Philadelphia, Pittsburg, Cincinnati, Louisville, Nashville, Vicksburg, Natchez, to New-Orleans. This is termed the Southern and Eastern connection, and is the only range having two or more wires the entire distance. Lines to Cleveland, Chicago, St. Louis, &c., &c., diverge from points mentioned on the above route. The business from New-York and other Eastern cities with New-Orleans on these lines is very great, and the public

ought to feel greatly indebted for the promptness with which it is executed. The public, however, never feels grateful for anything, and though the lines above use the greatest care, and spare neither money nor labor to secure a regular communication between the cities, the patronage is such as to enable the lines to pay but little upon the investments Pertaining to the capital invested in telegraphing, we contemplate saying something about it ere long. We give the following newspaper notices of the National lines.

Heavy Business in Telegraphing.—The National Telegraph line was in fine working order on Saturday, and communicating directly with the principal Eastern and Western cities. We learn from the obliging reporters that the number of messages left for transmission, during twenty-four hours, were 310, over 100 of which were for New-York, and the number received from all points was 261, making an aggregate of 571! without including what are termed "office messages." This is a large business for a single day, and we doubt if it has ever been beaten in the annals of Southern telegraphing.—*New-Orleans Paper.*

Another Great Telegraphic Feat.—The Southern and Eastern lines, uniting at Louisville were again working last night through from New-Orleans to New-York and back, a distance of over two thousand miles, without repeating. The history of telegraphing will not show an instance in the world to surpass this. It is certainly working the largest circuit in the United States. The lines, of course, are in fine order, and the companies are reaping the reward of their diligence. From fifty to one hundred and fourteen messages per day are passing and returning between those two distant cities. On Saturday, the 10th, the office of the New-Orleans and Ohio Company, at New-Orleans alone, received for that day's business $553 78, or at the rate per month of twenty-six working days, of $14,397 28. If this line can be kept working as it has been recently, it will realize the most sanguine expectations of its early friends.—*Louisville Journal.*

Wonders of the Telegraph.—Saturday evening the operators in the New-York and New-Orleans National Telegraph offices were holding a social chat in regard to matters and things in general, as if they were situated in the same apartment. The following conversation occurred in regard to the expected arrival of the steamer. Mr. Fuller, the reporter for the associated press at New-Orleans, came into the office there, and asked if the steamer had arrived yet, when New-Orleans asks New-York if the steamer has arrived. New-York says, "Not yet, but is hourly expected; she is nearly three days over due, and much anxiety is manifested in regard to her." New-Orleans says, "Thank you, that came good."

The distance from New-York to New-Orleans by the route the line runs is about 2,000 miles, and this is the first time in the history of the electric telegraph in this country, when direct communication was had over half that distance, without rewriting; and it is quite certain that such a feat has never before been performed on this globe. Just imagine, parties separated 2,000 miles communicating with each other as if they were face to face.—*Cincinnati Commercial.*

Complimentary.—We publish the annexed correspondence with great pleasure, and regret we could not give an engraving of the beautiful testimonials presented. The recipient of this splendid reward of merit, Mr. T. S. Faxton, of Utica, New-York, has been connected with the telegraph for many years. He has nobly stood by his line in the hours of adversity, and he left it in prosperity. Those who have been in like difficult places know

how to feel for him. We admire his energy, and hope his years will not end before his talents and services will be again in the cause.

PRESENTATION.—Some days ago we noticed that a beautiful Malacca Cane had been prepared for presentation to T. S. Faxton, Esq., by the employees of the New-York, Albany and Buffalo Telegraph Co. Since then the gift has been presented, accompanied by a letter expressive of their regard, to which he has replied in a manner characteristic of the man. We give copies of the note, and Mr. Faxton's acknowledgment.—*Utica Paper.*

UTICA, Dec. 1, 1853.

THEODORE S. FAXTON, Esq.—Dear Sir:—The Superintendents and Operators of the Company over which you have until recently presided, have assigned to me a task most grateful to my own feelings; and although I may but feebly and imperfectly give expression to their sentiments on the occasion, yet I trust you will give full credence to the sincerity in which they are presented.

The difficulties through which you have brought the Telegraph to its present maturity, were but little known except to those associated with you in the business; they, however, fully appreciated them; they can testify to the indomitable perseverance with which the many vexatious embarrassments incident to its early history were met and overcome; and thus the "visionary experiment," as the Telegraph was wont to be considered, triumphantly established as a permanent and invaluable auxiliary to the business of the times.

As a mark of their appreciation of the ability and energy by which your management was distinguished, but more particularly to express to you their regret that circumstances have induced you to withdraw from the position you have so honorably occupied, the employees of the New-York, Albany and Buffalo Telegraph Company very respectfully request your acceptance of the accompanying Cane, as also an assurance of their ever retaining a pleasing recollection of the frankness and kindness by which your business relations with them were characterized.

I am, dear Sir,
Yours very respectfully,
EDWARD CHAPMAN,
Treasurer N. Y., A. & B. Telegraph Co.

UTICA, *Dec.* 3, 1853.

E. CHAPMAN, Esq., Treas. N. Y., A. & B. Tel. Co.

DEAR SIR:—Your favor of the 1st inst., accompanying a splendid Cane from the employees of the New-York, Albany and Buffalo Telegraph Co., has just been presented to me. You will allow me to express to them, through you, my feelings of gratitude for this mark of their approval of my business intercourse with them while associated with them in the duties of telegraphing.

As you justly remark, the Telegraph enterprise was truly considered a "visionary experiment," but time and perseverance have demonstrated its practicability, and its utility is now appreciated by every business man in Christendom.

It is to me a source of gratification to know that almost every hand connected with this token of regard commenced their telegraphic occupation with this company, and have been connected in the business with myself up to the time of my resignation.

It is with pleasure I accept the gift, the value of which is not to be estimated by dollars and cents. It is entitled to a higher and more worthy consideration, inasmuch as it is a free-will offering from those whose esteem I shall always endeavor to hold in due regard.

Accept for yourself, and those associated with you in the business, my best wishes for your prosperity and happiness.

Yours respectfully,

T. S. Faxton.

Great Discovery.—A Universal Telegraph.—*The Mining Journal* minutely describes the marvellous improvements effected by Mr. Wilkins in the electric telegraph, by which the system bids fair to be thoroughly revolutionized. Mr. Wilkins is a telegraph engineer at Hampstead, and has secured a patent for his extraordinary invention, which will be made available to the public by the Universal Electric Telegraph Company. The improvements for which Mr. Wilkins's electric telegraph will be distinguished are intended to meet all existing defects. It will form one of its very peculiar and striking characteristics, that instead of the message being, as at present, expounded often by guess, liable to be misunderstood or mistaken from variations of the index, or from many other causes, *the message will be written by the telegraph instrument itself.* By means of his singularly ingenious apparatus, the message leaves the telegraph written on paper by the instrument in clear and distinct characters, delivered in a continuous line and unvarying position. It is not even dependent, as was formerly proposed, on the chemical action of the electric fluid on certain sensitive colors, but the machine will enable parties to perpetuate an accurate record of the message, the value of which, in all intercourse, as well in affairs of State as in all legal, monetary, and commercial transactions, is almost incalculable. The ingenuity is perfectly marvellous which arranges the telegraphic apparatus to be worked by the electric current in such a manner as to give motion to a marker, or tracer, and thereby impress, mark, or otherwise render visible, in a continuous line on paper, characters representing letters, words, and figures on the recording surface, which is kept constantly moving by means of clockwork, or other suitable machinery, while the characters are marked, or otherwise produced by the electric current, in a fixed manner, capable of being read upon it. By a contrivance of surpassing ingenuity, the transmission of the message will be simultaneous to any number of radiating stations without the aid of intermediate operators, only one operator being required at each telegraph. This branch of improvement is effected by a delicate piece of machinery, the "Automaton Repeater," by means of which any number of towns or places, within the circle of connection, may be communicated with at the same moment by one and the same electric touch. Mr. Wilkins's plan is also remarkable for the extreme simplicity of the telegraph, for one wire will be sufficient; and in order to prevent the uncertainties which have impeded the development of the telegraphic system, he has devised a superior plan of insulators. It is calculated to insure the most perfect and unerring accuracy by the total absence of quivering points and needles, and by abstaining from the use of chemical preparations, always liable to mislead and very often to fail. It will possess this further great advantage, that by a return communication the message will be repeated at the place from which it is sent, instantaneously with the delivery of it at the place for which it was intended, and the person sending it will thus be enabled at once to see, himself, that his message has been accurately transmitted, the telegraph, without any other intervention, in effect insuring its accuracy. The directors contemplate telegraphic communication with nearly 800 principal towns and places in the United Kingdom, irrespective altogether, when necessary, of railways. The company propose to establish district offices in all or most of the towns and places in the kingdom, containing over 2,000 inhabitants, for the purpose of receiving and transmitting messages upon the principles of radiation. When unerring certainty is thus assured, and the price and means of general communication brought within the reach of every person, it will be difficult

to speculate upon the possible extent to which the public may avail themselves of these proposed benefits.

The above is from the English Mining Journal. The editor seems to be rejoiced, and anticipates great results from this new and splendid achievement! As compared with the tardy system now used in England it certainly is a great stride towards perfection, and ought to be universally accepted. The system boasted of will not be adopted, because it is the invention of an American. Let the editor refer to the archives of the English Patent Office, about June, 1838, and he will find an application on file for a patent by Prof. Morse, of America, for the same invention, now newly proclaimed by the Journal. Morse was refused a patent because a description of his invention had been published. It seems that England was not only unjust enough to refuse Morse a patent for a *bona fide* invention, but now wishes to claim the invention as her own, fifteen years after it has been before the world. The plan may be to claim it as English to guarantee success. *Indocti discant, et ament meminisse peritis.*

New-York, Buffalo, and Chicago Range.—This range of lines is now better connected than ever, and transmits business from New-York to Chicago with one writing. The lines have been well insulated, and increased energy has brought them to a state of perfection never attained before. The Superintendent of the New-York end, Mr. Palmer, informs us that they can now transmit business as prompt and correct with Detroit, Chicago, and the West, as can be done on any range of lines of equal length in the country. The end is great, and we hope their success will be triumphant. We clip the following notice from an exchange paper:

Telegraphic Feat.—Messages were received in this city yesterday, *via* the Morse, New-York, Albany and Buffalo Telegraph, *direct* from Chicago; and we learn that arrangements have been perfected by which messages will be hereafter sent between the two cities in a single circuit.

Pictorial Life of a Telegrapher.—We are advised of the early issue of this interesting publication, containing some seventy engravings illustrating how telegraphers live and act. We have seen the original copy, and feel fully authorized to say, that it will be a work of interest and fun. It will be published at Louisville, Ky., by Mr. George Rutherford, of the National Lines, to whom subscriptions may be sent. We copy the following from the *Louisville Times* pertaining to this publication on the Telegraph:—

We are also advised of a forthcoming Pictorial work on the order of Cruikshanks' graphic caricatures, being the adventures of a telegrapher, the parties and scenes all being connected with the New-Orleans and Ohio line. It is a matter of some pride as well as pleasure to the editor of this paper, as the chief manager of that company, to be able to state, that all these pioneer enterprises in telegraph literature are the work of gentlemen who have been or are now connected with him in business. It speaks well for the talents, enterprise and industry of the respectable and eminently intellectual corps of telegraphers connected with this great Southwestern Telegraph line extending from Pittsburg to New-Orleans.

MAYSVILLE SUBMARINE CABLE.—We noticed in the former number of the COMPANION, that the Maysville cable had failed. Since then, another has been constructed, which has proved successful. The following we take from one of the Western papers, viz.:—

We are gratified in being able to state, that the New-Orleans and Ohio Telegraph Company, after repeated failures, and at a great expense, have at length succeeded in securing a double submarine crossing at Maysville, Ky., being the first submarine cable with two perfectly insulated wires yet laid, so far as we know, in the United States. Mr. J. B. Sleet has accomplished this work, under the directions of Mr. Tanner, President.

The New Orleans and Ohio and St. Louis and New-Orleans companies have laid a greater length of submarine cables this summer, of the kind to resist such obstructions as occur on the Western waters, than all other lines in this country. There are now five cables on these lines, viz: the double wire cable at Maysville, and single wire cables across the Tennessee and Ohio rivers near Paducah, the Mississippi at Cape Girardeau, and Merrimac eighteen miles below St. Louis."

Besides the above, there is a cable across the Ohio at Cincinnati on the House line, also at St. Louis on the Wade line. The latter was the pioneer cable. None but Mr. Andrew Wade had the courage to risk the expense. It has resisted the floods nobly.

HALIFAX AND BOSTON LINE.—We learn that this line continues to prosper and that its business is greatly increasing. We call it one line, though composed of two companies,—the Maine Telegraph Company and the Nova Scotia Electric Telegraph Company. Mr. James Eddy is the Superintendent of the former, and since his line has made a direct connection with Boston, the business is performed with much more speed and accuracy. We copy the following notice from a New-Orleans paper, and though speaking very justly of the merits of the line, exhibits great ignorance, as there is no House Telegraph east of Boston.

"We are gratified to learn," says the *Charleston Courier*, "that great improvements have just been made in telegraphic facilities between New-York and Halifax, by which communications, which heretofore have been re-written at four or five different points, are now sent direct, with but a single repetition. The new plan enables the lines to transmit messages in less than one-quarter the time heretofore required, and also lessens, in a very material degree, the liability to make errors. Messages were sent to and received from Halifax in the space of five minutes, via the House Printing Telegraph line. The distance by telegraph between Halifax and New-York is about one thousand miles."

SANDY HOOK TELEGRAPH.—We take the following notice of this important line from the New-York *Times*. We admire the spirit of the editorial, and wish the merchants would properly appreciate the great value of the electric communication with that point. Sometimes we see them very liberal—would give any amount of money if the line was in order that they might hear from a given vessel, but when the line is in order, fifty cents for a message over a line of about 120 miles long, without other offices or business to sustain it, looks to some of them as "large as a cart-wheel." Mr.

Walter O. Lewis is the lessee of the line. The House instrument is used. We hope he will have better luck than telegraphers generally.

"The great value of the New-York and Sandy Hook Magnetic Telegraph Line to the underwriters, and to the whole shipping interests of the city, has been well illustrated within the past few weeks, as through that channel most important and minute information has been conveyed from stranded vessels in the vicinity of Sandy Hook, to their owners and underwriters in this city, by which means many lives and much valuable property have been saved. The line is, as yet, but partially organized for business, but we trust its attentive Manager may receive adequate support from the underwriters and shipping merchants of the city, to enable him to perfect all of his arrangements for working it in the most efficient manner. Mr. Lewis, the Manager of the line, may be found at all hours at the office of the Company, No. 19 Wall-street, corner of Broad-street."

NOTICES OF THE COMPANION AND TARIFF SCALE.—The following from the *Louisville Times*, edited by Col William Tanner, President of the longest range of lines in the world, with whom we have been associated for many years, thus speaks of the COMPANION. We feel thankful for his good opinion:—

"This is one of the series of useful, practical publications which the genius and the enterprise of the present age have produced in rapid succession to an extent never before known in the periodical literature of this country. The great industrial pursuit of which it is an advocate and exponent, has, within the brief period of eight or nine years, established for itself claims upon the attention of the world not surpassed, if equalled, by any other enterprise of science and art of the present century. Any publication devoted exclusively to this vast and increasing pursuit, properly conducted, must command the attention, not only of the thousands of intelligent persons connected with it, but of the public at large.

"This unpretending monthly is designed not only to enlighten the public in regard to the principles of the science, but to inform those engaged in the business of the details of the system and of its success and progress It will be the repository of every thing interesting connected with each line operating under the Morse patents in the United States, and will record all improvements, suggestions, and new inventions for the more successful prosecution of the business; and in fine, will be a medium through which will be made known all that is connected with telegraphing.

"The position of the editor as Secretary to the voluntary confederation of the managers of the various lines will enable him to have access to all such sources of information as it may be proper to impart to the public, and his industry and long connection with the business are guarantees that he will do his part faithfully in making the work all that it promises to be.

"We are promised in a few days, from the same publishers and editor, a *Compound Tariff Telegraph Scale*, to be published monthly, in the same form as the COMPANION, containing 32 pages, with corrections and additions as they may occur. This, also, will be an eminently useful work, and should receive the encouragement of every company in the Union. It will enable every telegrapher to know what to charge, and every person using the telegraph lines, to know just what he has to pay for a message sent to any point in the United States or the British Provinces.

Here is a notice from the *Evansville Journal*, edited by A. H. Sanders, Esq., who always writes well, and is a judge of a good work. We always admired his good taste:—

SHAFFNER'S TELEGRAPH COMPANION.—We are indebted to Tal. P. Shaff-

ner for the January No. of a new work of which he has just commenced the publication at New-York, of the above name. It is issued monthly, at $2 per annum, or with the Telegraph Chart at $3. It contains a large quantity of reading matter devoted to Telegraphy in all its branches. It is a work almost indispensable in telegraph offices, and one which would prove useful to any reading man. Mr. Shaffner is well known in the West as a builder and superintendent of lines, and as an energetic business man. He is a fluent writer, and fully conversant with telegraph matters, so that he cannot help making a good telegraph periodical.

Extract of a Letter from Freeman Brady, Operator, Washington, Pa.—"Sir:—It affords me pleasure to be able to contribute a little aid to you in your praiseworthy, and, to a telegrapher, essentially necessary enterprise. Your COMPANION is replete with useful information, not only to a person engaged in the business, but to all persons who take any interest in the advancement of science. Your TARIFF SCALE is of the utmost value to Companies, and renders it the greatest aid to operators in charge of offices."

Extract of a Letter from C. Bassit, Operator, Roscoe, O.—" Your publications for January are received, and I am very much pleased with them. I need a work devoted to the details of practical telegraphing. Is there such a work published?"

[There is no such work in existence at present, though there is one in preparation.—EDITORS.]

Extract of a Letter from A. E. Trabue, Operator, Nashville, Tenn.—" I sincerely hope your Magazine will be the companion of every operator in the country. It is full of interest and information for telegraphers."

We publish the following notice to the respective Telegraph Companies of America, and hope it will tend to increase the zeal among them to be represented on that occasion. There are questions of very great importance that will be introduced to the Convention, requiring all the wisdom that can be associated to act upon, with proper consideration. We hear of the intended presence of a large representation.

To the Morse Telegraph Companies of America:—

The next Annual Convention of the American Telegraph Confederation will assemble at Washington City March 6th, 1854, and all companies using the Morse American Electro-Magnetic Telegraph are requested to be represented by one or more delegates. A general attendance is earnestly requested, as matters of importance to the system of telegraphing are expected to be brought before the Convention.

P. P. FRENCH, *President.*

WASHINGTON, *January*, 1854.

SHAFFNER'S

TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. I. MARCH, 1854. No. 3.

Art. I.—MORSE AMERICAN TELEGRAPH PATENTS.

CONTROVERSY WITH O'RIELLY—PEOPLE'S LINE TO NEW-ORLEANS—COMPLETED IN 1848 TO NASHVILLE—APPLICATION FOR INJUNCTION—THE COLUMBIAN TELEGRAPH AN INFRINGEMENT—MORSE SUSTAINED—INJUNCTION AWARDED—VIOLATORS ARRESTED—THE LINE SEIZED BY THE MARSHAL—THE BAIN SYSTEM—APPEAL TO SUPREME COURT—THE FINALE OF THE LINE—MORSE PATENTS OF 1840 AND 1846.

On the 13th of June, 1845, Prof. Samuel F. B. Morse, and associates, entered into a contract with Henry O'Rielly, granting to the latter the right to construct a line of Morse's Electro-Magnetic Telegraph from the seaboard to St. Louis, and to the principal towns on the Lakes. Morse and associates inserted in the contract a prohibitory clause against O'Rielly's extending the line to New-Orleans, expressly reserving that right to the patentees. Ere the line had reached Pittsburg from Philadelphia, a misunderstanding arose between the patentees and Mr. O'Rielly. The press throughout the land were burdened with circulars of caution, proclamations of fraud, and supremacy of respective rights. In December, 1847, the line was finished to St. Louis. By the exercise of great energy, worthy of a nobler end, Mr. O'Rielly obtained the popular furor in his favor, and against the merited and just rights of Prof. Morse. The people and the press regarded Mr. O'Rielly as a public benefactor. Success crowned his efforts within the range of his contract from Morse. In the midst of this conquest, his discretion became confused; and his enmity to Morse and associates, encouraged by public manifestation, made to order, induced him to make a grand but desperate bulge towards New-Orleans, totally regardless of all propriety, the dictates of sound reason and justice to the rights of Morse, whose invention he had and was using on

the immense range of lines constructed under the contract of June, 1845. It was a leap from prosperity to adversity—from an Eden to a vortex of fatality! Whatever may have been the misunderstanding between the patentees and Mr. O'Rielly, a justification of the construction of the line to New-Orleans, and the efforts to destroy the property of Morse, can find no existence. The grand moral code of society is unstained with a word in its defence upon its bright pages!

The public and the press joined with Mr. O'Rielly at the time, and thus encouraged, he felt sanguine of success. Rapidity of construction, regardless of permanency, was the test with the public as to the relative rights. The first flash to a city or a town determined who was right and who was wrong. Thus the public became accessory in the deeds of error, in a shameful waste of the rights of an American inventor, who now, by the decree of a tribunal, elevated above the poisoned fangs of sordid minds, proclaim to the world, through the heralds of the Supreme Court of the first nation on earth, that Morse is the true and original inventor of that grand and most wonderful art—the ELECTRO-MAGNETIC TELEGRAPH.

About the 23d of December, 1847, after the failure of other efforts, Hon. Amos Kendall and Hon. F. O. J. Smith, feeling provoked at the unwarrantable proceedings of Mr. O'Rielly, contracted with William Tanner and Tal. P. Shaffner, of Kentucky, to construct a line of Telegraph from Louisville to Nashville, Tenn., and from Louisville to Lexington, Ky., the same to be a section of the line to New-Orleans, and to the East therefrom. Messrs. Kendall and Smith advanced about $20,000 in the building of this section.

As soon as the existence of the above contract was known to Mr. O'Rielly, he placed a large force to work in constructing the line south of Louisville. Here commenced the race for New-Orleans. The parties agreed to occupy separate sides of the road, to avoid confusion and conflicts among the workmen. The O'Rielly line, proclaimed as the People's Line, was completed to Nashville about the last of February, 1848. The Columbian Telegraph was announced and put in operation. The equivalent for the Relay Magnet was a series of electro-magnetic multipliers, each being composed of a magnetic needle delicately suspended, and placed within a longitudinal coil of copper wire, covered with silk thread. In this arrangement, the needle is extremely sensitive of the least current transmitted through the coil. The wire passing many times above and below the needle, tends to move its poles with the united influence of the whole, and in the same direction; so that the effect of a single wire becomes multiplied in nearly the proportion of the number of times the coil passes above and below the needle. A needle thus circumstan-

ced, with a divided circle to measure the angle of deviation, constitutes an instrument termed a galvanometer, or, as it was first termed, *electro-magnetic multiplier*. Faraday, by means of a delicate instrument of this kind, succeeded in identifying common and Voltaic electricity as a source of electro-magnetic action. The application of this instrument as a part of the Columbian proved defective, owing, we believe, to its extreme sensitiveness. The Mutator was then introduced in its place, to perform the functions of a Relay Magnet. This instrument will hereafter be described as understood by the Court and explained by the inventor.

To enable the reader to understand the nature of the Columbian Telegraph, we copy a description of the Register, and Mutator, and history pertaining thereto, from the opinion rendered by the Hon. Thos. B. Monroe, of the District Court of the United States for the District of Kentucky, viz. :—

COLUMBIAN TELEGRAPH.

"The only question under this head is, upon the identity of the Telegraph of Mr. Morse, and the Columbian Telegraph employed by the defendants. The operations by the defendants are not controverted. They put their defence exclusively on the ground that their Telegraph is not within the description and given specifications found in the schedule of the patents under which the complainants assert their exclusive right.

"Now, having given a history of the invention of Mr. Morse, and its introduction into public use, it will be but equal to give the like history of the invention of the Columbian instrument, and how it was introduced to the public.

"It happened that Mr. Morse and his associates, in their anxiety to promote the establishment of lines of Telegraphs, and extend their operations, in June, 1845, entered into a contract with this Mr. Henry O'Rielly, by which he undertook, on terms then agreed upon, to raise the capital for the construction of a line of Telegraph from Philadelphia, or other convenient point on the great seaboard line, by the way of Harrisburg, and other intermediate towns, to Pittsburg, and thence through Wheeling and Cincinnati, and such other towns and cities as the said Henry O'Rielly and his associates might elect, to St. Louis, and also to the principal towns on the Lakes.

"It turned out, that under this contract, some progress having been made in the raising of capital and constructing Telegraph lines, the parties differed in respect to the contract, in relation to what had been done, and their rights. And,

"In this controversy, Mr. O'Rielly found what induced him to determine to establish a line of Telegraph from Louisville, via

Nashville, and other towns, to New-Orleans not under color of his contract, or otherwise claiming under the patents of Mr. Morse, but in disregard thereof.

"There was evidence that he at first represented that he had the right to establish these lines under his contract with Mr. Morse and others, and so operate under his patents, but this pretension was shortly afterwards abandoned.

"He was not, however, in the situation to contest the validity of the patents of Mr. Morse.

"He had formed joint stock companies, for the construction of Telegraphs, obtained the subscriptions, and induced his associates to advance their money on the faith of the validity of these patents. And,

"In the formation of such associations, he had reserved to himself and the owners of the patent large portions of the stock, and, of course, the right to corresponding shares of the dividends; and which was accorded to him on no other consideration but the supposed exclusive right of the patentee.

"The other partners subscribed and advanced their money. Mr. O'Rielly subscribed the patent rights of Mr. Morse, and was to have the same ownership in the joint stock, and dividends upon it, which the capitalists were to have upon their money, actually advanced.

"If, then, these patents were null, he was committing frauds upon these subscribers, to the full amount of the interest in the joint stock companies, he had, by such means, so reserved and secured to himself and the owners of the patent.

"It did not then become him to denounce these patents, and declare that all claims to rights under them were worthless. Such an admission on his part, in one of these associations he had formed on the north of the Ohio, would have at once established that he had no right in it, but that it belonged to those who had advanced the money by which the Telegraph had been constructed; he therefore looked for some other colorable invention, under which to construct and work a Telegraph in Kentucky.

"It happened that Mr. E. F. Barnes had been employed in the capacity of an operator on the Telegraph line of Mr. Morse, from Buffalo to New-York, and Mr. S. K. Zook had been operator and superintendent on the line from Washington City to New-York, and having both become well acquainted with the operations of all the instruments, and learned the principles of the Telegraph of Mr. Morse, each conceived some idea of improvements on the instruments of his invention, and uniting their notions, they contrived an instrument, in substitution, as they supposed, of the Receiving Magnet, and another instead of his Register, and, denominating their combination 'The Columbian

Telegraph,' claimed it as an invention. These young gentlemen applied to Mr. O'Rielly, or he applied to them, and some contract was made between the parties, for the use of this Columbian Telegraph, and Mr. O'Rielly commenced the construction of posts and wires from Louisville to Nashville, and in the month of May had gotten his Telegraph in operation."

COMPARISON OF THE TELEGRAPHS.

"1. The Main Circuit, with its Battery.

"2. The Key, with its Signal Lever or Correspondent.

"These parts of the two Telegraphs are identical; no diversity was pointed out, except that whilst the helices on the horseshoe magnet of Mr. Morse, which is constituted of the windings of the small wire, are fixed, this Magnet, in the Columbian Telegraph, is movable, and by its motion to and fro, when charged and *discharged*, instead of by attracting other things to it, performs its office.

"3. The Local Circuits, with their Batteries.

"The defendants have *two* batteries similar to the one of Mr. Morse, and two circuits of conductors in all respects similar to his, until we come to those which are instruments, or parts of the instruments of operation, and it is to these the attention is to be now applied.

"One of the conductors of Mr. Morse's office circuit, it will be recollected, is a perpendicular movable lever, and it is the movement of this lever into contact with the platina point of a screw, caused by the attraction of the armature on it, to the Electro-Magnet when charged by the opening of the main circuit by its signal lever, that the office circuit was opened and the register made to act and record the intelligence. Now, in the stead of such a lever, the defendants have this device to open and close alternately their two circuits, and thereby work their register.

MUTATOR OF THE COLUMBIAN TELEGRAPH.

"The Receiver, or Mutator, as it is called by Messrs. Barnes and Zook, is thus described by one of the inventors of this Telegraph, who was examined upon the hearing, in explanation of its several instruments and their operation:—

"'There is a thin U-shaped piece of soft iron suspended upon an arm attached to a cross-bar with pivots, so placed that its extremes approximate to the poles of a permanent Magnet.

"'About each leg of the soft iron is placed a brass spool filled with small insulated wires, the iron being left free to move within the spools.

" 'At the curve of the soft iron is placed a spring, so arranged as to have a tendency to draw the iron from the Magnet.

" 'In the absence of the Electric current, the magnetism of the permanent Magnet induces magnetism of opposite polarity in the soft iron, and holds it firmly.

" 'A current of Electricity being passed through the wire in such a manner as to induce in the iron magnetism of a similar polarity with that of the permanent Magnet, the iron is in a measure released from the power of the permanent Magnet, and is drawn away by the force of the spring; and upon withdrawing the Electric current, the reverse motion is obtained from the force of the permanent Magnet alone that overcomes the power of the spring.

" 'The motion so obtained renders it possible to connect the poles of two resident or local batteries, the currents of which run in opposite directions.' Now,

" The two spools, or helices, formed of the small wire of the main circuit wound on two legs of this U-shaped bar of soft iron, correspond to the two helices and horse-shoe Magnet mentioned in the description of Mr. Morse's Receiving Magnet.

" But this Magnet, instead of being fixed as that of Mr. Morse, is so suspended as to move with facility to and fro within the helices.

" On this bar, between the two helices or spools, there is fixed an upright bar, which extends up between two points of metal. We will return to these points of metal presently.

" Opposite the other *ends* of this bar, and which correspond to the *heels* of the horse-shoe, there is placed a fixed Magnet.

" When the main circuit is interrupted, and the instrument is at rest, this upright bar, which is in fact an arm of the Electro-Magnet, rests against one of the points of metal, and keeps one of the office circuits closed, whilst the other is broken.

" When the main circuit is open, and thereby this horse-shoe magnetized, it is impelled towards the fixed Magnet. This motion at once brings the upright bar, an arm of the Magnet, from contact with the point of metal against which we said it rested, (when the local circuit with which it is connected is broken,) and brings it into contact with the opposite point of metal connected with the other circuit, whereby *it* is opened.

" The main circuit being then broken, and the horse-shoe no longer a Magnet, a spring brings it back to its former position, ready to act again, by being again magnetized by the reopening of the main circuit. * * * *

" But in what are the two instruments identical?

" Each is worked by the motive power of the Electro-Magnet, and the mechanical power of the spring. The action of each, one way, is caused by the charging of the Magnet, and on the

Magnet being discharged, each is brought back to its position by the mechanical action of the spring. And,

"The operations of each are according to the will of the correspondent upon his lever, in the distant office, and each produces the same corresponding action in the Pen of the Register which indents the intelligence dispatched.

"They both effect this great end first accomplished by Mr. Morse in his discovery of the practicability of combining the circuits of Electricity, by which the extent of the operations by the Electro-Magnetic Telegraph is left circumscribed only by what may render impracticable the connecting of the necessary conductors of what constitutes the motive power of the instrument.

"It is concluded that the instrument called the *Mutator* of the Columbian Telegraph, in its combination therewith, is substantially the same with the Receiving Magnet, in its combination with the Telegraph of Mr. Morse; and that the defendants, in the use thereof, committed an infringement on the rights of the complainants, whether their Register, or any of its instruments, are within the description of the corresponding instruments of the complainants or not.

THE COMPARISON OF THE REGISTERS.

"The description of the Register of the Columbian Telegraph, with its instruments, will be first given, in the words of one of the inventors, who explained it on the hearing, after which we will proceed with the comparison.

"'It is composed of a train of clockwork, for moving the paper, and the apparatus necessary to produce the desired result, viz.:

"'Two permanent Magnets are so placed, that their opposite poles approximate to each other. Between the poles of these Magnets, a soft iron bar is suspended upon a carriage. The iron is wrapped with number 18 to 20 wire, insulated. In the absence of the electrical current, this bar stands at a point of indifference, being attracted to neither Magnet; but in closing one of the local circuits, the electrical current passes one direction through the wires in the iron, giving it polarity, and affinity for one permanent Magnet, while it is at the same time repulsed by the other; upon interrupting this, and closing the circuits of the other local battery, the current flows in a contrary direction, giving opposite polarity; and reverse motion is obtained.

"'Attached to this bar is an arm, at the extremity of which is a sharp point, so placed that at each alternate motion of the bar, the point comes in contact with the paper, placed before and running over a grooved plate in such a manner that an indentation is made.

"'Alternate dots and lines of these indentations form a system of arbitrary signs, representing the alphabet and numerals; the whole rendering it possible to make an instantaneous communication at a distance.'

"Now, we have here, in the first place, the motive power of the electro-magnet of the Register of Mr. Morse; and if no more was said, there would seem to be, in this respect, an identity.

"But it was argued for the defendants, that here, in the Columbian instrument, the repulsive as well as the attractive power is employed. Suppose it is, still the attractive power is used, and it cannot be maintained that the addition of another power, without any other change, constitutes a difference which will give to any one, making such addition, the right to employ the formerly invented instrument. He may, as before said, have his patent for this improvement, or he may use it without a patent, but he cannot in that mode acquire the right to use the original.

"But is there any difference between these two powers of the Magnet? It is wholly unnecessary to inquire and ascertain to what purposes these things are different, or to what intents they are one and the same; or in what sense the terms, identical and different, may be applied to them; we are concerned only with the settling the signification of words in order to apply the patent laws. And,

"It is apprehended that when an exclusive right has been granted to the use of an instrument worked by the *attractive* power of the Magnet, the working such an instrument by its *repulsive* power would be an infringement; and that the proposition is so obviously true, that it would be useless to look after plainer propositions from which to prove it; and it follows from this conclusion, that this diversity between the mode of working the two instruments cannot, of itself, avail the defendants.

"But it was insisted that the machinery, as it may be called, of this Magnet, and its operations, are different. And so they are in some respects. There is here much additional machinery, and this instrument has some operations which the other has not.

"By this machinery the changes in polarity of the Magnet are effected, and thereby its repulsive as well as attractive power is employed, by which its alternate action is produced, which accomplishes the result. But how does this happen?

"In order to employ this repulsive power, it became necessary to invent a contrivance to effect changes in the polarity of the Magnet; and to effect this, the two permanent Magnets are introduced, the two local circuits are added, and the alterations already mentioned were made in the Receiver of Mr. Morse;

and because these things had been done, it was contended that the instrument ought to be considered and adjudged substantially different.

"The machinery was necessary to effect the changes in the polarity of the Magnet, in order to bring into action the repulsive power, in addition to the attractive; but the employment of repulsion produces no substantial diversity, and yet the argument is, the machinery itself shall constitute an essential diversity.

"The attractive power of the Electro-Magnet is altogether sufficient to work any Telegraphic Register. The permanent Magnets are necessary only to employ the *repulsive* power, and *that* is useless; and if used, would not help the defendants to escape the charge of infringement; therefore, let them be removed, and all this machinery is at once wholly unnecessary. Let *it* be cast off, and the corresponding alterations of the Receiving Magnet are rendered equally useless. Now, all these useless things discarded, we have nothing left but the simple Receiving Magnet of the patentee.

"One of the alternate motions of this Columbian Magnet does draw back the pen after it has made an indentation upon the paper, and holds it in position for repetition; but this is accomplished by Mr. Morse by a simple spring, and it was not pretended that all this machinery and repulsive power of the Magnet had been brought into action for any such purpose.

"*The grooved rollers*, in combination with the clockwork, seemed to have been used by the defendants for some time, and without disguise. In the instrument exhibited here, there is a third *cylinder* introduced, over which the paper is made to pass, by the action of the two rollers, such as those found in the instrument of Mr. Morse. This is only an addition, which can give no right to use the thing to which it is added, and it is not supposed that it constitutes any improvement.

"*The Pen Lever* is the next thing. It was in proof that, shortly before the hearing of this motion commenced, the contrivance employed was somewhat different.

"This bar, which is here attached to the Electro-Magnet, on the other end of which is the sharp point which makes the indentations of intelligence upon the paper, was, in the instrument then employed, made fast to one end of the Pen Lever, which lever was bent in an angle somewhat greater than a right angle, and worked upon an axis or fulcrum at the angle; the other end, to which the armature was made fast, descending perpendicularly, or nearly so, from the fulcrum.

"The vibration of the armature, to and fro, carried this end of the pen lever with it, bringing the point, fixed in the other

end of the lever, in contact with the paper, and withdrawing it alternately, thus writing by the lever motion.

"This is unimportant, except to manifest in what a variety of forms every instrument in this Telegraph may be constructed, and to show how industrious and ingenious the inventors of this instrument of the defendants have been, in devising modes by which to obtain the benefit of the discoveries of the patentee, and yet evade the charge of an infringement of his rights.

"The effort here has, perhaps, as much the appearance of being successful as anywhere else, but it cannot prevail.

"In the Register of the patentee, the attraction of the armature on one end of the pen lever, downwards, gives an upward action to the other end, and thereby the indentations are made upon the paper. Here, by this last contrivance, the pen lever is made a part of the magnet, which, by its vibration, gives the same action to the pen; and such a difference in the mode of accomplishing such an end, can be regarded as no better than a substitution of one mechanical contrivance or arrangement for another, which can succeed only when such arrangement is the very essence of the invention, and without which it could not be said anything had been discovered. * * * *

THE COLUMBIAN INFRINGES ON MORSE.

"The conclusion is, that the employment of the Columbian Telegraph, in any of the forms which it appears to have assumed, would have been an infringement of the rights of the complainants, even had less of the sameness been found in their several parts. And this disposes of the question of infringement."

APPLICATION FOR INJUNCTION.

This judicial examination took place in 1848, commencing on the 24th day of August, and terminating on the 9th day of September. The complainants were Messrs. Morse, Vail, and Smith, against Henry O'Rielly and others. The former applied for an injunction against the O'Rielly or People's Line, extending south of Louisville. After the most tedious examination of the questions at issue, the Honorable Judge, sitting in Chamber, gave his opinion, fully sustaining the Morse Patents, in which was embraced the preceding descriptions of the Columbian Telegraph, and he closed his masterly examination by entering an order of injunction, containing the following, viz.:—

INJUNCTION AWARDED.

"You, Henry O'Rielly, Eugene L. Whitman, and W. F. B. Hastings, are therefore—as by the order of our said Judge in the premises is directed—*Enjoined* and commanded, that you, and

each of you, your servants and agents, do henceforth desist and refrain from all further employment, in the District of Kentucky, of the Electro-Magnetic Telegraph in the complainants' bill mentioned; which, it appears by the proofs, was, by you, the defendants, lately employed, *and*, of the Telegraph by the defendant, O'Rielly, in his answer mentioned, which is by you called 'The Columbian Telegraph;' and which, it appeared, you proposed to employ hereafter—but which *two* are considered here, for the purpose of this matter, as *one* and the same Telegraph—in the transmission of intelligence from one place to another distant place by making thereat a legible record thereof: and from such employment for such purpose of any other Telegraph worked by the motive power of Electro-Magnetism, and consisting of combined circuits of electricity, connected by what is called, by the complainants, the *Receiver*, and by you, the defendants, the *Mutator*, and the Register, worked by Electro-Magnetism, in whole or in part, or in any combination whatever, within, and in violation of the exclusive rights, as here determined, granted by letters patent to the complainant, Samuel F. B. Morse, until the further order of the Court, or until the effect of the said order of our Judge, at his Chambers, shall have expired."

INJUNCTION PERPETUATED.

At the fall term of the Circuit Court, the following order, perpetuating the injunction, was entered by the Honorable Court:—

"*It was ordered*, that the injunction granted herein, by the District Judge at his Chambers, be continued, until the further order of the Court."

INJUNCTION EVADED.

Early after the injunction was granted, the defendants sought other means to evade the Morse Patents, by receiving intelligence by sound. Complaint was made to the Judge, and writs for the arrest of the parties were issued. On the hearing, the Judge entered the following, viz.:—

"*It is considered by the Court*, that the operations of the Telegraph of the defendants, O'Rielly and others, in the writ of injunction mentioned, by the said Barnes, in the transmission of intelligence from the city of Louisville, within the District of Kentucky, to Nashville, without the District, by making at that place, the record thereof in the Telegraphic characters indented upon the paper, off which it was put into the manuscript for the correspondents, was a palpable violation of the injunction; and that his operation of the same Telegraph in receiving intelligence from Nashville at Louisville in and by the sounds made by the same action of the Telegraph, which, in its regular operation, would have made the record in the Telegraphic characters in

dented upon the paper, and therefrom putting the same into manuscript for the correspondents, was a mere evasion of the injunction, and substantially a violation thereof, and of the vested rights of the complainants."

SECOND EVASION OF INJUNCTION.

Not satisfied with the order in the above case, placing the parties under bonds for contempt of Court, the defendant sought another mode to evade the patents and the injunction. Complaint was made to the Judge, and the following is a part of the proceedings in the case, viz.:—

"The Court stated the matter, and delivered its judgment in case of the attachment against Zook and Woolfolk.

"'*The short statement of the case* is, that the defendants, after being prohibited the employment of their Telegraph within the District of Kentucky, removed the instruments of their office to Jeffersonville, without the District, but still kept their posts and wires within it, and with their Telegraph so situated, partly within the District, and partly without it, continued their prohibited operations, in violation of the injunction; and in order to still have the benefit of the transmission of intelligence to and from Louisville, established a post-office in the city, and a regular mail from it, to their office in Jeffersonville, in violation of the prohibition of the injunction and of act of Congress, prohibiting the establishment of private mails. It is difficult to see how any person could have imagined that the law or judgment of a court could be thus evaded, or how they could have supposed it was justifiable to adopt such means of accomplishing such an end.

"'*It is found*, on proofs, that S. K. Zook was the superintendent of the line of Telegraphs of the defendants from Louisville to Nashville, and as such had under them the power over it, and their agents employed in its operations; and that after the proceeding had herein against Barnes, and the defendants had absented themselves from the District, caused the line of wires to be extended from Louisville to Jeffersonville, Indiana, without the District of Kentucky, and caused the instruments of the Telegraph Office in Louisville, the use whereof the defendants, O'Rielly and others, had been prohibited, by this injunction, to be removed across the Ohio to that place; and thereupon, as such superintendent caused the Telegraph of the defendants, with the position of a portion of the instruments so changed, to be put in operation and conducted in a mode within the prohibitions of the writ of injunction against his principals.

"'It appears that the same office of the defendants in Louisville was still occupied, and that all communications to be trans-

mitted thence were received thereat, and thence transferred by the carriers and servants of the defendants to Jeffersonville, whence they were accordingly dispatched on this Telegraph, so situated, in part, within this District; and it seems to the Court, that such change of the position of a portion of the instruments was but an attempt to evade the injunction, and that such operations of the Telegraph, with the instruments, partly within the District, the use whereof within it had been prohibited by the injunction, was a violation thereof, and this party, S. K. Zook, is guilty of the contempt wherewith he is charged. And,

"'*It is ordered*, that the said S. K. Zook, for his offence aforesaid, make his fine to the United States, by the payment of the sum of two hundred and fifty dollars, and also the costs in this proceeding expended, and that he stand committed, and be confined in the jail of the county of Franklin, State of Kentucky, until the same shall have been paid, or he shall be discharged by due course of law.'"

The same order of Court was given in the case of Mr. Woolfolk, and both placed under bonds. They were released from the fine.

THE UNITED STATES MARSHAL SEIZES THE LINE.

The repeated efforts of the defendants to evade the injunction, and act in contempt of the Court, induced the entering of the following order, which terminated the ability of the parties to abuse the privilege given them to take charge of their line:—

"'*It is ordered*, that the Marshal be, and he is hereby directed to take into his possession such parts of the line of wires and posts of the Telegraph of the defendants, within the District of Kentucky, as may be necessary for the purpose herein presently expressed, and by *breaking and intercepting the circuit of Electricity through the wires, stop and prevent the defendants from further operations upon their Telegraph, within the District, in any mode prohibited by the injunction herein;* but in doing this he will take such possession of no part of such wires or posts which shall not be necessary for him to have in his custody to effect and secure this object, but will leave the other parts thereof in possession, or under the superintendence of the defendants or their agents, as he may find them; and that he so hold the possession of such parts of the Telegraph, and thereby prevent the violation of the injunction until this cause shall be fully heard, or the further order of the Court.'"

The Marshal executed this order of the Court, and thus ended the inventive powers of evasion.

APPEAL TO THE SUPREME COURT.

It was upon the proceedings above recited that Mr. O'Rielly

appealed to the Supreme Court of the United States, and upon which the annexed decision was rendered by Chief Justice Taney, and the dissenting opinion by Justice Grier.

THE BAIN CHEMICAL TELEGRAPH.

After the proceedings in the District Court of Kentucky took place, Mr. O'Rielly proposed to put on the People's Line aforesaid the Bain Chemical Telegraph, and he applied to the Court for possession of the Line. The Morse counsel resisted the application, contending that it would be another violation of the patents. The Court decided that the question was upon its *violation of the injunction* granted. The decree of the Court was against the Columbian Telegraph—an Electro-Magnetic Telegraph—and the Bain system was a Chemical Telegraph, which was not considered in the former trial. Whether or not it was a violation of the patents of Prof. Morse, could only be ascertained by a separate action thereon. Such was the opinion of the Honorable Court. The Line was then given in charge of the defendants, they giving bond and security not to put on the said Line any instrument *infringing the patents granted to Morse.*

THE FINALE OF THE LINE.

The Line was then worked by the Bain system. Mr. O'Rielly having made an assignment, the Line was placed in charge of trustees, and ultimately under a corporate control. With the utmost difficulty it was continued at work, each year increasing its debt, until June, 1852, when it became blended in management with the Morse Line. The two combined cleared about $30,000 for the year, which was applied in the payment of old debts. June, 1853, the two companies consolidated and became one, the Morse Company taking the other at an agreed valuation, assuming the debts, amounting to some $40,000 or $45,000, the combined debt being about $70,000. Such is the history of these two Lines, both groaning under a heavy debt. One good Line could have accumulated handsome gains. Free the present Company from debt, and the stock will pay large dividends. It is not with pride that we refer to these reminiscences. To all it is a sad tale. No one has been benefited, but it has been a sip of gall to each and every one who has been connected with the cause and the contest.

VOTE IN THE SUPREME COURT.

Before closing our remarks upon this question, we desire to give a statement of the case in the Supreme Court, for general information.

The opinion of the Court was read by Chief Justice Taney,

which was concurred in by Justices McLean, Catron, and Daniel. The dissenting opinion was read by Justice Grier, and concurred in by Justices Nelson and Wayne. Justice Curtis, having been a Morse counsel, did not sit in the case. Justice Campbell, having been appointed since the argument, did not sit in the case.

CONCLUSION.

We close this article by giving the claims of the Morse patents. The preceding pages give the history of the controversy as briefly as possible; also, the points of the opinion of the Court below pertaining to the Columbian Telegraph, the efforts to evade the solemn decrees of the judiciary, and the finale of the Line.

In making reference to the history of the above case, we have endeavored to avoid exhibiting any personal allusion disrespectful of the parties. We respect them all, and regret the existence of past and present troubles. The controversy is now at an end, and whatever pride or mortification either or any of us may have had, we hope will be buried forever, and our future career be marked with well-directed consideration in the acquirement of food to eat and raiment to wear.

PATENT 1840—RE-ISSUED 1848.

" 'Be it known that I, Samuel F. B. Morse, now of * * * the State of New-York, have invented a new and useful apparatus for, and a system of transmitting intelligence between distant points by means of Electro-Magnetism, which puts in motion machinery for producing *sounds* or *signs*, and *recording* said signs upon paper or other suitable material, which invention I denominate the American Electro-Magnetic Telegraph, and that the following is a full, clear, and exact description of the principle or character thereof, which distinguishes it from all other Telegraphs previously known; and of the manner of making and constructing said apparatus, and of applying said system, reference being had to the accompanying drawing, making part of this specification. * * * * *

CLAIMS.

" 'First. Having thus fully described my invention, I wish it to be understood that I do not claim the use of the Galvanic current, or current of Electricity, for the purpose of Telegraphic communications generally; but what I specially claim as my invention and improvement, is making use of the motive power of Magnetism, when developed by the action of such current or currents, substantially as set forth in the foregoing description of the first principal part of my invention, as means of operating or giving motion to machinery, which may be used to IMPRINT signals upon paper or other suitable material, or to produce

sounds in any desired manner, for the purpose of Telegraphic communication at any distances.

"'The only ways in which the Galvanic currents had been proposed to be used, prior to my invention and improvement, were by bubbles resulting from decomposition, and the action or exercise of electrical power upon a magnetized bar or needle; and the bubbles and deflections of the needles, thus produced, were the subjects of inspection, and had no power, or were not applied to record the communication. I therefore characterize my invention as the first RECORDING OR PRINTING Telegraph by means of Electro-Magnetism.

"'There are various known modes of producing motion by Electro-Magnetism, but none of these had been applied prior to my invention and improvement, to actuate or give motion to PRINTING OR RECORDING *machinery*, which is the chief point of my invention and improvement.

"'Second. I also claim as my invention and improvement the employment of the machinery called the Register or Recording Instrument, composed of the train of clock wheels, cylinders and other apparatus, or their equivalent, for moving the material upon which the characters are to be imprinted, and for imprinting said characters, substantially as set forth in the foregoing description of the second principal part of my invention.

"'Third. I also claim as my invention and improvement, the combination of machinery herein described, consisting of the generator of Electricity, the circuit of conductors, the contrivance for closing and breaking the circuit, the Electro-Magnet, the pen or contrivance for marking, and the machinery for sustaining and moving the paper, altogether constituting one apparatus or Telegraphic machine, which I denominate the *American Electro-Magnetic Telegraph.*

"'Fourthly. I also claim as my invention the combination of two or more Galvanic or Electric circuits, with independent batteries, substantially by the means herein described, for the purpose of obviating the diminished force of Electro-Magnetism in long circuits, and enabling me to command sufficient power to put in motion Registering or Recording machinery at any distances.

"'Fifthly. I claim, as my invention, the system of signs, consisting of dots and spaces, and of dots, spaces and horizontal lines, for numerals, letters, words, or sentences, substantially as herein set forth and illustrated, for Telegraphic purposes.

"'Sixth. I also claim, as my invention, the system of signs, consisting of dots and spaces, and of dots, spaces, and horizontal lines, substantially as herein set forth and illustrated, in combination with machinery for recording them, as signals for Telegraphic purposes.

" 'Seventh. I also claim, as my invention, the types, or their equivalent, and the Type Rule and port rule, in combination with the signal lever or its equivalent, as herein described, for the purpose of breaking and closing the circuit of Galvanic or Electric conductors.

" 'Eighth. *I do not propose to limit myself to the specific machinery, or parts of machinery, described in the foregoing specifications and claims: the essence of my invention being the use of the motive power of the Electric or Galvanic current, which I call Electro-Magnetism, however developed, for marking or printing intelligible characters, letters, or signs, at any distances, being a new application of that power, of which I claim to be the first inventor or discoverer.*' "

PATENT 1846—RE-ISSUED 1848.

" This patent is the reissue of the patent of April, 1846, and is for a new and useful improvement in '*Electro-Magnetic Telegraphs.*' It grants the exclusive use to the patentee for the term of fourteen years from the eleventh day of April, 1846, * * *

OBJECT OF THE INVENTION.

" 'The original and final object of all Telegraphing is the communication of intelligence at a distance by signs or signals.

" 'Various modes of Telegraphing, or making signs or signals at a distance, have for ages been in use. The signs employed heretofore have had one quality in common. They are *evanescent*—shown or heard a moment, and leaving no trace of their having existed. ' The various modes of these evanescent signs have been by *beacon fires* of different characters, by *flags*, by *balls*, by *reports of fire-arms*, by bells heard from a distant position, by *movable arms from posts, &c.*

" 'I do not, therefore, claim to be the inventor of Telegraphs generally. The Electric Telegraph is a more recent kind of Telegragh, proposed within the last century, but no practical plan was devised until about sixteen years ago. Its distinguishing feature is the employment of Electricity to effect the same general result of communicating intelligence at a distance by signs or signals.

" 'The various modes of accomplishing this end by Electricity have been :—

" 'The employment of common or machine Electricity as early as 1787, to show an evanescent sign by the *divergence of pith-balls.*

" 'The employment of common or machine Electricity in 1794, to show an evanescent sign by the Electric spark.

" 'The employment of Voltaic Electricity in 1809, to show an

evanescent sign by the *evolution of gas-bubbles*, decomposed from solution in a vessel of transparent glass.

"'The employment of Voltaic Electricity in the production of temporary Magnetism in 1820, to show an evanescent sign by *deflecting a magnet* or *compass-needle*.

"'The result contemplated from all these Electric Telegraphs was the production of *evanescent signs* or signals only.

"'I do not, therefore, claim to have first applied Electricity to Telegraphing for the purpose of showing evanescent signs or signals.

"'The original and final object of my Telegraph is, *to imprint characters at any distance as signals for intelligence*; its object is to *mark or impress them in a permanent manner*.

"'To obtain this end, I have applied Electricity in two distinct ways. 1st. I have applied, by a novel process, the *motive power of Electro-Magnetism, or Magnetism produced by Electricity, to operate machinery for printing* signals at any distance. 2dly. I have applied the *chemical effects* of Electricity to print signals at any distance. * * * * *

CLAIMS.

"'First. What I claim as my invention, and desire to secure by letters patent, is the employment, in a main Telegraphic circuit, of a device or contrivance called the Receiving Magnet, in combination with a short local independent circuit or circuits, each having a Register and Register Magnet, or other Magnetic contrivances for registering, and sustaining such a relation to the Register Magnet, or other Magnetic contrivances for registering, and to the length of circuit of Telegraphic line, as will enable me to obtain with the aid of a Galvanic battery and main circuit, and the intervention of a local battery and local circuit, such motion or power for registering as could not be obtained otherwise without the use of a much larger Galvanic battery, if at all.

"'Second. I also claim as my invention, the combination of the apparatus called the *self-stopping apparatus*, connected with the clockwork by the Register, for setting said Register in action, and stopping it with the Pen Lever F, as herein described.

"'Third. I also claim as my invention, the combination of the point or points of the pen and pen lever, or its equivalent, with the grooved roller, or other equivalent device, over which the paper, or other material suitable for marking upon, may be made to pass for the purpose of receiving the impression of the characters; by which means I am enabled to MARK or PRINT signs or signals upon paper or other fabric, by indentation, thus dispensing with the use of coloring matter for marking, as specified in my letters patent, of January 15th, 1846.'"

Art. II.—DECISION OF SUPREME COURT OF THE UNITED STATES.

SAMUEL F. B. MORSE *vs.* HENRY O'RIELLY.

This was an Appeal from the District Court of Kentucky, wherein Morse was granted an Injunction against O'Rielly, for an Infringement of the Morse Patents, by the use of the Columbian Telegraph. The Supreme Court perpetuates that Injunction.

Counsel for Morse.	*Counsel for O'Rielly.*
GEORGE GIFFORD,	SOLOMON P. CHASE,
ST. GEO. T. CAMPBELL,	R. H. GILLETT.
GEORGE HARDING.	

DECISION WAS RENDERED JAN. 30TH, 1854.

December Term, 1853.

HENRY O'RIELLY, EUGENE L. WHITMAN, and W. F. B. HASTINGS, Appellants, *versus* SAMUEL F. B. MORSE, ALFRED VAIL, and FRANCIS O. J. SMITH, Appellees.

Appeal from the Circuit Court of the United States for the District of Kentucky.

Chief Justice TANEY delivered the opinion, which was concurred in by Justices DANIEL, CATRON, and MCLEAN.

In proceeding to pronounce judgment in this case, the Court is sensible, not only of its importance, but of the difficulties in some of the questions which it presents for decision. The case was argued at the last Term, and continued over by the Court for the purpose of giving it a more deliberate examination. And since the continuance, we have received from the counsel on both sides printed arguments, in which all of the questions raised on the trial have been fully and elaborately discussed.

The appellants take three grounds of defence: In the first place, they deny that Professor Morse was the first and original inventor of the Electro-Magnetic Telegraphs, described in his two reissued patents of 1848. Secondly, they insist that if he was the original inventor, the patents under which he claims have not been issued conformably to the acts of Congress, and do not confer on him the right to the exclusive use. And thirdly, if these two propositions are decided against them, they insist that the Telegraph of O'Rielly is substantially different

from that of Professor Morse, and the use of it, therefore, no infringement of his rights.

In determining these questions, we shall, in the first instance, confine our attention to the patent which Professor Morse obtained in 1840, and which was reissued in 1848. The main dispute between the parties is upon the validity of this patent; and the decision upon it will dispose of the chief points in controversy in the other.

In relation to the first point, (the originality of the invention,) many witnesses have been examined on both sides.

It is obvious that, for some years before Professor Morse made his invention, scientific men in different parts of Europe were earnestly engaged in the same pursuit. Electro-Magnetism itself was a recent discovery, and opened to them a new and unexplored field for their labors, and minds of a high order were engaged in developing its power, and the purposes to which it might be applied.

Professor Henry, of the Smithsonian Institute, states in his testimony, that prior to the winter of 1819–20, an Electro-Magnetic Telegraph—that is to say, a Telegraph operating by the combined influence of electricity and magnetism—was not possible; that the scientific principles on which it is founded were until then unknown; and that the first fact of Electro-Magnetism was discovered by Oersted, of Copenhagen, in that winter, and was widely published, and the account everywhere received with interest.

He also gives an account of the various discoveries subsequently made from time to time, by different persons in different places, developing its properties and powers; and among them his own. He commenced his researches in 1828, and pursued them with ardor and success from that time until the Telegraph of Professor Morse was established and in actual operation. And it is due to him to say that no one has contributed more to enlarge the knowledge of Electro-Magnetism, and to lay the foundations of the great invention of which we are speaking, than the professor himself.

It is unnecessary, however, to give in detail the discoveries enumerated by him—either his own, or those of others. But it appears from his testimony, that very soon after the discovery made by Oersted, it was believed by men of science that this newly-discovered power might be used to communicate intelligence to distant places. And before the year 1823, Ampère, of Paris, one of the most successful cultivators of physical science, proposed to the French Academy a plan for that purpose. But his project was never reduced to practice. And the discovery made by Barlow, of the Royal Military Academy at Woolwich, England, in 1825, that the galvanic current greatly diminished

in power as the distance increased, put at rest for a time all attempts to construct an Electro-Magnetic Telegraph. Subsequent discoveries, however, revived the hope; and in the year 1832, when Professor Morse appears to have devoted himself to the subject, the conviction was general among men of science everywhere, that the object could, and, sooner or later, would be accomplished.

The great difficulty in their way was the fact that the galvanic current, however strong in the beginning, became gradually weaker as it advanced on the wire; and was not strong enough to produce a mechanical effect after a certain distance had been traversed. But encouraged by the discoveries which were made from time to time, and strong in the belief that an Electro-Magnetic Telegraph was practicable, many eminent and scientific men in Europe, as well as in this country, became deeply engaged in endeavoring to surmount what appeared to be the chief obstacle to its success. And in this state of things, it ought not to be a matter of surprise, that four different Magnetic Telegraphs, purporting to have overcome the difficulty, should be invented, and made public so nearly at the same time that each has claimed a priority; and that a close and careful scrutiny of the facts in each case is necessary to decide between them. The inventions were so nearly simultaneous, that neither inventor can be justly accused of having derived any aid from the discoveries of the other.

One of these inventors, Doctor Steinheil, of Munich, in Germany, communicated his discovery to the Academy of Science in Paris, on the 19th of July, 1838, and states in his communication that it had been in operation more than a year.

Another of the European inventors, Professor Wheatstone, of London, in the month of April, 1837, explained to Professors Henry and Bache, who were then in London, his plan of an Electro-Magnetic Telegraph, and exhibited to them his method of bringing into action a second galvanic circuit in order to provide a remedy for the diminution of force in a long circuit; but it appears by the testimony of Professor Gale, that the patent to Wheatstone & Cooke was not sealed until January 21, 1840, and their specification was not filed until the 21st of July, in the same year; and there is no evidence that any description of it was published before 1839.

The remaining European patent is that of Edward Davy. His patent, it appears, was sealed on the 4th of July, 1838, but his specification was not filed until January 4, 1839; and when these two English patents are brought into competition with that of Morse, they must take date from the time of filing their respective specifications. For it must be borne in mind that, as the law then stood in England, the inventor was allowed six

months to file the description of his invention after his patent was sealed, while, in this country, the filing of the specification is simultaneous with the application for patents.

The defendants contend that all, or at least some one of these European Telegraphs, were invented and made public before the discovery claimed by Morse; and that the process and method by which he conveys intelligence to a distance is substantially the same, with the exception only of its capacity for impressing upon paper the marks or signs described in the alphabet he invented.

Waiving, for the present, any remarks upon the identity or similitude of these inventions, the Court is of opinion that the first branch of the objection cannot be maintained, and that Morse was the first and original inventor of the Telegraph described in his specification, and preceded the three European inventions relied on by the defendants.

The evidence is full and clear that when he was returning from a visit to Europe, in 1832, he was deeply engaged upon this subject during the voyage; and that the process and means were so far developed and arranged in his own mind, that he was confident of ultimate success. It is in proof that he pursued these investigations with unremitting ardor and industry, interrupted occasionally by pecuniary embarrassments; and we think that it is established by the testimony of Professor Gale and others, that early in the spring of 1837, Morse had invented his plan for combining two or more Electric or Galvanic Circuits, with independent Batteries, for the purpose of overcoming the diminished force of Electro-Magnetism in long circuits, although it was not disclosed to the witness until afterwards; and that there is reasonable ground for believing that he had so far completed his invention, that the whole process, combination, powers, and machinery, were arranged in his mind, and that the delay in bringing it out arose from his want of means; for it required the highest order of mechanical skill to execute and adjust the nice and delicate work necessary to put the Telegraph into operation, and the slightest error or defect would have been fatal to its success. He had not the means at that time to procure the services of workmen of that character; and without their aid no model could be prepared which would do justice to his invention; and it moreover required a large sum of money to procure proper materials for the work. He, however, filed his caveat on the 6th of October, 1837, and on the 7th of April, 1838, applied for his patent, accompanying his application with a specification of his invention, and describing the process and means used to produce the effect. It is true that O'Rielly in his answer alleges that the plan by which he now combines two or more galvanic or electric currents, with independent bat-

teries, was not contained in that specification, but discovered and interpolated afterwards; but there is no evidence whatever to support this charge. And we are satisfied from the testimony, that the plan, as it now appears in his specification, had then been invented, and was actually intended to be described.

With this evidence before us, we think it is evident that the invention of Morse was prior to that of Steinheil, Wheatstone, or Davy. The discovery of Steinheil, taking the time which he himself gave to the French Academy of Science, cannot be understood as carrying it back beyond the months of May or June, 1837; and that of Wheatstone, as exhibited to Professors Henry and Bache, goes back only to April in that year. And there is nothing in the evidence to carry back the invention of Davy beyond the 4th of January, 1839, when his specification was filed, except a publication said to have been made in the *London Mechanics' Magazine*, January 20, 1838; and the invention of Morse is justly entitled to take date from early in the spring of 1837. And in the description of Davy's invention, as given in the publication of January 20, 1838, there is nothing specified which Morse could have borrowed; and we have no evidence to show that his invention ever was or could be carried into successful operation.

In relation to Wheatstone, there would seem to be some discrepancy in the testimony. According to Professor Gale's testimony, as before mentioned, the specification of Wheatstone and Cooke was not filed until July 21, 1840, and his information is derived from the *London Journal of Arts and Sciences*. But it appears by the testimony of Edward F. Barnes, that this Telegraph was in actual operation in 1839. And in the case of the Electric Telegraph Company *vs.* Brett & Little, 10 Common Pleas Reports, by Scott, his specification is said to have been filed Dec. 12, 1837. But if the last-mentioned date is taken as the true one, it would not make his invention prior to that of Morse. And even if it would, yet this case must be decided by the testimony in the record, and we cannot go out of it, and take into consideration a fact stated in a book of reports. Moreover, we have noticed this case merely because it has been pressed into the argument. The appellants do not mention it in their answer, nor put their defence on it. And if the evidence of its priority was conclusive, it would not avail them in this suit. For they cannot be allowed to surprise the patentee by evidence of a prior invention of which they gave him no notice.

But if the priority of Morse's invention was more doubtful, and it was conceded that in fact some one of the European inventors had preceded him a few months or a few weeks, it would not invalidate his patent. The act of Congress provides that when the patentee believes himself to be the first inventor, a

previous discovery in a foreign country shall not render his patent void, unless such discovery or some substantial part of it had been before patented or described in a printed publication.

Now we suppose no one will doubt that Morse believed himself to be the original inventor when he applied for his patent in April, 1838. Steinheil's discovery does not appear to have been ever patented, nor to have been described in any printed publication until July of that year. And neither of the English inventions are shown by the testimony to have been patented until after Morse's application for a patent, nor to have been so described in any previous publication as to embrace any substantial part of his invention. And if his application for a patent was made under such circumstances, the patent is good, even i in point of fact, he was not the first inventor.

In this view of the subject, it is unnecessary to compare the Telegraph of Morse with these European inventions, to ascertain whether they are substantially the same or not. If they were the same in every particular, it would not impair his rights. But it is impossible to examine them, and look at the process and the machinery and results of each, so far as the facts are before us, without perceiving at once the substantial and essential difference between them, and the decided superiority of the one invented by Professor Morse.

Neither can the inquiries he made, nor the information or advice he received from men of science, in the course of his researches, impair his right to the character of an inventor. No invention can possibly be made, consisting of a combination of different elements of power, without a thorough knowledge of the properties of each of them, and the mode in which they operate on each other. And it can make no difference in this respect whether he derives his information from books, or from conversation with men skilled in the science. If it were otherwise, no patent in which a combination of different elements is used, could ever be obtained. For no man ever made such an invention without having first obtained this information, unless it was discovered by some fortunate accident. And it is evident that such an invention as the Electro-Magnetic Telegraph could never have been brought into action without it. For a very high degree of scientific knowledge, and the nicest skill in the mechanic arts, are combined in it, and were both necessary to bring it into successful operation. And the fact that Morse sought and obtained the necessary information and counsel from the best sources, and acted upon it, neither impairs his rights as an inventor, nor detracts from his merits.

Regarding Professor Morse as the first and original inventor of the Telegraph, we come to the objections which have been made to the validity of his patent.

We do not think it necessary to dwell upon the objections taken to the proceedings upon which the first patent was issued, or to the additional specifications in the reissued patent of 1848. In relation to the first, if there was any alteration, at the suggestion of the Commissioner, it appears to have been in a matter of form rather than of substance; and as regards the second, there is nothing in the proof, or on the face of the reissued patent, to show that the invention therein described is not the same with the one intended to be secured by the original patent. It was reissued by the proper lawful authority, and it was the duty of the Commissioner of Patents to see that it did not cover more than the original invention. It must be presumed, therefore, that it does not, until the contrary appears. Variations from the description given in the former specification do not necessarily imply that it is for a different discovery. The right to surrender the old patent, and receive another in its place, was given for the purpose of enabling the patentee to give a more perfect description of his invention, when any mistake or oversight was committed in his first. It necessarily, therefore, varies from it. And we see nothing in the reissued patent that may not, without proof to the contrary, be regarded as a more careful description than the former one, explaining more fully the nice and delicate manner in which the different elements of power are arranged and combined together and act upon one another, in order to produce the effect described in the specification. Nor is it void because it does not bear the same date with his French patent. It is not necessary to inquire whether the application of Professor Morse to the Patent Office, in 1838, before he went to France, does or does not exempt his patent from the operation of the act of Congress upon this subject. For if it should be decided that it does not exempt it, the only effect of that decision would be to limit the monopoly to fourteen years from the date of the foreign patent. And in either case the patent was in full force at the time the injunction was granted by the Circuit Court, and when the present appeal stood regularly for hearing in this Court.

And this brings us to the exceptions taken to the specification and claims of the patentee in the reissued patent of 1848.

We perceive no well-founded objection to the description which is given of the whole invention and its separate parts, nor to his right to a patent for the first seven inventions set forth in the specification of his claims. The difficulty arises on the eighth.

It is in the following words:

"Eighth. I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing

specification and claims; the essence of my invention being the use of the motive power of the electric or galvanic current, which I call Electro-Magnetism, however developed, for marking or printing intelligible characters, signs, or letters, at any distances, being a new application of that power of which I claim to be the first inventor or discoverer."

It is impossible to misunderstand the extent of this claim. He claims the exclusive right to every improvement where the motive power is the electric or galvanic current, and the result is the marking or printing intelligible characters, signs, or letters, at a distance.

If this claim can be maintained, it matters not by what process or machinery the result is accomplished. For aught that we now know, some future inventor in the onward march of science may discover a mode of writing or printing at a distance, by means of the electric or galvanic current, without using any part of the process or combination set forth in the plaintiff's specification. His invention may be less complicated—less liable to get out of order—less expensive in construction and in its operation. But yet, if it is covered by this patent, the inventor could not use it, nor the public have the benefit of it, without the permission of this patentee.

Nor is this all. While he shuts the door against inventions of other persons, the patentee would be able to avail himself of new discoveries in the properties and powers of Electro-Magnetism which scientific men might bring to light. For he says he does not confine his claims to the machinery or parts of machinery which he specifies: but claims for himself a monopoly in its use, however developed, for the purpose of printing at a distance. New discoveries in physical science may enable him to combine it with new agents and new elements, and by that means attain the object in a manner superior to the present process, and altogether different from it. And if he can secure the exclusive use, by his present patent, he may vary it with every new discovery and development of the science, and need place no description of the new manner, process, or machinery, upon the records of the Patent Office. And when his patent expires, the public must apply to him to learn what it is. In fine, he claims an exclusive right to use a manner and process which he has not described, and indeed had not invented, and therefore could not describe when he obtained his patent. The Court is of opinion that the claim is too broad, and not warranted by law.

No one, we suppose, will maintain that Fulton could have taken out a patent for his invention of propelling vessels by steam, describing the process and machinery he used, and claimed under it the exclusive right to use the motive power of steam,

however developed, for the purpose of propelling vessels. It can hardly be supposed that under such a patent he could have prevented the use of the improved machinery which science has since introduced; although the motive power is steam, and the result is the propulsion of vessels. Neither could the man who first discovered that steam might, by a proper arrangement of machinery, be used as a motive power to grind corn or spin cotton, claim the right to the exclusive use of steam, as a motive power, for the purpose of producing such effects.

Again, the use of steam as a motive power in printing-presses is comparatively a modern discovery. Was the first inventor of a machine or process of this kind entitled to a patent, giving him the exclusive right to use steam as a motive power, however developed, for the purpose of marking or printing intelligible characters? Could he have prevented the use of any other press subsequently invented, where steam was used? Yet so far as patentable rights are concerned, both improvements must stand on the same principles. Both use a known motive power to print intelligible marks or letters; and it can make no difference, in their legal rights under the patent laws, whether the printing is done near at hand or at a distance. Both depend for success not merely upon the motive power, but upon the machinery with which it is combined. And it has never, we believe, been supposed by any one, that the first inventor of a steam printing-press was entitled to the exclusive use of steam, as a motive power, however developed, for marking or printing intelligible characters.

Indeed, the acts of the patentee himself are inconsistent with the claim made in his behalf. For in 1846 he took out a patent for his new improvement of local circuits, by means of which intelligence could be printed at intermediate places along the main line of the Telegraph; and he obtained a reissued patent for this invention in 1848. Yet in this new invention the electric or galvanic current was the motive power, and writing at a distance the effect. The power was undoubtedly developed by new machinery and new combinations. But if his 8th claim could be sustained, this improvement would be embraced by his first patent. And if it was so embraced, his patent for the local circuits would be illegal and void. For he could not take out a subsequent patent for a portion of his first invention, and thereby extend his monopoly beyond the period limited by law.

Many cases have been referred to in the argument, which have been decided upon this subject, in the English and American courts. We shall speak of those only which seem to be considered as leading ones. And those most relied on, and pressed upon the Court, in behalf of the patentee, are the cases which arose in England upon Neilson's patent for the introduction of

heated air between the blowing apparatus and the furnace in the manufacture of iron.

The leading case upon this patent is that of Neilson and others *vs.* Harford and others, in the English Court of Exchequer. It was elaborately argued, and appears to have been carefully considered by the Court. The case was this:—

Neilson in his specification described his invention as one for the improved application of air to produce heat in fires, forges, and furnaces, where a blowing apparatus is required. And it was to be applied as follows:—The blast or current of air produced by the blowing apparatus was to be passed from it into an air-vessel or receptacle made sufficiently strong to endure the blast; and through or from that vessel or receptacle by means of a tube, pipe, or aperture, into the fire: the receptacle to be kept artificially heated to a considerable temperature by heat externally applied. He then described in rather general terms the manner in which the receptacle might be constructed and heated, and the air conducted through it to the fire: stating that the form of the receptacle was not material, nor the manner of applying heat to it. In the action above mentioned for the infringement of this patent, the defendant, among other defences, insisted—that the machinery for heating the air and throwing it hot into the furnace was not sufficiently described in the specification, and the patent void on that account—and also, that a patent for throwing hot air into the furnace, instead of cold, and thereby increasing the intensity of the heat, was a patent for a principle, and that a principle was not patentable.

Upon the first of these defences the jury found that a man of ordinary skill and knowledge of the subject, looking at the specification alone, could construct such an apparatus as would be productive of a beneficial result sufficient to make it worth while to adapt it to the machinery in all cases of forges, cupolas, and furnaces, where the blast is used.

And upon the second ground of defence, Baron Parke, who delivered the opinion of the Court, said:—

"It is very difficult to distinguish it from the specification of a patent for a principle, and this at first created in the minds of the Court much difficulty; but after full consideration, we think that the plaintiff does not merely claim a principle, but a machine embodying a principle, and a very valuable one. We think the case must be considered as if the principle being well known, the plaintiff had first invented a mode of applying it by a mechanical apparatus to furnaces; and his invention then consists in this: by interposing a receptacle for heated air between the blowing apparatus and the furnace. In this receptacle he directs the air to be heated by the application of heat externally to the receptacle, and thus he accomplishes the object of apply-

ing the blast, which was before cold air, in a heated state to the furnace."

We see nothing in this opinion differing in any degree from the familiar principles of law applicable to patent cases. Neilson claimed no particular mode of constructing the receptacle, or of heating it. He pointed out the manner in which it might be done; but admitted that it might also be done in a variety of ways; and at a higher or lower temperature; and that all of them would produce the effect in a greater or less degree, provided the air was heated by passing through a heated receptacle. And hence it seems that the Court at first doubted whether it was a patent for anything more than the discovery that hot air would promote the ignition of fuel better than cold. And if this had been the construction, the Court, it appears, would have held his patent to be void; because the discovery of a principle in natural philosophy or physical science is not patentable.

But after much consideration, it was finally decided that this principle must be regarded as well known, and that the plaintiff had invented a mechanical mode of applying it to furnaces; and that his invention consisted in interposing a heated receptacle between the blower and the furnace, and by this means heating the air after it left the blower, and before it was thrown into the fire. Whoever, therefore, used this method of throwing hot air into the furnace, used the process he had invented, and thereby infringed his patent, although the form of the receptacle or the mechanical arrangements for heating it might be different from those described by the patentee. For whatever form was adopted for the receptacle, or whatever mechanical arrangements were made for heating it, the effect would be produced in a greater or less degree, if the heated receptacle was placed between the blower and the furnace, and the current of air passed through it.

Undoubtedly the principle that hot air will promote the ignition of fuel better than cold, was embodied in this machine. But the patent was not supported, because this principle was embodied in it. He would have been equally entitled to a patent, if he had invented an improvement in the mechanical arrangements of the blowing apparatus, or in the furnace, while a cold current of air was still used. But his patent was supported, because he had invented a mechanical apparatus, by which a current of hot air instead of cold could be thrown in. And this new method was protected by his patent. The interposition of a heated receptacle in any form was the novelty he invented.

We do not perceive how the claim, in the case before us, can derive any countenance from this decision. If the Court of Exchequer had said that Neilson's patent was for the discovery that hot air would promote ignition better than cold, and that he had an exclusive right to use it for that purpose, there might,

perhaps, have been some reason to rely upon it. But the Court emphatically denied his right to such a patent; and his claim, as the patent was construed and supported by the Court, is altogether unlike that of the patentee before us.

For Neilson discovered that by interposing a heated receptacle between the blower and the furnace, and conducting the current of air through it, the heat in the furnace was increased. And this effect was always produced, whatever might be the form of the receptacle, or the mechanical contrivances for heating it, or for passing the current of air through it, and into the furnace.

But Professor Morse has not discovered that the electric or galvanic current will always print at a distance, no matter what may be the form of the machinery or mechanical contrivances through which it passes. You may use Electro-Magnetism as a motive power, and yet not produce the described effect—that is, print at a distance intelligible marks or signs. To produce that effect it must be combined with and passed through and operate upon certain complicated and delicate machinery adjusted and arranged upon philosophical principles, and prepared by the highest mechanical skill. And it is the high praise of Professor Morse, that he has been able by a new combination of known powers, of which Electro-Magnetism is one, to discover a method by which intelligible marks or signs may be printed at a distance. And for the method or process thus discovered he is entitled to a patent. But he has not discovered that the Electro-Magnetic current, used as a motive power, in any other method, and with any other combination, will do as well.

We have commented on the case in the Court of Exchequer more fully, because it has attracted much attention in the courts of this country as well as in the English courts, and has been differently understood. And perhaps a mistaken construction of that decision has led to the broad claim in the patent now under consideration.

We do not deem it necessary to remark upon the other English decisions in relation to Neilson's patent, nor upon the other cases referred to, which stand upon similar principles. The observations we have made on the case in the Court of Exchequer will equally apply to all of them.

We proceed to the American decisions; and the principles herein stated were fully recognized by this Court in the case of Leroy *et al. vs.* Tatham and others, decided at the last Term, 14 How., 156.

It appeared in that case that the patentee had discovered that lead, recently set, would, under heat and pressure in a close vessel, reunite perfectly after a separation of its parts, so as to make wrought instead of cast pipe. And the Court held that

he was not entitled to a patent for this newly-discovered principle or quality in lead; and that such a discovery was not patentable; but that he was entitled to a patent for the new process or method in the art of making lead pipe which this discovery enabled him to invent and employ; and was bound to describe such process or method fully in his specification.

Many cases have also been referred to which were decided in the Circuit Courts. It will be found, we think, upon careful examination, that all of them, previous to the decision on Neilson's patent, maintain the principles on which this decision is made. Since that case was reported, it is admitted that decisions have been made which would seem to extend patentable rights beyond the limits here marked out. As we have already said, we see nothing in that opinion which would sanction the introduction of any new principle in the law of patents; but if it were otherwise, it would not justify this Court in departing from what we consider as established principles in the American courts. And to show what was heretofore the doctrine upon this subject, we refer to the annexed cases. We do not stop to comment on them, because such an examination would extend this opinion beyond all reasonable bounds. 1 Stor. Rep. 270, 285; Wyeth *vs.* Stone, 3 Sumn. 540; Blanchard *vs.* Sprague. The first-mentioned case is directly in point.

Indeed, independently of judicial authority, we do not think that the language used in the act of Congress can justly be expounded otherwise.

The 5th section of the act of 1836 declares that a patent shall convey to the inventor, for a term not exceeding fourteen years, the exclusive right of making, using, and vending to others to be used, his invention or discovery, referring to the specification for the particulars thereof.

The 6th section directs who shall be entitled to a patent, and the terms and conditions on which it may be obtained. It provides that any person shall be entitled to a patent who has discovered or invented a new and useful art, machine, manufacture, or composition of matter, or a new and useful improvement on any previous discovery in either of them. But before he receives a patent, he shall deliver a written description of his invention or discovery, "*and of the manner and process of making, constructing, using, and compounding the same,*" in such exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound and use the same.

This Court has decided that the specification required by this law is a part of the patent, and that the patent issues for the invention described in the specification.

Now whether the Telegraph is regarded as an art or machine,

the manner and process of making or using it must be set forth in exact terms. The act of Congress makes no difference in this respect between an art and a machine. An improvement in the art of making bar iron or spinning cotton must be so described, and so must the art of printing by the motive power of steam. And in all of these cases, it has always been held that the patent embraces nothing more than the improvement described and claimed as new, and that any one who afterwards discovered a method of accomplishing the same object, substantially and essentially differing from the one described, had a right to use it. Can there be any good reason why the art of printing at a distance, by means of the motive power of the electric or galvanic current, should stand on different principles? Is there any reason why the inventor's patent should cover broader ground? It would be difficult to discover anything in the act of Congress which would justify this distinction. The specification of this patentee describes his invention or discovery, and the manner and process of constructing and using it, and his patent, like inventions in the other arts above mentioned, covers nothing more.

The provisions of the acts of Congress in relation to patents may be summed up in a few words.

Whoever discovers that a certain useful result will be produced in any art, machine, manufacture or composition of matter, by the use of certain means, is entitled to a patent for it; provided he specifies the means he uses in a manner so full and exact, that any one skilled in the science to which it appertains can, by using the means he specifies, without any addition to, or subtraction from, them, produce precisely the result he describes. And if this cannot be done by the means he describes, the patent is void. And if it can be done, then the patent confers on him the exclusive right to use the means he specifies to produce the result or effect he describes, and nothing more. And it makes no difference in this respect whether the effect is produced by chemical agency or combination; or by the application of discoveries or principles in natural philosophy, known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case, he must describe the manner and process as above mentioned, and the end it accomplishes. And any one may lawfully accomplish the same end without infringing the patent, if he uses means substantially different from those described.

Indeed, if the 8th claim of the patentee can be maintained, there was no necessity for any specification, further than to say that he had discovered that by using the motive power of Electro-Magnetism, he could print intelligible characters at any distance. We presume it will be admitted on all hands that no

patent could have issued on such a specification. Yet this claim can derive no aid from the specification filed. It is outside of it, and the patentee claims beyond it. And if it stands, it must stand simply on the ground that the broad terms above mentioned were a sufficient description, and entitled him to a patent in terms equally broad. In our judgment, the act of Congress cannot be so construed.

The patent then being illegal and void, so far as respects the 8th claim, the question arises whether the whole patent is void, unless this portion of it is disclaimed in a reasonable time after the patent issued.

It has been urged on the part of the complainants that there is no necessity for a disclaimer in a case of this kind. That it is required in those cases only in which the party commits an error in fact, in claiming something which was known before, and of which he was not the first discoverer; that in this case he was the first to discover that the motive power of Electro-Magnetism might be used to write at a distance; and that his error, if any, was a mistake in law in supposing his invention, as described in his specification, authorized this broad claim of exclusive privilege; and that the claim, therefore, may be regarded as a nullity, and allowed to stand in the patent without a disclaimer, and without affecting the validity of the patent.

This distinction can hardly be maintained. The act of Congress above recited requires that the invention shall be so described, that a person skilled in the science to which it appertains, or with which it is most nearly connected, shall be able to construct the improvement from the description given by the inventor.

Now in this case there is no description but one of a process by which signs or letters may be printed at a distance. And yet he claims the exclusive right to any other mode and any other process, although not described by him, by which the end can be accomplished, if Electro-Magnetism is used as the motive power. That is to say, he claims a patent for an effect produced by the use of Electro-Magnetism distinct from the process or machinery necessary to produce it. The words of the act of Congress above quoted show that no patent can lawfully issue upon such a claim. For he claims what he has not described in the manner required by law. And a patent for such a claim is as strongly forbidden by the act of Congress as if some other person had invented it before him.

Why, therefore, should he be required and permitted to disclaim in the one case and not in the other? The evil is the same if he claims more than he has invented, although no other person has invented it before him. He prevents others from attempting to improve upon the manner and process which he

has described in his specification, and may deter the public from using it, even if discovered. He can lawfully claim only what he has invented and described, and if he claims more his patent is void. And the judgment in this case must be against the patentee, unless he is within the act of Congress which gives the right to disclaim.

The law which requires and permits him to disclaim is not penal, but remedial. It is intended for the protection of the patentee as well as the public, and ought not, therefore, to receive a construction that would restrict its operation within narrower limits than its words fairly import. It provides, "that when any patentee shall have in his specification claimed to be the first and original inventor or discoverer of any material or substantial part of the thing patented, of which he was not the first and original inventor, and shall have no legal or just claim to the same,"—he must disclaim in order to protect so much of the claim as is legally patented.

Whether, therefore, the patent is illegal in part, because he claims more than he has sufficiently described, or more than he invented, he must in either case disclaim, in order to save the portion to which he is entitled; and he is allowed to do so when the error was committed by mistake.

A different construction would be unjust to the public, as well as to the patentee, and defeat the manifest object of the law, and produce the very evil against which it intended to guard.

It appears that no disclaimer has yet been entered at the Patent Office. But the delay in entering it is not unreasonable. For the objectionable claim was sanctioned by the head of the office; it has been held to be valid by a Circuit Court, and differences of opinion in relation to it are found to exist among the justices of this Court. Under such circumstances, the patentee had a right to insist upon it, and not disclaim it until the highest court to which it could be carried had pronounced its judgment. The omission to disclaim, therefore, does not render the patent altogether void, and he is entitled to proceed in this suit for an infringement of that part of his invention which is legally claimed and described. But as no disclaimer was entered in the Patent Office before this suit was instituted, he cannot, under the act of Congress, be allowed costs against the wrong-doer, although the infringement should be proved. And we think it is proved by the testimony. But as the question of infringement embraces both of the reissued patents, it is proper, before we proceed to that part of the case, to notice the objections made to the second patent for the local circuits, which was originally obtained in 1846 and reissued in 1848.

It is certainly no objection to this patent, that the improvement is embraced by the eighth claim in the former one. We

have already said that this claim is void, and that the former patent covers nothing but the first seven inventions specifically mentioned.

Nor can its validity be impeached upon the ground that it is an improvement upon a former invention, for which the patentee had himself already obtained a patent. It is true that, under the act of 1836, S. 13, it was in the power of Professor Morse, if he desired it, to annex this improvement to his former specification, so as to make it from that time a part of the original patent. But there is nothing in the act that forbids him to take out a new patent for the improvement, if he prefers it. Any other inventor might do so; and there can be no reason, in justice or in policy, for refusing the like privilege to the original inventor. And when there is no positive law to the contrary, he must stand on the same footing with any other inventor of an improvement upon a previous discovery. Nor is he bound in his new patent to refer specially to his former one. All that the law requires of him is, that he shall not claim as new what is covered by a former invention, whether made by himself or any other person.

It is said, however, that this alleged improvement is not new, and is embraced in his former specification; and that if some portion of it is new, it is not so described as to distinguish the new from the old.

It is difficult, perhaps impossible, to discuss this part of the case so as to be understood by any one who has not a model before him, or perfectly familiar with the machinery and operations of the Telegraph. We shall not, therefore, attempt to describe minutely the machinery or its mode of operation. So far as this can be done intelligibly, without the aid of a model to point to, it has been fully and well done, in the opinion delivered by the learned Judge who decided this case in the Circuit Court. All that we think it useful or necessary to say is, that after a careful examination of the patents, we think the objection on this ground is not tenable. The force of the objection is mainly directed upon the receiving magnet, which, it is said, is a part of the machinery of the first patent, and performs the same office. But the receiving magnet is not of itself claimed as a new invention. It is claimed as a part of a new combination or arrangement to produce a new result. And this combination does produce a new and useful result. For by this new combination, and the arrangement and position of the receiving magnet, the local independent circuit is opened by the electric or galvanic current as it passes on the main line, without interrupting it in its course, and the intelligence it conveys is recorded almost at the same moment at the end of the line of the Telegraph and at the different local offices on its way. And it

hardly needs a model or a minute examination of the machinery to be satisfied that a Telegraph which prints the intelligence it conveys, at different places, by means of the current as it passes along on the main line, must necessarily require a different combination and arrangement of powers from the one that prints only at the end. The elements which compose it may all have been used in the former invention, but it is evident that their arrangement and combination must be different to produce this new effect. The new patent for the local circuits was, therefore, properly granted, and we perceive no well-founded objection to the specification or claim contained in the reissued patent of 1848.

The two reissued patents of 1848, being both valid, with the exception of the 8th claim in the first, the only remaining question is, whether they, or either of them, have been infringed by the defendants.

The same difficulty arises in this part of the case which we have already stated in speaking of the specification and claims in the patent for the local circuits. It is difficult to convey a clear idea of the similitude or differences in the two Telegraphs to any one not familiarly acquainted with the machinery of both. The Court must content itself, therefore, with general terms, referring to the patents themselves for a more special description of the matters in controversy.

It is a well-settled principle of law, that the mere change in the form of the machinery (unless a particular form is specified as the means by which the effect described is produced), or an alteration in some of its unessential parts, or in the use of known equivalent powers, not varying essentially the machine, or its mode of operation or organization, will not make the new machine a new invention. It may be an improvement upon the former, but that will not justify its use without the consent of the first patentee.

The Columbian (O'Rielly's) Telegraph does not profess to accomplish a new purpose or produce a new result. Its object and effect is to communicate intelligence at a distance, at the end of the main line and at the local circuits on its way. And this is done by means of signs or letters impressed on paper or other material. The object and purpose of the Telegraph is the same with that of Professor Morse.

Does he use the same means? Substantially, we think he does, both upon the main line and in the local circuits. He uses upon the main line the combination of two or more galvanic or electric circuits, with independent batteries, for the purpose of obviating the diminished force of the galvanic current, and in a manner varying very little in form from the invention of Professor Morse And, indeed, the same may be said of the

entire combination set forth in the patentee's third claim. For O'Rielly's can hardly be said to differ substantially and essentially from it. He uses the combination which composes the Register, with no material change in the arrangement, or in the elements of which it consists; and with the aid of these means he conveys intelligence, by impressing marks or signs upon paper; these marks or signs being capable of being read and understood by means of an alphabet, or signs adapted to the purpose. And as regards the second patent of Professor Morse, for the local circuits, the mutator of the defendant does not vary from it in any essential particular. All of the efficient elements of the combination are retained, or their places supplied by well-known equivalents. Its organization is essentially the same.

Neither is the substitution of marks and signs differing from those invented by Professor Morse any defence to this action. His patent is not for the invention of a new alphabet, but for a combination of powers composed of tangible and intangible elements, described in his specification, by means of which marks or signs may be impressed upon paper at a distance, which can there be read and understood. And if any marks, or signs, or letters are impressed in that manner, by means of a process substantially the same with his invention, or with any particular part of it covered by his patent, and those marks or signs can be read, and thus communicate intelligence, it is an infringement of his patent. The variation in the character of the marks would not protect it, if the marks could be read and understood.

We deem it unnecessary to pursue further the comparison between the machinery of the patents. The invasion of the plaintiff's rights, already stated, authorized the injunction granted by the Circuit Court, and so much of its decree must be affirmed. But for the reasons hereinbefore assigned, the complainants are not entitled to costs, and that portion of the decree must be reversed, and a decree passed by this Court, directing each party to pay his own costs in this and in the Circuit Court.

Art. III.—DISSENTING OPINION OF JUSTICE GRIER.

SUPREME COURT OF THE UNITED STATES,

December Term, 1853.

HENRY O'RIELLY, *et al.*, Appellants,

vs.

SAMUEL F. B. MORSE, *et al.*, Appellees.

Appeal from the Circuit Court of the United States for the District of Kentucky.

The opinion of Justice GRIER, concurred in by Justices NELSON and WAYNE.

I entirely concur with the majority of the Court that the appellee and complainant below, Samuel F. B. Morse, is the true and first inventor of the recording telegraph, and the first who has successfully applied the agent or element of nature, called electro-magnetism, to printing, and recording intelligible characters at a distance; and that his patent of 1840, finally reissued in 1848, and his patent for his improvements, as reissued in the same year, are good and valid; and that the appellants have infringed the rights secured to the patentee by both his patents. But, as I do not concur in the views of the majority of the Court, in regard to two great points of the case, I shall proceed to express my own.

I.—Does the complainant's first patent come within the proviso of the sixth section of the act of 1839; and should the term of fourteen years, granted by it, commence from the date of his patent here, or from the date of his French patent in 1838?

If the complainant's patent is within the provisions of this section, I cannot see how we can escape from declaring it void. The proviso declares, that "in all cases every *such patent* (issued under the provisions of that section) shall be limited to the term of fourteen years from the date or publication of such foreign letters patent." It is true it does not say that the patent shall be void if not limited to such term on its face; but it gives no power to the officer to issue a patent for a greater term. If the patent does not show the true commencement of the term granted by it, the patentee has it in his power to deceive the public by claiming a term of fourteen years, while in reality it may be not more than one.

But, I am of opinion, that the patent in question does not come within this proviso. The facts of the case, as connected with this point, are these: On the 6th of October, 1837, Morse filed, in the office of the Commissioner of Patents, a caveat, accompanied by a specification, setting forth his invention, and praying that it may be protected till he could finish some experiments necessary to perfect its details. On the 9th of April, 1838, he filed a formal application for a patent, accompanied by a specification and drawings. On the

1st of May, 1838, the Commissioner informs him *that his application has been granted.* Morse answers on the 15th of May, that he is just about to sail for Europe, and asks the Commissioner to delay the issue of his patent for the present, fearing its effect upon his plans abroad.

On the 30th of October, 1838, he obtained his useless French patent. On his return to this country, in 1840, he requests his patent to be perfected and issued. In his application filed on 9th of April, 1838, there was an oversight in filling up the day and month. This clerical omission was wholly immaterial, but *ex majori cautela,* a second affidavit was filed, and the patent issued on the 20th of June, 1840, for the term of 14 years from its date.

The application of 1838 had a set of drawings annexed to the specification. The second set of drawings required by the 6th section of the act of 1837, being for the purpose of annexation to the patent, they were entirely unnecessary till the patent issued, and are not required by law to accompany the application when first made, and the want of them cannot affect the validity of the application.

In many instances, owing to various causes, the patent is not issued till many months, and sometimes a year or more after the application. The Commissioner requires time to examine the specification; he may suggest difficulties and amendments; and disputes often arise which delay the issuing of the patent. But the application does not require to be renewed, and is never considered abandoned in consequence of such delay. It still remains as of the date of its filing for every purpose beneficial to the applicant. The law does not require that the specification and its accompaniments should be in the precise form which they afterwards assume in the patent. It requires only that the application be "*in writing*," and that the applicant should "make oath that he is the original inventor," &c. The other requirements of the act must precede the issuing of the patent, but make no part of the application, and are not conditions precedent to its validity. In the present case, we have, therefore, a regular application in due form, accompanied by a specification and drawings, filed on the 9th of April, 1838. It has not been withdrawn, discontinued, or abandoned. There is nothing in the act of Congress which requires that the patent should be issued within any given time after the application is filed, or which forbids the postponement of it for a time at the suggestion either of the applicant or the officer; nor is there any thing in the general policy of the patent laws which forbids it. On the contrary, it has always been the practice, when a foreign patent is desired, to delay the issuing of the patent here, after application filed, for fear of injuring such foreign application. It forms no part of the policy of any of our patent acts to prevent our citizens from obtaining patents abroad. By the Patent Act of 1793, the applicant must swear that his invention was not known or used *before the application.* The filing of the application was the time fixed for determining the applicant's right to a patent. If a patent had issued abroad, or the invention had been in use or described in some public work *before that time,* it was a good defence to it. The time of filing the application was, therefore, made by law the criterion of his right to claim as *first inventor.*

A foreign patent, subsequent to the date of his application, could not be set up as a defence against the domestic patentee. The American inventor, who had filed his application and specification at home, was thus enabled to obtain his patent abroad without endangering his patent at home. This was a valuable privilege to American citizens, and one of which he has never been deprived by subsequent legislation; and thus the law stood till the act of 4th July, 1836.

Before this time, the right to obtain a patent was confined to American citizens, or those who had filed their intentions to become such. The policy of this act was to encourage foreign inventors to introduce their inventions to this country, but in doing so, it evinces no intention of limiting our own citizens by taking away from them rights which they had hitherto enjoyed. Accordingly, it gave an inventor, who had obtained a patent abroad, (and who was generally a foreigner,) a right to have one here, provided he made *his application* here within six months after the date of his foreign patent. Neither the letter nor the spirit of this act interferes with the right to an inventor, who has filed *his application* here, from obtaining a patent abroad, or his right to a term of fourteen years from the date of his patent.

In 1838, therefore, when complainant filed his application, he was entitled to such a patent. But in March, 1839, an act was passed, by the sixth section of which it is alleged the complainant's rights have been affected. That section is as follows :—"That no person shall be debarred from receiving a patent for any invention, &c., as provided in the act of 4th July, 1836, to which *this is additional*, by reason of the same having been patented in a foreign country more than six months prior to his application; *provided* that the same shall not have been introduced into public and common use in the United States prior *to the application for such patent. And provided, also*, that in all cases *every such patent* shall be limited to the term of fourteen years from the date or publication of such foreign letters patent." Now the act of 1836, as we have shown, had given a privilege to foreign patentees to have a patent within six months after date of such foreign patent; it had not affected, in any manner, the right previously enjoyed by American citizens to take out a foreign patent *after filing their application here*. This section gives "*additional*" rights to those who had first taken out patents abroad, and holds out an additional encouragement to foreign inventors to introduce their inventions here, subject to certain conditions contained in the provisoes. Neither the letter, spirit, nor policy of this act, have any reference to, or bearing upon, the case of persons who had first made their applications here. To construe a proviso, as applicable to a class of cases not within its enacting clause, would violate all settled rules of construction. The office of a proviso is either to except something from the enacting clause, or to exclude some possible ground of misinterpretation, or to state a condition to which the privilege granted by the section shall be subjected. Here the proviso is inserted, to restrain the general words of the section, and impose a condition on those who accept the privileges granted by the section. It enlarged the privileges of foreign patentees, which had before been confined to six months, on

two conditions: first, provided the invention patented abroad had not been introduced into public use here; and secondly, on condition that *every such patent* should be limited in its term. The general words, "*in all cases*," especially when restrained to "*every such patent*," cannot extend the condition of the proviso beyond such cases as are the subject-matter of legislation in the section.

The policy and spirit of the act are to grant privileges to a certain class of persons which they did not enjoy before; to encourage the introduction of foreign inventions and discoveries, and not to deprive our own citizens of a right heretofore enjoyed, or to affect an entirely different class of cases, when the *applications had been filed here before* a patent obtained abroad.

It is supposed that certain evils might arise by allowing an applicant for a patent here to delay its issue till he can obtain a foreign patent. To which it is a sufficient answer to say, that if such evil consequences should be found to exist, it is for Congress to remedy them by legislation. It is no part of the duty of this Court, by a forced construction of existing statutes, to attempt the remedy of possible evils by anticipation.

I am therefore of opinion that the complainant's patent, as renewed, contained a valid grant of the full term of fourteen years from its original date.

II.—The other point in which I cannot concur with the opinion of the majority, arises in the construction of the eighth claim of complainant's first patent, as finally amended. The first claim, as explanatory of all that follow, should be read in connection with the eighth—they are as follows:—"First—Having thus fully described my invention, I wish it to be understood that I do not claim the use of the galvanic current or currents of electricity for the purpose of telegraphic communications generally; but what I specially claim as my invention and improvement, is making use of the motive power of magnetism, when developed by the action of such current or currents substantially as set forth in the foregoing description of the first principal part of my invention, as means of operating or giving motion to machinery which may be used to imprint signals upon paper or other suitable material, or to produce sounds in any desired manner for the purpose of telegraphic communication at any distances. The only ways in which the galvanic current had been proposed to be used prior to my invention and improvement, were by bubbles resulting from decomposition, and the action or exercise of electrical power upon a magnetized bar or needle; and the bubbles and the deflections of the needles thus produced, were the subjects of inspection, and had no power, or were not applied to record the communication. I therefore characterize my invention as the first recording or printing telegraph by means of electro-magnetism.

"There are various known modes of producing motions by electro-magnetism, but none of these had been applied prior to my invention and improvement, to actuate or give *motion* to printing or recording machinery, which is the chief point of my invention and improvement."

"Eighth.—I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing specification and claims, the essence of my invention being the use of the motive power of the electric or galvanic current, which I call electro-magnetism, however developed, for marking or printing intelligible characters, signs or letters, at any distances, being a new application of that power, of which I claim to be the first inventor or discoverer."

The objection to this claim is, that it is *too broad*, because the inventor does not confine himself to specific machinery or parts of machinery as described in his patent, but claims that the essence of his invention consists in the application of electro-magnetism as a motive power, however developed, for printing characters at a distance. This being a new application of that element or power, of which the patentee claims to be the first inventor or discoverer.

In order to test the value of this objection as applied to the present case, and escape any confusion of ideas too often arising from the use of ill-defined terms and propositions, let us examine, 1st. What may be patented, or what forms a proper subject of protection under the Constitution and acts of Congress relative to this subject.

2d. What is the nature of the invention now under consideration? Is it a mere machine, and subject to the rules which effect a combination of mechanical devices to effect a particular purpose?

3d. Is the claim true in fact; and, if true, how can it be *too broad*, in any legal sense of the term, as heretofore used, either in the acts of Congress or in judicial decisions?

4th. Assuming the hypothesis that it is too broad; how should that affect the judgment for costs in this case?

"1st. The Constitution of the United States declares that Congress shall have the power to promote the progress of science and *useful arts*, by securing, for limited times, to authors and inventors, the exclusive right to their respective writings and *discoveries*."

The act of Congress of 1836 confers this exclusive right, for a limited time, on "any person who has discovered or invented any *new and useful art*, *machine*, *manufacture* or *composition of matter*, or any new and useful improvements on any *art*, machine, manufacture, or composition of matter, not known or used by others before his or their discovery or invention thereof, and not, at the time of his application for a patent, in public use," &c.

A new and useful *art*, or a new and useful improvement on any known art, is as much entitled to the protection of the law as a machine or manufacture. The English patent acts are confined to "manufactures," in terms; but the courts have construed them to cover and protect arts as well as machines; yet without using the term *art*. Here we are not required to make any latitudinous construction of our statute for the sake of equity or policy; and surely we have no right, even if we had the disposition, to curtail or narrow its liberal policy by astute or fanciful construction.

It is not easy to give a precise definition of what is meant by the term "*art*," as used in the acts of Congress. Some, if not all, the traits which distinguish an *art* from the other legitimate subjects of a

patent, are stated with clearness and accuracy by Mr. Curtis, in his treatise on patents. The term *art* "applies," says he, "to all those cases where *the application of a principle is the most important part of the invention*, and where the machinery, apparatus, or other means by which the principle is applied are incidental only, and not of the essence of his invention. It applies also to all those cases where the result, effect, or manufactured article, is old, but the invention consists in a new process or method of producing such result, effect, or manufacture." (Curt. Pat., 80.)

A machine, though it may be composed of many parts, instruments, or devices combined together, still conveys the idea of unity. It may be said to be invented, but the term "*discovery*" could not well be predicated of it. An art may employ many different machines, devices, processes, and manipulations, to produce some useful result. In a previously known art, a man may discover some new process, or new application of a known principle, element, or power of nature, to the advancement of the art; and will be entitled to a patent for the same, as an improvement in the art; or he may invent a machine to perform a given function, and then he will be entitled to a patent only for his machine. That improvements in the arts which consist in the new application of some known element, power, or physical law, and not in any particular machine or combination of machinery, have been frequently the subject of patents, both in England and this country, the cases in our books most amply demonstrate. I have not time to examine them at length; but would refer to James Watt's patent for a method of saving fuel in steam-engines, by condensing the steam in separate vessels, and applying non-conducting substances to his steam-pipes; Clegg's patent for measuring gas in water—Jupe *vs.* Pratt: Webster's Pat. Cases, 103—and the celebrated case of Neilson's patent for the application of hot blast, being an important improvement in the art of smelting iron.

In England, where their statute does not protect an art in direct terms, they have made no clear distinction between an art and an improvement in an art, and a process, machine or manufacture. They were hampered and confined by the narrowness of the phraseology of their patent acts. In this country the statute is as broad as language can make it; and yet if we look at the titles of patents as given at the Patent Office, and the language of our courts, we might suppose that our statute was confined entirely to *machines*, notwithstanding in Knoop *vs.* The Bank (4 Washington, C. C. R. 19), Mr. Justice Washington supported a patent which consisted in nothing else but a new application of copper plates to both sides of a bank bill as a security against counterfeiting. The new application was held to be an *art*, and therefore patentable. So the patent in McClurg *vs.* Kingsland (1 How. 204) was in fact for an improvement in the art of casting chilled rollers by conveying the metal to the mould in a direction approaching to the tangent of the cylinder, yet the patentee was protected in the principle of his discovery (which was but the application of a known law of nature to a new purpose) against all forms of machinery embodying the same principle. The great art of printing, which

has changed the face of human society and civilization, consisted in nothing but a new application of principles known to the world for thousands of years; no one could say it consisted in the type or the press, or in any other machine or device used in performing some particular function more than in the hands which picked the types or worked the press. Yet if the inventor of printing had, under this narrow construction of our patent law, claimed his *art* as something distinct from the machinery, the doctrine now advanced would have declared it unpatentable to its full extent as an *art*, and that the inventor could be protected in nothing but his first rough types and ill-contrived press.

I do not intend to review the English cases which adopt the principle for which I now contend, notwithstanding their narrow statute. But would refer to the opinion of my brother Nelson, in 14 How. 177; and will add, that Mr. Justice McLean, in delivering the opinion of the Court in that case, quotes with approbation the language of Lord Justice Clerk in the Neilson case, which is precisely applicable to the question before us. He says, "The specification does not claim anything as to form, nature, shape, materials, numbers or mathematical character of the vessel or vessels, in which the air is to be heated, or as to the mode of heating such vessels." Yet this patent was sustained as for a new application of a known element, or to use correct language, as an improvement in the art of smelting iron, without any regard to the machinery or parts of machinery used in the application. —Such I believe to be the established doctrine of the English courts.

He who first discovers that an element or law of nature can be made operative for the production of some valuable result, some new art, or the improvement of some known art, who has devised the machinery or process to make it operative, and introduced it in a practical form to the knowledge of mankind, is a discoverer and inventor of the highest class. The discovery of a new application of a known element or agent may require more labor, expense, persevering industry and ingenuity than the invention of any machine; sometimes, it is true, it may be the result of a happy thought or conception, without the labor of experiment, as in the case of the improvement in the art of casting chilled rollers, already alluded to. In many cases it is the result of numerous experiments; not the consequence of any reasoning *a priori*, but wholly empyrical, as in the discovery that a certain degree of heat, when applied to the usual processes for curing India rubber, produced a substance with new and valuable qualities.

The mere discovery of a new element, or law, or principle of nature, without any valuable application of it to the arts, is not the subject of a patent. But he who takes this new element or power, as yet useless, from the laboratory of the philosopher, and makes it the servant of man, who applies it to the perfecting of a new and useful art, or to the improvement of one already known, is the benefactor to whom the patent law tenders its protection. The devices and machines used in the exercise of it may or may not be new, yet, by the doctrine against which I contend, he cannot patent them, because they were

known and used before. Or if he can, it is only in their new application and combinations in perfecting the new art. In other words, he may patent the new application of the mechanical devices, but not the new application of the operative element which is the essential agent in the invention. He may patent his combination of machinery, but not his art.

Where a new and hitherto unknown product or result beneficial to mankind is effected by a new application of any element of nature, and by means of machines and devices, whether new or old, it cannot be denied that such invention or discovery is entitled to the denomination of a "new and useful art." The statute gives the inventor of an art a monopoly in the exercise of it, as fully as it does to the inventor of a mere machine; and any person who exercises such new art without the license of the inventor, is an infringer of his patent, and of the franchise granted to him by the law as a reward for his labor and ingenuity in perfecting it. A construction of the law which protects such an inventor in nothing but the new invented machines, or parts of machinery used in the exercise of his art, and refuses it to the exercise of the art itself, annuls the patent law. If the law gives a franchise or monopoly to the inventor of an art, as fully as to the inventor of a machine, why shall its protection not be coextensive with the invention in one case, as well as in the other? To look at an art as nothing but a combination of machinery, and give it protection only as such against the use of the same or similar devices, or mechanical equivalents, is to refuse it protection *as an art*. It ignores the distinction between an art and a machine; it overlooks the clear letter and spirit of the statute, and leads to inextricable difficulties; it is viewing a statue or a monument through a microscope.

The reason given for thus conferring the franchise of the inventor of an art to his machines and parts of machinery, is, that it would retard the progress of improvement, if those who can devise better machines or devices differing in mechanical principle from those of the first inventor of the art, or, in other words, who can devise an improvement in it, should not be allowed to pirate it.

To say that a patentee who *claims the art of writing at a distance by means of Electro-Magnetism*, NECESSARILY CLAIMS ALL FUTURE IMPROVEMENTS IN THE ART, *is to misconstrue it, or draw a consequence from it not fairly to be inferred from its language*. An improvement in a known art is as much the subject of a patent as the art itself; so also is an improvement on a known machine. Yet, if the original machine be patented, the patentee of an improvement will not have a right to use the original. This doctrine has not been found to retard the progress of invention in the case of machines; and I can see no reason why a contrary one should be applied to an art.

The claim of the patentee is, that he may be protected in the exercise of his art as against persons who may improve or change some of the processes or machines necessary in its exercise. The Court, by deciding that this claim is too broad, virtually decides that such an inventor of an improvement may pirate the art he improves, because it is contrary to public policy to restrain the progress of invention;

or, in other words, it may be said that it is the policy of the courts to refuse that protection to an art which it affords to a machine, and which it is the policy of the Constitution and the laws to grant.

2d. Let us now consider what is the nature of the invention now under consideration.

It is not a composition of matter, or a manufacture, or a machine. It is the application of a known element or power of nature to a new and useful purpose by means of various processes, instruments and devices, and if patentable at all, it must come within the category of "*a new and useful art.*" It is as much entitled to this denomination as the original art of printing itself. The name given to it in the patent is generally the act of the Commissioner, and in this, as in many other cases, a wrong one. The true nature of the invention must be sought in the specification. The word Telegraph is derived from the Greek, and signifies to "write afar off, or at a distance." It has heretofore been applied to various contrivances or devices to communicate intelligence by means of signals or semaphores which speak to the eye for a moment; but in its primary and literal signification of *writing*, *printing*, *or recording at a distance*, it never was invented, perfected, or put into practical operation, till it was done by Morse. He preceded Steinheil, Cook, Wheatstone, and Davy, in the successful application of the mysterious power or element of electro-magnetism to this purpose; and his invention has entirely superseded their inefficient contrivances. It is not only "a new and useful art," if that term means anything, but a most wonderful and astonishing invention, requiring tenfold more ingenuity and patient experiment to perfect it, than the art of printing with types and press, as originally invented.

3d. Is it not true, as set forth in this eighth claim of the specification, that the patentee was the first inventor or discoverer of the use or application of electro-magnetism to print and record intelligible characters or letters? It is the very ground on which the Court agree in confirming his patent. Now the patent law requires an inventor, as a condition precedent to obtaining a patent, to deliver a written description of his invention or discovery, and to particularly specify what he claims to be his own invention or discovery. If he has truly stated the principle, nature, and extent of his art or invention, how can the Court say *it is too broad*, and impugn the validity of his patent for doing what the law requires as a condition for obtaining it? And if it is only in case of a machine that the law requires the inventor to specify what he claims as his own invention and discovery, and to distinguish what is new from what is old, then this eighth claim is superfluous, and cannot affect the validity of his patent, provided his art is new and useful, and the machines and devices claimed separately are of his own invention. If it be in the use of the words "*however developed*" that the claim is to be adjudged too broad, then it follows that a person using any other process for the purpose of developing the agent or element of electro-magnetism than the common one now in use and described in the patent, may pirate the whole art patented.

But if it be adjudged that the claim is too broad, because the inventor claims the application of this element to his new art, then his patent is to be invalidated for claiming his whole invention, and nothing more. If the result of this application be a new and useful art, and if the essence of his invention consists in compelling this hitherto useless element to record letters and words at any distance, and in many places at the same moment, how can it be said that the claim is for a principle or an abstraction? What is meant by a claim being *too broad?* The patent law and judicial decisions may be searched in vain, for a provision or decision that a patent may be impugned for claiming no more than the patentee invented or discovered. It is only when he claims something before known and used, something as new which is not new, either by mistake or intentionally, that his patent is affected.

The act of Congress requires the applicant for a patent to swear that "he is the original and first inventor of the art, machine," &c. It requires the Commissioner to make an examination of the alleged invention, "and if it shall appear that the same *has not been invented prior to the alleged invention,* he shall grant a patent, &c. But if it shall appear that the applicant is not the original and first inventor or discoverer thereof, *or that any part of that which is claimed as new had before been invented,*" then the applicant to have leave to withdraw his application.

The 13th section treats of defective specifications, and their remedy, where the applicant, through mistake or inadvertency, had claimed "*more than he had a right to claim as new.*"

The 15th section, in enumerating the defences which a defendant may be allowed to make to a patent, states that *inter alia* he may show "that the patentee was not the original and first inventor or discoverer of the thing patented, or of a *substantial and material part thereof claimed as new,*" and the proviso to the same section allows the court to refuse costs, "when the plaintiff shall fail to sustain his action on the ground that in his specification or claim is embraced *more than that of which he was the first inventor.*

The 7th section of the act of March 3d, 1837, specially defines the meaning of the phrase *too broad* to be, when the patent claims more than that of which the patentee was the original and first inventor; and the 9th section of the same act again providing for cases where, by accident or mistake, the patentee claims more than he is justly entitled to, describes it to be, "where the patentee shall have in his specification claimed to be the original inventor or discoverer of any material or substantial part, of which he is not the first and original inventor, *and* shall have no legal and just right to the same." Thus we see that it is only where, through inadvertence or mistake, the patentee has claimed something of which he was not the *first inventor,* that the Court are directed to refuse costs.

The books of reports may be searched in vain for a case where a patent has been declared void, for being *too broad* in any other sense.

Assuming it to be true, then, for the purpose of the argument, that the new application of the power of electro-magnetism to the art of

telegraphing or printing characters at a distance, is not the subject of a patent, because it is patenting a principle ; yet as it is also true that Morse was the first who made this application successfully, as set forth in this 8th claim, I am unable to comprehend how, in the words of the statute, we can adjudge "that he has failed to sustain his action on the ground that his specification or claim embraces more than that of which he was the first inventor." It is for this alone that the statute authorizes us to refuse costs.

4th. Assuming this 8th claim to be too broad, it may well be said, that the patentee has not unreasonably delayed a disclaimer, when we consider that it is not till this moment he had reason to believe it was too broad. But the bill claims, and it is sustained by proof, that the defendant has infringed the complainant's second patent for his improvement.

The Court sustain the validity of this patent. Why, then, is the complainant not entitled to his costs? At law, a recovery on one good count is sufficient to entitle the plaintiff to recover costs; and I can see no particular equity which the defendants can claim, who are adjudged to have pirated two inventions at once.

I am of opinion, therefore, that the decree of the Circuit Court should be affirmed, with costs.

True copy.

Test: Wm. Thos. Carroll,
C. S. C. U. S.

SHAFFNER'S
TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. I. APRIL, 1854. No. 4.

Art. I.—ATLANTIC AND PACIFIC TELEGRAPH.

THE LINE PRACTICABLE—GREAT BENEFIT TO THE GOVERNMENT AND THE PEOPLE — REPORT OF SENATE COMMITTEE IN FAVOR OF A LINE — SENATE BILL FOR ITS CONSTRUCTION.

THE subject of a line of Telegraph connecting the two ocean shores of America is one of no ordinary import. None more so for the United States Government.

The electric wires spreading over the country are of the most commanding importance to the people, and to the official machinery of the Republic. We have seen instances where the Government could have saved money enough to build the entire line to the Pacific. A loss, in failing to use the telegraph, is but little considered. The press, throughout the country, teem with editorials crying aloud against Galphin, Gardiner, and other frauds. Money thus lost is monstrous to all, and the most intense excitement is created. The fatal consequences are matters of excitement for the moment, and the sum of money thus attained, nearly everybody seems to feel as though it were their own private loss. This may be all right, and we do not think otherwise.

Why make a discrimination between the losses of the Government? A dollar is a dollar the world over, and the people ought to feel the loss occasioned by want of judgment upon the part of the officers in failing to *save*, as they do in expending. They are the same. We have reason to believe and to know, that the cost of building a line of two wires, from the frontiers to the Pacific Ocean, can be saved by the Government in less than two years after its completion. Ask Mr. Marcy, Secretary of State, if the Government would not have saved a sum sufficient to build a line to the Pacific had there been a line to New-Orleans from Washington during the Mexi-

can war? We could mention monstrous losses sustained by the United States, by non-use of the lines with the West. We dare not mention details, but we know that we speak correctly.

We do hope Congress will pass the bill appended, and even do more than the bill requires. The route ought to be protected with soldiers, not only on account of the line, but to protect the traveller.

The following report was presented by General Jones, Senator from Iowa, on the 21st of February, 1854, recommending an amended bill, originally presented by Mr. Hamlin, of Maine.

The Senate will doubtless pass the proposed bill, but how soon it will become a law no human can divine.

On another occasion we contemplate discussing this subject further, in connection with the railroad. The Atlantic and Pacific Company of New-York has passed very favorable resolutions. We feel confident this road and line will be built ere many years.

Mr. Jones, of Iowa, made the following report:—

" The Committee on Territories, to whom was referred the memorial of Hiram O. Alden and James Eddy, asking for the right of way for a telegraph to the Pacific, and a grant of land in aid of the construction of such telegraph, having considered the same, beg leave to report:—

The proposition to connect the eastern and western shores of this continent by magnetic telegraph is one of such vast importance, involving alike the highest consideration of public and private interest, civilization and power, that it is almost impossible to do it justice within the limits usually assigned to an official communication to Congress. It is proposed, therefore, to divide the subject, and to consider chiefly—

1st. The necessity, uses and advantages of the enterprise to the Government and the public.

2d. The feasibility of its execution.

3d. Its comparatively small cost, in view of the advantages to be derived from it.

That there is an absolute necessity for a line of telegraph, connecting our Atlantic and Lake cities with the cities on the Pacific coast, is apparent to the humblest capacity. The various business relations of Boston, New-York, Philadelphia, Baltimore, Washington, Charleston, and New-Orleans, as well as Buffalo, Chicago, St. Louis, and Cincinnati, with the cities of our new Pacific empire, must necessarily partake of the nature of chance, and involve innumerable losses, till the wants of California and the means of supplying these shall be known to our merchants, flour and provision dealers, in time to make profit-

able shipments. A commercial telegraphic correspondent at San Francisco, informing his friends on the Atlantic coast, on the Lakes, or on the Ohio, Mississippi and Missouri rivers, of the state of the markets, the arrival from foreign countries, the abundance or scarcity of provisions, the accumulation of the precious metals, &c., would annually save millions of property, and give to that which is now considered hazardous speculation, the reality and substance of healthy trade. Capital, which is now misapplied or lost, would find a profitable investment, and help to develop and multiply the resources of the whole country. And as the business people of our Atlantic and Western cities would be the first to receive all this valuable information, so would they also be the first to profit by it, even to a point which would enable them to import into San Francisco, direct from Europe, the goods which cannot be supplied by our own domestic markets.

So far the necessities of commerce; let us now consider those of the Government. The acquisition of California secures to the United States the most favorable position on the entire globe for a world-empire. Bounded east and west, respectively, by the two great oceans which divide the continents, its northern expanse only limited by barren wilds or sparsely settled colonies of a distant country, and to the southward encountering a nation yielding at every step to our superior energy and progress, nothing is wanting to render the machinery of our Government perfect, but a safe and rapid intercommunication between the heart and the extremities. In proportion to the distance of a State or Territory from the Federal Government is the necessity of protection, especially when the wealth and resources of those States and Territories are apt to invite the cupidity of strangers. Our Pacific seacoast is as yet entirely unguarded, and must necessarily remain so for a number of years; though a vast amount of Government property may, in the meanwhile, be accumulating in the sea-ports. There are wharves and docks, Government stores, custom-houses, assay offices, barracks—in short, property amounting to millions, intrusted to officers, with whom the Government must be in correspondence at all times, but who might require double the care and attention in time of war. Our California gold fleets might require convoys, and the commanders of our men-of-war in the Pacific fresh instructions from the Government, which could not be conveyed in season except by telegraph. Troops may be ordered to march, or be conveyed from one point on the coast to another, reinforcements may be demanded or announced—in short, the action of the Government invoked in a thousand ways, when success may depend on promptness of execution.

In all these cases the telegraph would be an instrument of *power*, either for offensive or defensive measures.

On the score of economy, it would save the Government the employment of expresses, and the multiplication of Government officials in the civil and military service. It would cause the business of the Government to be done almost as soon as the orders may be issued from the respective departments in Washington, and thus prevent the waste of means consequent on delay. It would add strength and efficiency to every Executive act, and preserve that faith and reliance on our Federal Government, in citizens separated from us by snow-capped mountains and vast deserts, which would animate their hopes, and sustain their courage, in times of trial.

But there are yet other advantages to be derived from the use of a line of telegraph from the Atlantic to the Pacific. We have a fleet of some six hundred whalers in the Pacific Ocean, the captains and crews of which are ever anxious to be put in communication with their friends at home, and the merchants in our Eastern cities. They are naturally desirous to bring the product of their daring industry to the best markets, whether American or European, and the telegraph is the best means of imparting to them the information needed for that purpose. In addition to this, our carrying trade in the Pacific has quadrupled since the discovery of the precious metals in California and Australia, amounting now to some 300,000 tons, and employing a capital of more than a hundred millions of dollars; while the revolution in China, and the prospect of opening the ports of Japan, promise a field of enterprise to our merchants and navigators, which must make San Francisco and New-York the emporiums of the world's commerce, and the Atlantic and Pacific Telegraph the great source of commercial information to all trading nations. When our Pacific steamers shall carry the mails from San Francisco to Shanghai and Canton, intelligence will be conveyed from India to China, and thence through the United States to Europe, in less time, and with more safety, than by the overland route. The India mail, by the overland route, requires, on an average, sixty-eight days to reach England, and twelve days more to reach New-York and Boston—in all, eighty days. When the Atlantic and Pacific Telegraph shall be built, and a line of steamers run from San Francisco to Shanghai, news from China will be received in New-York in seventeen days, fifteen of which will be required in the transmission of the mails from China to San Francisco, and one or two days, at furthest, from San Francisco by telegraph to New-York. Add to this distance of seventeen days, twelve days for the transmission of the mails from New-York to Liverpool or London, and the

Eastern news, via the United States, will reach England in less than half the time now required for its transit by the overland route.

The news from India, the Sandwich Islands, the Dutch East Indies, Australia, and New-Zealand will all be conveyed by the United States, until, when the Pacific Railroad shall be built, commerce itself will follow in the train of commercial intelligence.

That the Atlantic and Pacific Telegraph would be the source of infinite satisfaction to thousands of our hardy Western pioneers who, through it, would be enabled to communicate with their wives and children, friends and relatives at home, need scarcely be mentioned. Many a heart would be gladdened, many an expense saved, and many a comfort added to scanty means, by early tidings of the emigrant's new favorable location and success. In whatever light the subject may be considered, whether in reference to the interests of the government, the prosperity of our merchants and navigators, or the happiness and comfort of the citizens at large, the enterprise is eminently calculated to promote the power, wealth, and general prosperity of the country.

As regards the feasibility of the enterprise, the experience o the memorialists, tested by successful undertakings of a similar nature in other parts of the country, as well as the fact that they ask no aid from the government *till their line is completed and in working order*, furnish the strongest presumptive evidence in its favor. The wires, which they propose to lay down underground, to protect them against storms, wild animals, or Indians, are covered by an imperishable insulating substance, impervious to moisture, and unaffected by any other decomposing influences of the earth. They propose to lay them deep enough to prevent their being disturbed; and they have discovcred a process of carrying them across the beds of rivers, and through masses of rocks. Experiments of the same kind have been made in Europe and proved successful. Besides, the memorialists propose to have testing tubes every five miles, and operating stations every hundred miles, on the entire length of the line. Their confidence in their plan of construction, and the entire success of its execution is so great, that they propose to complete the line within two years from the passage of this bill, or to forfeit all the rights and privileges acquired under it. Such confidence can only be imparted by science, which subjects matter to the immutable laws of nature, and predicts with unerring certainty the result of their application. The government is not asked to aid in making experiments; it is not called upon to appropriate a dollar, or donate an acre of the public domain, until the enter-

prise is crowned with success, and that success manifest, by the actual use the government is invited to make of it.

It remains to be shown that the expense of the undertaking is commensurate with its advantages in practice.

All the memorialists ask, after the line is completed and in working order, is a donation of two millions of acres of land along the line, or in some other territories of the United States not interfering with the grants that may have been made, or may hereafter be made for railroad purposes. This is a small donation, compared with the liberal grants which have been made for railroads and other improvements of a less general character, and less likely to affect the wealth and progress of the whole country. Neither is it asked that the lands granted shall be in a continuous line, only benefiting the grantees. The improvements on the line will enhance the value of the adjacent lands, cause their settlement, and thus bring them, at an early period, into market. The telegraph will be the forerunner of civilization and power, and increase the revenue of the government, from customs and divers other sources.

But there is yet another most important consideration. The memorialists do not ask that the government shall grant them lands without receiving an *equivalent*. They bind themselves, in perpetuity, to transmit monthly, free of charge, and prior to all other business, eight thousand words for the sole use of the government, and agree to work the line, day and night, without interruption. This the Committee consider the most valuable feature in the whole proposition. At the rate of charges proposed by the memorialists for so large a distance, and worked at so great an outlay of labor and capital, it would be equal to the payment of $100,000 *per annum;* but the actual saving to government, in expresses, messengers, &c., would amount to much more, and far exceed the interest on the value of the donated lands. Viewed in this light, the grant of lands from the government would, in fact, be nothing else but a perpetual *lease* of them, at the yearly rent of $100,000 and upwards; and not in the nature of a *gift*, but of a profitable *investment.*

Considering, then, that the memorialists assume the whole risk and responsibility of the enterprise, and that the government is only called upon, at its successful *completion*, to make a moderate grant of land *for the use of it*, in all time to come, in the nature of rent, their proposition appears eminently just and reasonable on the face of it, and perfectly safe to the government.

Your Committee beg leave to report the following bill:—

A BILL AUTHORIZING THE CONSTRUCTION OF A LINE OF TELEGRAPH FROM THE MISSOURI OR MISSISSIPPI RIVER TO THE PACIFIC OCEAN.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Hiram O. Alden and James Eddy, their successors, associates and assigns, are hereby authorized and empowered to construct at their own expense, a line of telegraph from such point on the Mississippi or Missouri River as they may hereafter select, through the public lands belonging to, and under the jurisdiction of the United States, over which lands the right of way for that purpose is hereby granted, to San Francisco, in California, or some other point on the Pacific coast, in as direct a line as practicable, with the liberty to construct also diverging lines to and through the public lands in the States and Territories lying both north and south of said direct or main line, as is hereinafter set forth.

SEC. 2. *And be it further enacted*, That said line of telegraph shall be constructed of durable materials, with at least two independent conductors thoroughly insulated, and securely placed under the surface of the earth, rock, or water, with testing tubes every five miles, and working stations at distances averaging not more than one hundred miles, to secure the through working of the same, and for its repair and protection. Said working stations are to be supplied with all the requisite telegraph apparatus, instruments, operators and men, necessary to its efficacy and reliability, and the same shall be completed and put in operation within two years from the passage of this bill, and such State legislation as may be necessary to authorize its construction in the States through which it may pass. And said line of telegraph, when so completed, shall thereafter be kept in operation by night as well as by day.

SEC. 3. *And be it further enacted*, That there shall be reserved and granted to the General Government forever, the free and prior use of said line of telegraph, for the transmission of all official despatches and communications between said government and its officers: Provided, however, That said free despatches and communications shall not exceed a monthly aggregate of more than eight thousand words; but still reserving to the government the further prior use, to any extent within the capacity of said line, by paying the same tolls or charges paid by individuals for like services, and no more.

SEC. 4. *And be it further enacted*, That for the transmission of all private despatches and communication over said main line,

between the Mississippi and the Pacific, the tolls or charges shall, in no case, exceed ten dollars for each message of ten words or less, exclusive of date, address and signature; and not exceeding seventy-five cents for each word added thereto.

SEC. 5. *And be it further enacted*, That said Alden and Eddy, their associates and assigns, shall, at their own expense, keep said line of telegraph in working order, and at their own cost operate the same, transmitting said government despatches and communications, at all times, when said line shall be in working condition, as requested by the officers or authorized agents of said government; and if they shall, at any time, unreasonably refuse so to do, or shall neglect, for the space of six successive months, to operate said line—unless prevented from so doing by some unforeseen disaster or some unavoidable calamity, arising from the sickness of operators or from Indian hostility and depredation—said line of telegraph, with all its appurtenances, shall be forfeited to, and become the property of the United States.

SEC. 6. *And be it further enacted*, That upon the completion of said line of telegraph, as aforesaid, and so soon as the same shall be put in successful operation, and the free use thereof, as hereinbefore provided, tendered to the government of the United States, then shall be issued to said Alden and Eddy, their heirs or assigns, in exchange and payment for the free and prior use of said line in perpetuity, as aforesaid, land warrants for two millions acres of land, which they are hereby authorized to select and locate as follows: from and after said completion they shall have the right to select from any of the public lands along and near said line of telegraph, not before sold or appropriated, any quantity, not less than a section nor more than a township in one body. If more than a township shall be selected in the same locality, alternate townships only shall be taken. Where unsurveyed lands shall have been selected, the President of the United States shall cause the same to be surveyed; and if, after two years from the completion, as aforesaid, said lands shall not have been surveyed, it shall be optional with said Alden and Eddy, their heirs or assigns, and they shall have the right to relocate the like quantities of land in any Territory where they have been surveyed, and shall then be open to private entry or sale. And as fast as selections and locations of said lands shall thus be made, the Commissioner of the General Land Office is hereby authorized and required to issue patents to said Alden and Eddy, their heirs or assigns, on application therefor: Provided, That in the event a railroad to the Pacific Ocean shall be located on or near said line of telegraph, the grant of land contemplated in this section shall be so located as not to interfere with any grant Congress may make in aid of the construction of said railroad.

SEC. 7. *And be it further enacted*, That all voluntary or intentional injuries to said line of telegraph, or to any property thereto belonging, shall be deemed, and are hereby declared to be wilful and malicious trespasses, and shall be punished as such, and all laws of the United States now in force in any Territory thereof, or which may hereafter be enacted for the better security and protection of property, and applicable to such offences, shall be, and they hereby are extended, for the protection of said line of telegraph, into and over all the unorganized territory belonging to, and under the jurisdiction of the United States, through which the same may be constructed; and all legal process and proceedings for the detection and punishment of the aforesaid offences shall be within the jurisdiction of the courts, and shall be issued and executed by the proper law officers in the adjoining States and organized Territories."

Art. II.—ATLANTIC OCEAN TELEGRAPH.

THE OCEAN SOUNDED—BOTTOM FOUND FROM AMERICA TO EUROPE—LIEUT. MAURY—THE OCEAN BASIN—THE WATER QUIET ON THE BOTTOM—TELEGRAPH ACROSS THE OCEAN PRACTICABLE—LIEUT. MAURY'S LETTER TO SECRETARY OF THE NAVY.

IN the January number of the COMPANION we published the deep-sea soundings made by Lieut. Berryman, from the United States brig Dolphin. By an examination of a map, and marking the positions of the vessels, observing the longitudes and latitudes, each sounding is seen, the fathoms are given, and all the details necessary to give a full understanding of the deep sea. These explorations of the ocean are wonderful, and will tend to advance science and society far more than any other discovery since the telegraph. It is necessary to extend these soundings northward of the last; and when the sea between the coast of Labrador and South Greenland, ranging thence northward to Iceland, the Shetland and coasts of Scotland, Norway and Sweden, the ocean will be as well understood as to its bottom as the land on which we walk. Not only do these soundings prove the depth of the ocean and the geology of the bottom, but also greatly aid in discovering the currents of the sea, which seem to be as diversified as the currents of air that sweep over the earth's surface.

We learn from Lieut. Maury, of the National Observatory, that "the deepest parts of the ocean will probably be found south of the parallel of 35° south. * * * As to the physical geography of the sea, it may be said we know nothing, or only so much as may be gathered from a few faint rays that

modern explorations have cast upon; and the officers of the navy have here afforded them the rare opportunity of building up a new department in physical geography.

The problem before them is an old one—to fathom the depths of the ocean is the proposition. It has either appalled by its magnitude, or baffled with its difficulties. At any rate, no systematic attempts have ever been made to guage its depths 'off soundings.' But now, with means the most simple, this first great problem in the physical geography of the sea seems to be in a fair way of receiving a satisfactory solution, at least so far as to enable us to form a tolerable correct idea as to the general forms of the great oceanic basins and the troughs, which, like spurs from the mountain ranges, start out from the depressions in the solid crust below its waters, into bays, gulfs, and arms of the sea. Of all the contrasts in nature, perhaps none would be more striking than that afforded between the elevations of the earth's crust into mountains on the one hand, and its depressions below the sea-level in the beds of the ocean on the other. Certainly, few would be more grand—none can be more imposing. * * * * * *

The ocean teems with life, we know. Of the four elements of the old philosophers—fire, earth, air, and water—perhaps the sea most of all abounds with living creatures. * * *

Brooke's lead and the microscope, therefore, it would seem, are about to teach us to regard the ocean in a new light. Its bosom, which so teems with animal life, its face, upon which time writes no wrinkles, makes no impression, are, it would seem, as obedient to the great law of change as is any department whatever, either of the animal or the vegetable kingdom. It is now suggested that, henceforward, we should view the surface of the sea as a nursery teeming with nascent organisms; its depths, as the cemetery for families of living creatures that outnumber the sands on the sea-shore for multitude.

Where there is a nursery, hard by there will be found also a graveyard. Such is the condition of the animal world. But it never occurred to us before to consider the surface of the sea one wide nursery, its every ripple as a cradle, and its bottom as one vast burial-place. * * * * *

In the deep sea there are no abrading processes at work; neither frosts nor rains are felt there; and the force of gravitation is so paralyzed down there that it cannot use half its power, as on the dry land, in tearing the overhanging rock from the precipice, and casting it down in the valley below.

When, therefore, I was treating of the basin of the Atlantic, the imagination was disposed to regard the waters of the sea as a great cushion placed between the air and the bottom of the ocean, to protect and defend it from these abrading agencies of the atmosphere.

The geological clock may, thought I, strike new periods; its hands may point to era after era; but so long as the ocean remains in its basin, so long as its bottom is covered with blue water, so long must the deep furrows and strong contrasts in the solid crust below stand out raggedly and boldly rugged. Nothing can fill up the hollows there; no agent now at work, that we know of, can descend into its depths and level off the floors of the sea.

But it now seems that we forgot these oceans of animalculæ that make the surface of the sea sparkle and glow with life. They are secreting from its surface solid matter, for the very purpose of filling up those cavities below.

These little marine insects are building their habitations at the surface; and when they die, their remains, in vast multitudes, sink down, and settle upon the bottom. They are the atoms out of which mountains are formed—plains spread out. Our marl-beds, the clay in our river bottoms, large portions of many of the great basins of the earth, are composed of the remains of just such little creatures as these, which the ingenuity of Brooke and the industry of Berryman have enabled us to fish from the depth of more than two miles below the sea-level.

These foraminifera, therefore, when living, may have been preparing the ingredients for the fruitful soil of a land that some earthquake or upheaval, in ages far away in the future, may be sent to cast up from the bottom of the sea.

The study of these 'sunless treasures,' recovered with so much ingenuity from the rich bottom of the sea, suggests new views concerning the physical economy of the ocean."

Such are the views entertained by Lieut. Maury of the United States Navy, in charge of the National Observatory at Washington. The commerce of the world is indebted to this distinguished gentleman. Nations enjoy the blessings resulting from his learned discoveries. The field of his labor is boundless, and his zeal and eminent talents are bringing forth fruits to bless the age.

The laying of a cable across the briny deep has been to many, even some who are prominently engaged in telegraphing, deemed wild, and a fruitless theme of reflection. From the moment we ascertained that a bottom of the ocean had been found, we felt confident of the practicability of laying a telegraph cable from America to Europe. If a twine string can stand the power of the cross-currents of the ocean, and let to the bottom a cannon-ball of sixty-four pounds, and then raise a tube filled with the shells and earth of the ocean bottom, we are confident that a cable of strength could be stretched from land to land. We conclude this article by giving a letter recently written to the Secretary of the Navy by Lieut. Maury, relative to an ocean

telegraph, and we rejoice to see that in questions of science he is not afraid to give his opinion.

"NATIONAL OBSERVATORY,
WASHINGTON, *February* 22, 1854.

SIR:—The United States brig 'Dolphin,' Lieutenant Commanding O. H. Berryman, was employed last summer upon special service connected with the researches that are carried on at this office concerning the winds and currents of the sea.

Her observations were confined principally to that part of the ocean which the merchantmen, as they pass to and fro upon the business of trade between Europe and the United States, use as their great thoroughfare.

Lieutenant Berryman availed himself of this opportunity to carry along also a line of deep-sea soundings from the shores of Newfoundland to those of Ireland.

The result is highly interesting, as it bears directly, in so far as the bottom of the sea is concerned, upon the question of a submarine telegraph across the Atlantic, and I therefore beg leave to make it the subject of a special report.

This line of deep-sea soundings seems to be decisive of the question as to the practicability of a submarine telegraph between the two continents, *in so far as the bottom of the deep sea is concerned.*

From Newfoundland to Ireland, the distance between the nearest points is about 1,600 miles;* and the bottom of the sea between the two places is a plateau, which seems to have been placed there especially for the purpose of holding the wires of a submarine telegraph, and of keeping them out of harm's way. It is neither too deep nor too shallow; yet it is so deep that the wires, but once landed, will remain forever beyond the reach of vessels' anchors, icebergs, and drifts of any kind; and so shallow that the wires may be readily lodged upon the bottom.

The depth of this plateau is quite regular, gradually increasing from the shores of Newfoundland to the depth of from 1,500 to 2,000 fathoms as you approach the other side.

The distance between Ireland and Cape St. Charles, or Cape St. Lewis, in Labrador, is somewhat less than the distance from any point of Ireland to the nearest point of Newfoundland.

But whether it would be better to lead the wires from Newfoundland or Labrador, is not now the question; nor do I pretend to consider the question as to the possibility of finding a time calm enough, the sea smooth enough, a wire long enough, a ship big enough, to lay a coil of wire 1,600 miles in length;

*From Cape Freels, Newfoundland, to Erris Head, Ireland, the distance is 1,611 miles; from Cape Charles, or Cape St. Lewis, Labrador, to ditto, the distance is 1,601 miles.

though I have no fear but that the enterprise and ingenuity of the age, whenever called on with these problems, will be ready with a satisfactory and practical solution of them.

I simply address myself at this time to the question in so far as the *bottom of the sea* is concerned; and as far as that, the greatest practical difficulties will, I apprehend, be found after reaching soundings at either end of the line, and not in the deep sea.

I submit herewith a chart, showing the depth of the Atlantic according to the deep-sea soundings, made from time to time, on board of vessels of the navy, by authority of the department, and according to instructions issued by the chief of the Bureau of Ordnance and Hydrography. This chart is plate XIV. of the sixth edition of Maury's Sailing Directions.

By an examination of it, it will be perceived that we have acquired, by these simple means, a pretty good idea as to the depression below the sea-level of that portion of the solid crust of our planet which underlies the Atlantic Ocean, and constitutes the basin that holds its waters.

A wire laid across from either of the above-named places on this side, will pass to the north of the Grand Banks, and rest on that beautiful plateau to which I have alluded, and where the waters of the sea appear to be as quiet and as completely at rest as it is at the bottom of a mill-pond.

It is proper that the reasons should be stated for the inference that there are no perceptible currents, and no abrading agents at work at the bottom of the sea upon this telegraphic plateau.

I derive this inference from a study of a physical fact, which I little deemed, when I sought it, had any such bearings.

It is unnecessary to speak on this occasion of the germs which physical facts, even apparently the most trifling, are often found to contain.

Lieut. Berryman brought up, with Brooke's deep-sea sounding apparatus, specimens of the bottom from this plateau.

I sent them to Prof. Bailey, of West Point, for examination under his microscope. This he kindly gave, and that eminent microscopist was quite as much surprised to find, as I was to learn, that all these specimens of deep-sea soundings are filled with microscopic shells; to use his own words, '*not a particle of sand or gravel exists in them.*'

These little shells, therefore, suggest the fact, that there are no currents at the bottom of the sea whence they came—that Brooke's lead found them where they were deposited in their burial-place after having lived and died on the surface, and by gradually sinking, were lodged on the bottom.

Had there been currents at the bottom, these would have

swept and abraded, and mingled up with these microscopic remains the debris of the bottom of the sea, such as oaze, sand, gravel, and other matter; but not a particle of sand or gravel was found among them. Hence the inference that these depths of the sea are not disturbed either by waves or currents.

Consequently, a telegraphic wire once laid there, there it would remain, as completely beyond the reach of accident as it would be if buried in air-tight cases. Therefore, so far as the bottom of the deep sea between Newfoundland, or the North Cape, at the mouth of the St. Lawrence, and Ireland, is concerned, the practicability of a submarine telegraph across the Atlantic is proved.

The present state of Europe invests the subject of a line of telegraphic wires across the Atlantic with a high degree of interest to the government and people of the United States. A general European war seems now almost inevitable; the attitude which this government will assume with regard to all the belligerent powers that may be involved in that war is that of strict, impartial neutrality.

The better to enable this government to maintain that position, and the people of the United States to avail themselves of all the advantages of such a position, a line of daily telegraphic communication with Europe would be of incalculable service.

In this view of the subject, and for the purpose of hastening the completion of such a line, I take the liberty of suggesting for your consideration the propriety of an offer from the proper source of a prize to the company through whose telegraphic wire the first message shall be passed across the Atlantic.

* * * * *

I have the honor to be, respectfully, &c.,

M. F. MAURY,
Lieut. U. S. Navy.

Hon. J. C. Dobbin,
Secretary of the Navy,
Washington, D. C."

Art. III.—TELEGRAPHS IN EUROPE AND AFRICA.

SUBTERRANEAN LINES—SUBMARINE—TELEGRAPHS IN FRANCE, BELGIUM, DENMARK, HOLLAND, PRUSSIA, RUSSIA—ACROSS THE MEDITERRANEAN SEA TO CORSICA, SARDINIA, ALGERIA, EGYPT.

EVERY person connected with the Electric Telegraph feels a great interest in the extension of that enterprise, and none more than the American Telegrapher, who wishes to be fully informed on a subject the means by which he makes his daily bread. There is a great difference between the art of Telegraphing in the American and that of the Eastern Continent. The most of the lines there use a modified system of the Morse Telegraph, whether for better or worse, we do not at this time desire to say. In future numbers we hope to give full and detailed descriptions of all the Electric Telegraphs in use, and the illustrations will tend to strengthen confidence in the American marking, writing, or printing telegraphs. Many of the lines on the Eastern Continent are subterranean, and excel the American system. In the January number we published a short article on subterranean lines, but since then we have received much intelligence relative to the modes of laying lines, and we must confess, that with the present information, the practicability of subterranean lines seems to be unquestionable, even over the most sparsely settled and uneven country.

America is in advance of Europe in the art of telegraphing, as a science, but the latter has excelled us in the construction of lines not only on land, but in water. In saying this, we do not mean that in every detail their lines are superior, but as a system of construction, the lines of Europe are very far in advance of our mode. We hope to be able to present at an early day a detailed account of the manner of building the lines, the quality of wire, posts, insulators, and the arrangement of connections. All these are essential elements in telegraphing, and if we can be benefited by the experience of the telegraphs of the East, we would do well to avail ourselves of their excellence; and, at the same time, we think the European lines would do well to abandon their semiphores and adopt the American telegraph.

For the information of our readers, we cut the following from the *London Chronicle* of February 6th, which indicates the rapid strides the electric telegraph is destined to make in the old world:—

"It is a fortunate thing for commerce and the intercourse of communities that the electric wires have been found even more indispensable to governments than to the children of govern-

ments. The *vox populi* might have demanded telegraphic facilities until it had grown hoarse, and yet never have obtained them for continental enlightenment—with the brilliant exceptions of France and Sardinia—never would have proved adequate to the appreciation of this modern science, nor to the wonders worked by it. But the necessity of the government became the opportunity of the people, and, we shall see, wonderfully has that opportunity been improved, and wonderfully and beneficially has it operated within its peculiar district. The moving cause thus explained, the rapid and universal ramification of this method of intercommunication and the wiry embrace which has encircled and is encircling Denmark, Holland, Russia, Austria, Prussia, the union of Belgium, France, Switzerland, Italy, Spain, and even Africa, becomes more easily appreciable; and it is with France, Sardinia, and Africa, and even with Gibraltar, Malta, India, and the antipodes, that this notice has to do.

Had we spoken only a year since of the lines laid down on the continent, we should have been confined to a few detached portions severed by frontiers, or counties and districts. We should have found the southern Liverpool of France (Marseilles) still resorting to the old semaphore to make known its wants; and continually '*interrompu par le broullaræ*'—a stereotyped phrase, which will be familiar to all our commercial, and especially to our Indian readers. This state of things has passed away. The French government has extended its lines to Marseilles for the Mediterranean, to Bayonne for Spain, and to Chambery for Sardinia. Sardinia takes up the communication at Chambery, and continues it to Genoa, and from Genoa lines are now erecting to Spezzia. At Spezzia the Mediterranean cable will take up the link and extend it under the sea to Corsica; across Corsica, under the Straits of Bonafacio, over to the island of Sardinia, and again under the sea from Cape Suelada to Cape Rosas in Africa. By a decree bearing date the 15th ult., the French government threw open its African wires to the public. Thus far do we run upon certain grounds; and, after having explained the present advancement of portions of the preceding works, we will pass on to the possible fortune of telegraphic intercourse. The Sardinian government has promised to complete the line from Genoa to Spezzia before May next, and thus to connect in one chain of telegraphic communication the northernmost point of Scotland with the southernmost point of Piedmont.

The Mediterranean Telegraph Company have already advertised for tenders to lay down their cable from Spezzia to Corsica, and from Corsica to Sardinia, across the Straits of Bonifacio, and the vessels were to be ready to receive the cable, con-

sisting of eighteen iron and copper wires, on or before the first of May next. The remaining portion of cable from Cape Suelada to Cape Rosas was to be finished and laid down by August, thus completing our connection with Africa this year. Two hundred men of pith and sinew have been digging and delving in the islands of Corsica and Sardinia ever since the beginning of September, 1858, so that the moment the cables are laid down they may be connected instantaneously to the land wires, and signals passed from Africa to the European continent. All this work has been done by contracts taken and materials already purchased within the limits of the capital, so that the company should be secured from liability beyond its subscribed stock, any loss falling upon the contractors. The bane of Continental undertakings, the supineness of the people, rendered it necessary for the French and Sardinian governments to guarantee respectively four per cent. upon £180,000, the other five per cent. upon £120,000, for fifty years, from the moment of opening, up to which time the shareholders receive four per cent., the total capital amounting to £300,000. Operations traced to Africa, and the wires connected to the Algerian lines of the French government, we find that signals will be passed to the westernmost and easternmost points of the Algerian territory. Having reached thus far, we perceive that new wires are projected beyond these points, and with very important objects. The French government providing for Algeria, the company commences again. From the westernmost point of Algeria, then, it is proposed to carry an underground line through Morocco and Tangier to Gibraltar. The English government would doubtless support such a line. From the easternmost point of Algeria, a subterranean telegraph is projected through Tunis and Tripoli to Alexandria, with a branch to Cairo, Suez, the main line to continue to Beyrout, Damascus, Aleppo, Bagdad, Bussora, and along the Persian Gulf, joining the Indian line at Hyderabad. A submarine cable is also proposed from Tunis to Malta. Were the system now in operation, its importance to the government in the present crisis would be incalculable, for the wires would connect England and France with their naval stations in the Mediterranean—with Egypt, Turkey, and India, all countries favorably disposed to us, and against the extension of Russian power—we could flash every movement of the Emperor's forces from the extremest portion of his line of operations to Downing street and the Tuileries, and direct our fleets and armies to take positions in the Mediterranean or elsewhere, or provide reinforcements, &c., at a moment's notice. Who knows but that war, should it unfortunately ensue, will be the cause of the provision of these very means of communication?"

Art. IV.—ANCIENT AND MODERN HERALDRY.

No. 2.

ORDER OF THE GARTER—ITS ORIGIN, OBJECTS, AND BENEFITS.

We now come to treat of the most noble and illustrious Order of the Garter, which, if we consider either its antiquity, or the nobleness of the personages connected with it since its origin, it excels and outvies all other institutions of honor in the whole world. When we use so bold an expression, we confine the comparison to institutions established for like purposes. The Order owes its origin to Edward III., King of England and France; yet, as to the occasion, there are several opinions, to which we shall briefly allude. The more general impression seems to prevail among the early authors, that "the Garter of Joan, Countess of Salisbury, dropping casually off as she danced at a ball, King Edward, stooping, took it up from the ground, whereupon some of his nobles smiled, as if it was an amorous action of the king, or so indicating by their behavior at the time." The king, observing the sportive humor of his friends, felt somewhat mortified, turned it off with a reply in French, *Honi soit qui mal y pense;* and added, in a frown of disdain at their merriment, "*that shortly they should see that* GARTER *advanced to so high an honor and renown as to account themselves happy to wear it.*"

The above history of the origin of this noble Order seems to be generally accepted as correct, but there are others who advance a very different account of its birth. In the original statutes of this Order, there is not the least information given on the subject; and some two hundred years after its institution, the question of its origin was very warmly discussed among the authors of that day, and the diversified opinions then advanced, rather tended to throw doubt on that which may really have been the first cause. Some authors urge the fact of its being the queen's garter, and that "she was departing from the king to her own apartments, and he following soon after, chanced to spy a blue garter lying on the ground—supposed to have slipped from her leg—whilst some of his attendants carelessly passed by it, as disdaining to stoop at such a trifle; but he, knowing the owner, commanded it to be given him; at the receipt of which he said, "You make but small account of this garter; but within a few months, I'll cause the best of you all to reverence it alike." Some suppose that the queen answered the language of the motto, *Honi soit qui mal y pense*, when informed of the accident and the incidents. Among the

authors who throw great doubt on these statements is Ashmole, who attributes their peculiar accounts to a propensity of the people of that age to attribute the beginning of all the orders of sovereign foundation to an amorous, instead of an honorable account. Another opinion prevailed, that "it had its origin with King Richard I., who, whilst his forces were employed against Cypress and Acon, and extremely tired with the siege, he, by the assistance and mediation of St. George (as imagined), was inspired with fresh courage, and bethought himself of a new device, which was to tie about the legs of a number of knights a *leathern thong garter*, for such had he then at hand, whereby they being emulated to future glory, with assurance of reward if they proved victorious, they might be excited to behave themselves intrepidly and well, much after the example of the old Romans."

Of this statement there seems to be little to substantiate its correctness, and we have no faith in it.

The true and legitimate origin of the Order of the Garter was, doubtless, with King Edward, but not occasioned by the lady's garter or King Richard's leathern thong. King Edward was reputed to be a man of consummate virtue, giving himself up to military affairs. Being engaged in war for the recovery of his right to France, he made use of the best martialists of the age, and designed the restoration of King Arthur's Round Table, to give an opportunity for assembling together the gallant spirits from abroad, and thereby foster a feeling of good-will among the guests for his success and welfare. This scheme was successful, and it did not end with the restoration of that ancient order, but was extended far beyond its early plan of organization. The grand feast day was Whitsuntide, and the time was spent in all kinds of noble feats of arms, mock fights on horseback, or tournaments; so were a great part of the nights consumed in public balls, and dancing with the ladies that attended the queen. It was probably conjectured that, at some of these balls, the queen's garter, or the garter of Catherine, Countess of Salisbury, might have slipped off, and the king taking it up, occasioned a smile in the by-standers; and afterwards, when the king had modelled the Order, a garter offering itself for an ensign, might have added to the conjecture.

Though King Edward advanced the honor of the Garter, as to denominate the Order, yet it seems not to have been his purpose to add reputation to, or perpetuate an effeminate occasion, but to adorn martial prowess with honors, rewards, and splendor; to increase virtue and valor in the hearts of his nobility, that so true worth, after long and hazardous exploits, should not enviously be deprived of that glory which it hath intrinsically deserved, and that active and hardy youth might not want a

spur in their progression in the path of virtue, which is to be esteemed glorious and eternal.

It is further observable, that the French King, Philip de Vallois, in emulation of this assembling at Windsor, England, set up a Round Table at his Court, and invited knights and valiant men of arms out of Italy and other countries, lest they should repair to the feasts of King Edward of England, which, meeting with success, proved a countermine to his main design; and perceiving that his hospitality towards strange knights, upon account of reviving King Arthur's Round Table, was too general, nor did sufficiently ingratiate them to his person, but being unconstrained and at liberty, did after their departure take what side they pleased in the ensuing wars, he at length resolved upon a projection more particular and select, and such as might oblige those whom he thought fit to make his associates, in a lasting bond of friendship and honor;—and he issued forth his own Garter for the signal of a battle that was crowned with success, the battle of Cressy, fought about three years after the establishment of the Round Table. Upon this remarkable victory he took occasion to institute the Order of the GARTER. He made the garter an ensign, and placed it as pre-eminent, whence the select few who were admitted into that noble fraternity were styled *Equites Aureæ Periscelidis*, and more vulgarly known as Knights of the Garter. By this he designed to bind the knights together as one band of Fellows, and all jointly to himself as Sovereign of the Order.

The expectation of the King in the establishment of this order did not only serve to bind them in indissoluble bonds to each other and promote their affection towards him, and also to command their aid in the welfare of the Sovereign and the public good, but it served as a spur and incentive to Honor and martial Virtue. It formed a golden bond of unity. The Garter then became a badge of unity and concord, and remains symbolical of those essential elements in society to the present day.

By the symbols of this Garter the knights are reminded, with all religiousness, sincerity, friendliness, faithfulness and dexterity, not to leave the pursuit of whatsoever they take in hand, nor to indulge in anything contrary to the statutes of the Order, not to frustrate the rights of peace and friendship between men, nor to vilify the law of arms, or proceed in anything farther than faith and compact or the bond of friendship would admit. Moreover, in the binding of the leg with this ennobled ensign, there was given this exhortation, that the knights should not pusillanimously betray the valor and renown which is ingrafted in consistency and magnamity. Nay, so exactly did the founder contrive the whole habit into the signification of the garter, that

he ordained his and the Knights-Companions' robes and ornaments to be all alike, both for materials and fashion, intimating thereby, that they ought to conserve brotherly love among themselves.

The great collar of the Order was made of equal weight, and like number of knots and links, in token of the like bond of faith, peace and amity, inviolably to be observed and retained amongst them. In fact, all things were so designed, that every one might plainly perceive how much these things tended to the maintenance of fellowship and concord.

In further reference to the establishment of this Order, King Edward, calling together the Earls, Barons and principal Knights of his kingdom, "freely and obligingly declared his mind to them concerning this affair," and according to Froissart, "all of them being well inclined, entertained the motion with equal joy and applause, deeming it would prove a very great advancement to Piety, Nobility and Virtue, and likewise an excellent expedient for the uniting, not only his subjects one with another, but all foreigners, conjunctively with them, in the bonds of amity and peace."

In order to make the institution more binding in fraternal association, and to draw the tie of friendship more close, the king caused those who were of the Order to be called Fellows, Associates, Colleagues, Brethren, and Knights-Companions. He styled the Order a Society, Fellowship, College of Knights, and Knights' Companionship. Their habits or dress to be all alike, to represent how they ought to be united in all the turns of fortune, and through the course of their lives to show fidelity and friendship towards each other. Ashmole gives the cause of the institution, to "fortifie the confidence of the King, the Kingdom, and Martial Vertue; that is to say, to strengthen the Faith of the Subjects towards them, and for their greater Security; and because the Garter carries with it a Bond or Tye of Fellowship, and is a Symbol of Amity between Princes, being Companions of the same Order."

The statutes of King Henry VIII., in an act pertaining to the order, says that it was instituted "for the Honor of God and Exaltation of the Catholick Faith, joyn'd both with Piety and Charity, in establishing a College of religious Men to pray for the Prosperity of the Sovereign of the Order and the Knights-Companions, and to perform other Holy Duties; as also ordaining a Maintenance for a Company of Alms-Knights, who have not otherwise wherewith to support themselves."

We have now given the cause and objects of the institution of the Order of the Garter, one of the most noble orders ever blended with Sovereign custom. None were admitted but gentlemen of royal blood, and without reproach. The feasts and

meetings were regular for several centuries, and at this day partake in the customs of the aristocracy of England. The Garter will be found in the heraldry of the higher orders, and the Sovereign Arms. The color of the Garter is blue, and the circumscription gold. The King having laid claim by his title to the Kingdom of France, and in right thereof assumed its Arms, he, from the color of them, caused the Garter to be made blue, as aforesaid.

The motto adopted was, *Honi soit qui mal y pense*—that he retorted shame and defiance upon him that should dare to think amiss of so just an enterprise as he had undertaken for recovering of his lawful right to that crown; and that the magnanimity and bravery of those Knights whom he had elected into this Order, was such as would empower and enable them to maintain the king's rights against all who thought ill of them. The Sovereign, on the assemblage of the Sir Knights, concluded his lecture by solemnly cautioning them to "be of one mind, love each other, defend the rights and reputation of the brethren, not to admit anything in their actions, or among their thoughts, derogatory to themselves and their HONOR."

As to the time the Order of the Garter was instituted historians widely differ. Selden, Cowper, and others say the eighteenth year of King Edward III.; but others contend that the time was later, and that the claimants for the above time confound it with the Order of the Round Table, at Windsor, being the place of both. Judging from the views expressed by the authors whom we have consulted, it was instituted in the twenty-third year of Edward III., or A. D. 1350.

The orders of honor were in the habit of electing some patron, to whom they were dedicated. The Garter was dedicated to several; among them were the *Holy Trinity*, the *Virgin Mary*, *St. Edward the Confessor*, and *St. George of Cappadocia.*

Of these patrons, the most prominent in symbolic reverence was St. George, who was deemed a most choice champion of Christ, and famous martyr. The cause of electing St. George a patron was because, as was firmly believed, in those wars which were waged by the Christians against Infidels, he, by several appearances, manifested his presence as a most certain encourager and assistant to the Christians, the relations whereof may be seen in history, particularly Heylius', who hath judiciously maintained the history of this saint against those who will not allow him a place in Heaven, or a being in the Church. In like manner the learned Selden hath maintained St. George to be the special Patron, Protector, Defender, and Advocate of the realm of England, and shows in what veneration he has ever been regarded by the nation. This title of patron to the English nation is given to St. George by the founder of this

Order, in a patent granted to the Dean and Canons of the Chapel of St. Stephen at Westminster, and St. George at Windsor. And though in general he was styled the principal Patron of the affairs of Christendom, and a guardian of military men, yet, among all Christians, the English did excel; and the founder of this Order, in making choice of such an approved and expert patron, in particular respect of whom the Knights had the title of *Equites Georgiani*, St. George's Knights; and the Order itself came to be called the *Ordo Divi Sancti Georgii*, the ORDER OF ST. GEORGE. The badge and jewels were composed of the Garter and St. George's Cross, and those symbols remain as part of the Arms of Great Britain and provinces to this day. The cross is seen on the British flag, being the right-angled cross, joined with St. Andrew's, as before described.

Art. V.—TELEGRAPH REGISTER, MAGNET, AND KEY.

PERFECT AND IMPERFECT INSTRUMENTS—DAMAGES RESULTING FROM THE IMPERFECT—DESCRIPTION OF NEW REGISTER—ENGRAVINGS—SPRING AND WEIGHT DRUMS—PAPER ADJUSTMENT—RECEIVING MAGNET—TWO SIZES—KEY AND CIRCUIT BREAKER—KEY WITHOUT CIRCUIT BREAKER.

IN the January number of the TELEGRAPH COMPANION, we announced, in the official circular on the subject of supplies, that it was our purpose to devise a system of machinery for the telegraph enterprise, that would likely be capable of longer service than those in use heretofore. We were aware that the consummation of that purpose required the highest order of mechanical skill as well as scientific attainments. We consulted many practical and expert telegraphers, and carefully considered each suggestion. As to mechanics, we had the aid of that master-spirit, Col. Richard M. Hoe, of New-York, who is known to all the world as unrivalled in theoretical and practical mechanic arts. To him we are indebted for valuable aid in perfecting the machines now presented.

The instruments now in use are as diversified as the flowers of the prairies. Scarcely two alike! Some have been gotten up for utility, others again for fancy. In speaking thus, we have no particular reference to any one, nor do we desire our remarks to be considered as personal, for we rank ourselves with those who have been the victims of these misfortunes. Some years ago we constructed a line of telegraph, intending it to be a "model line." No pains were spared to perfect its erection. The machinery was to be the best. Our associate purchased extra registers for the two main offices—$80 was the price for each.

They looked beautiful, and being of the harp shape, no one could look at them, appearing in their beautiful and golden glitter, without imagining old David with his long beard, playing his beautiful songs. It was about the days of Jenny Lind, and their appropriateness seemed in beautiful harmony! But these beautiful-shaped things soon proved to be about as useful as the gaudy butterfly. Ere they were in use a few months, they broke and continued to break, and no means of repairing at hand, the loss to the line was heavy, and sad to the empty treasury.

One thousand dollars would not repay that line for the losses sustained by those faulty machines. We could cite a book full of cases, where companies have suffered by the misfortune of the breaking of a single wheel. The whole machine had to be packed up and sent off by boat, railroad, or wagon, to some distant city, to have that *one* wheel repaired. Sometimes the box would remain in store until advertised, or some extra effort made to find it. The machine when repaired and sent back, in the transportation and hard usage, would frequently break material parts, causing additional trouble. These, and tenfold more, are truths, that cannot be disputed. We know them to be so, because we have experienced them, and we know others have had like misfortunes to occur with them.

It must be remembered that the builders of a line are responsible for many of these losses, but they are beyond the pale of accountability. The line is delivered to the Company, and they are no longer responsible. Companies ought to look to these points, and see that they are not imposed upon. We have known some builders to purchase cheap machines, anything that would answer until the line was accepted by the Company. They bargain to construct a good line, and furnish all machinery "to put the line in complete working order." Their obligation to furnish good instruments ought to be as sacred as any other promise. Some care not for the ultimate prosperity of the line, but only to have the line built cheap, and get it off their hands—cheap wire, cheap poles, cheap machines—then deliver the line in a hurry before the faults are discovered. The public ought to look to these questions. Examine the line thoroughly, and let it be done by one fully qualified. One who can tell the difference between pot metal wire and good wire, between a cheap instrument and one made for service. Let these matters be looked after, and lines will do much better after they commence. Many that have soon run in debt, would have paid something on the stock. Instead of being useless and vexatious nuisances in society, the people would realize the blessings of the telegraph and venerate the inventor's name, and hail the presence of the constructor and all who partake in the management of the line.

To enable companies and builders of lines to shun the serious evils before alluded to, we have been earnest in our efforts to present to them the proper guards, in the form of an instrument simple in construction, and designed for service in the enterprise. We have disregarded the overwhelming appeals of *form*, as some gentlemen preferred the scroll, some the harp, the crescent, the cross, the garter, the lone star, and we presume some would have them fashioned after the original fig-leaf, and "made of the very best hammered brass!"

The original Register, invented by Professor Morse, has never been improved upon, nor do we see how it can be. Effort after effort has been made to adopt equivalents, claimed as superior, but sooner or later laid aside, and the original resorted to. The Register we now offer is nothing new, except the peculiar mode of placing the original combinations for more convenience. Various experiments have been resorted to in its perfection. Many had to be made ere the present completeness was attained. These experiments cost money, time, and labor. No one can estimate the exercise of mental reflection required. We will not go further, however, with these remarks, but will proceed at once to describe the machines represented in the engravings accompanying.

THE REGISTER.

The Register, or Instrument, is known in the Morse patents as the *Recording Register*, but, for abbreviation, we usually call it the Register, which may be considered its legitimate name. An explanation of its functions in the art of telegraphing we do not deem necessary at present, as it is very well understood by telegraphers, and it is to them that we are addressing these remarks. We purpose giving the arrangements of construction as to mechanics only, waiving, for the present, questions of science, promising to take these up on a future occasion.

Plate I. is a skeleton view of the Register, with the combination of wheels required to run the rollers which move the paper from the pen point. No. 1 is the driving wheel or drum, acting either as a weight or spring drum. The cogs of this wheel acting in the pinion cogs of wheel No. 2, and the cogs of wheel No. 2 in the pinion cogs of wheel No. 3, and the cogs of this wheel in the pinion cogs of wheel No. 4, and the cogs of this wheel in the pinion cogs of fly wheel No. 5, and thus the machine is put in full motion. Letter A is the side frame, and *q* is a projecting screw through the sides A. All the wheels act in these screws, made of the very best metal, securing long service. In the plate, we have left off the caps, or nuts, which are

designed to hold the screws in proper adjustment. By these caps on the screws, the wheels, each or all, can be made to run as true and delicately as circumstances may require.

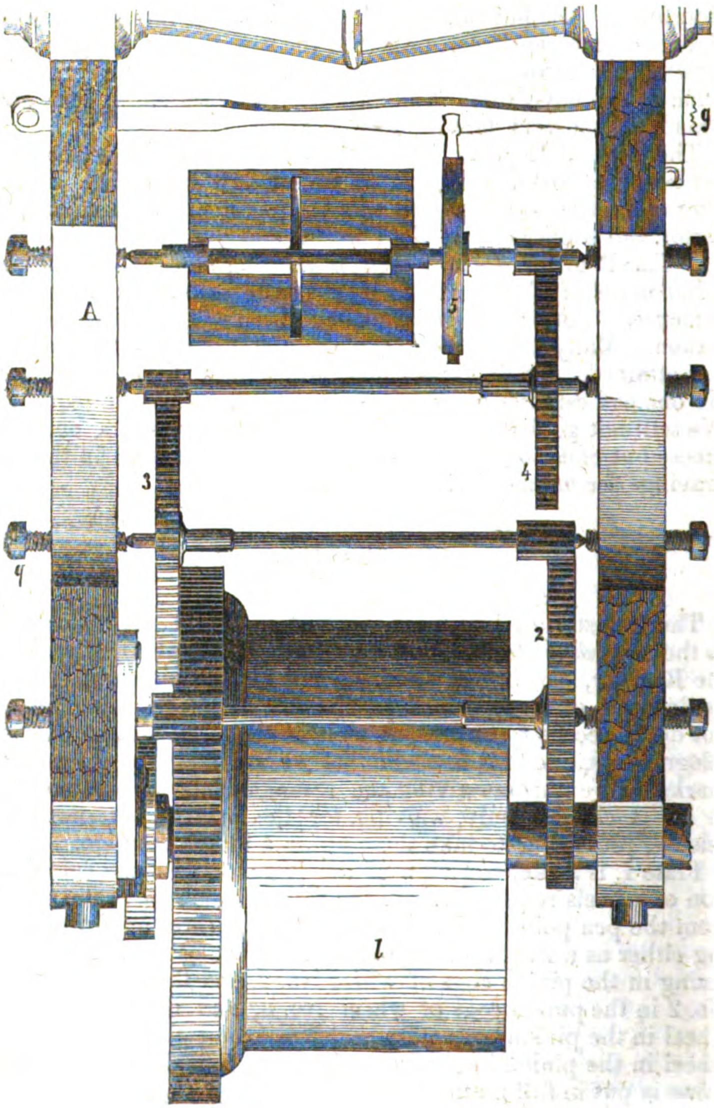

PLATE I.—DIAGRAM OF REGISTER.

PLATE II.—THE REGISTER.

This is a representation of the Register, ready to place on the table for service. It represents a diagonal view from the rear,

with the eye at an angle of 45 degrees. C is a base composed of wood, either rose-wood, mahogany, oak, or any other kind. B is the brass base of Register, fastened to the wood base C. A is the side frames; F is a connecting bar, connecting the side frames A A, aided by another of the same guage in front, held firm by screws *h h*. The sides should be put up and connected by the two connecting bars F and screws *h h*. They will firmly hold the frame. Proceed to put in any of the wheels at pleasure. To put in the driving wheel, or drum, unscrew the angle G in side frame A, and set in the socket the axle of the drum or wheel No. 1. It is not material which of these wheels are put in first. Wheels 6 and 7 are the rollers. Letter *u* is a lock or guage to regulate the velocity and pressure of the roller No. 7, which will be further illustrated in the next plate; *e e* are the screw cups, or standards, to which are attached the local wires.

C is the magnet standard, fastened in bases B and C by a screw; *a* and *b* are the local or register magnets, fastened by screws, either of which may be taken off without disturbing the other; *m* is the armature; *p* the adjusting screw on standard *c*, which projects through the centre of armature *m*, enabling the operator to adjust the sound of the "back stroke" to suit his pleasure; *o* is a spring bar subtending, and *d* the adjusting rod or screw, passing through standard *c*; *n* is the pen lever, with pen and adjusting screws thereon.

D is the proper adjusting apparatus, which will be more particularly described in Plate III.; *k* is the key for winding the register; *i* is a guage for the spring drum. If a spring drum is used, it should be wound until the full strength of the spring is attained. Guage *i* will then allow the register to run until the cogs pass a projecting tooth from the axle, when it will stop, and it should be again re-wound. If it is desired to take out a single wheel from the register, the *full force of the spring* must be wasted, or its power otherwise neutralized; and if this care is not taken, the other wheels are greatly endangered. For the same reason that you would not take out a wheel when the power of the weight is on the drum, you should not disturb the combination until the power of the spring drum is compromised. We especially call attention to this point, for we have seen more than one register broken by this carelessness. Let it be remembered, then, that you should never attempt to move a single wheel, either in a weight or spring drum, until you render powerless the spring or the weight. Don't attempt to accomplish this end by taking out the angle G, and removing the drum first, for that will lead you into ten-fold trouble. The moment you get it loose on the spring drum, it will fly off, and perhaps your face will first feel the force of its power; besides,

broken wheels on the floor of your office will manifest themselves as the result of your indiscretion.

The spring and weight drums are made to fit in the same register. They have to be separate. They could not be made to perform the functions of both, without encumbering the register with too much machinery. The self-stopping apparatus or break is *g*, made to act upon a balance wheel connected with the fly wheel No. 5. The adjusting screws of the pen lever are *f f*.

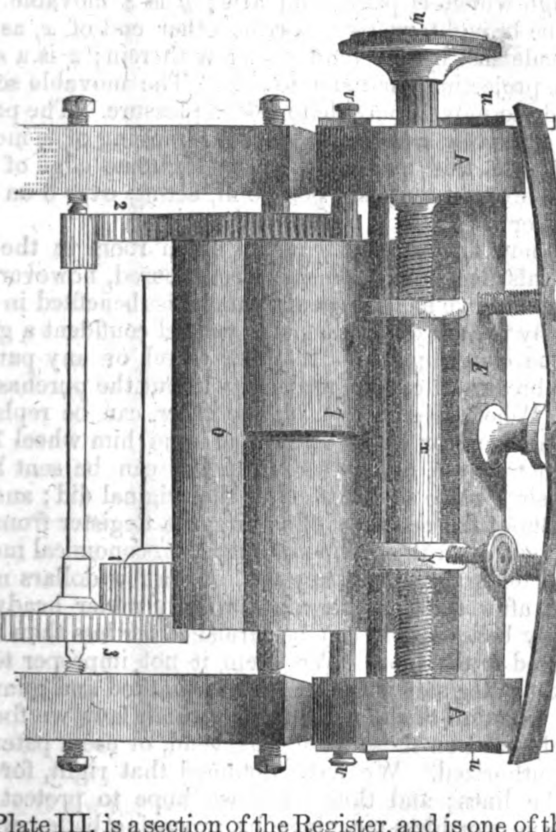

PLATE III.—PAPER ADJUSTMENT.

Plate III. is a section of the Register, and is one of the most beautiful arrangements for the adjustment of the paper and running of the machine that we have ever seen. The same amount of ingenuity, and as successfully applied, in a locomotive, would have been worth a fortune to any man. In this instance, however, the reward is the same usually received by telegraphers.

Nos. 6 and 7 are the paper rollers, No. 6 acting on screws at pinion ends, and No. 7 projecting through the sides, as seen at

v v, whereon *u u* rest. In order to make roller 9 press heavier on roller 6, or the paper passing between them, you must screw *r r*, which presses down the spring bars *s s* upon *t* at centre, and *u u* at the outer ends, and forces the break *u u* heavy on *v v*, and thus the power is made effective.

A A are the sides; E is a connecting bar at top, placed there to make firm the machine, and to consummate the purposes just mentioned; *w* is an adjusting screw, projecting through the sides A A, designed to guage the paper; *x* is a movable screw, through which *w* passes and acts; *y* is a movable end which can be brought nearer *x*, or the other end of *x*, as desired, and made fast by the binding screw therein; *z* is a steel bar or screw projecting from side to side. The movable screw *x* can be made to move from side to side at pleasure. The paper passes between screw *x* and bar *z*, and the moving of *x* moves the paper, and in this manner the very extreme edge of the paper can be brought over the pen point, acting over 6 on the groove of roller 7.

We have now devoted, we fear, too much room in the description of this Register. We must be excused, however, on account of the zeal we have to see the companies benefited in this particular. By the use of this Register, we feel confident a great saving will be consummated. If either wheel or any part of the machine breaks, it can be replaced without the purchase of a new one. Wheel Nos. 2, 3, 4, or any other, can be replaced by mail. The operator can telegraph to send him wheel 1, 2, 3, 4, or magnet A or *b*, or any screw, and it can be sent him, fitting the desired place as delicately as the original did; and all this done without the necessity of taking the Register from his table. We look upon this as one of the most economical moves yet taken in telegraphing. They will cost a few dollars more at first; but, after the Confederation is fairly under headway, we confidently believe they can be furnished for less than they are now offered to the lines. We deem it not improper to remark, that each Register will be properly marked and guarded against any violation of the patent laws; which laws we find to be excessively hard on those who *make*, vend, or use a patented machine unauthorized. We have obtained that right, for the benefit of the lines; and thus, while we hope to protect the companies from worthless machines, by procuring better, we do not infringe the sacredness of the laws of the country, or the rights of an inventor.

RECEIVING MAGNET.

We have procured two forms of Receiving Magnets, and have a third under advisement. We cannot describe them better than by taking each separately. Not desiring to place

one inferior to the other, we shall call one the Oblong Magnet, and the other the Rotund Magnet.

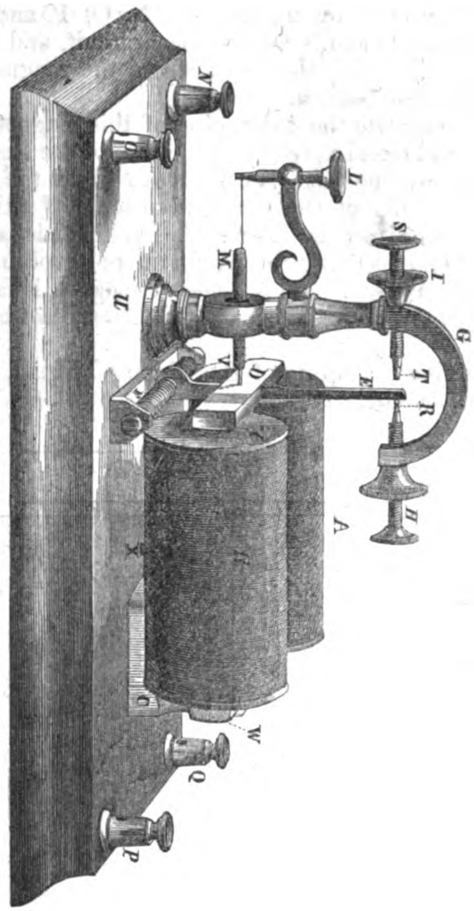

PLATE IV.—OBLONG MAGNET.

OBLONG MAGNET.

A B are the helices or coils, the exact size of which are given in the accompanying diagram. C is the supporter of the magnets, tightly screwed on to the rear or connecting bar of the magnets, W. The ends of the magnet, Y, are rose-wood, ivory, or other suitable insulators. D is the movable armature, fastened to upright lever, E. The axle, V, of the lever, E, is above F, acting in screws projecting through lever frame, F. The axle has surrounding it a spiral wire, P, to perfect connection, in case of fault at the ends of the axle. M is the adjusting

spring; L, the adjusting screw; R, a platina point on screw H. T is an insulator point, on screw S. I is a binding screw, to tighten the adjustment. There is one, also, on screw H. These, being well arranged on upright, G, N, O, P, and Q, are the binding screws—O and N for the local circuit, and P and Q, for the main circuit. X is the point where the magnet wires pass down through the base, *u*.

We thus complete the description of this magnet. They are well made, and based upon the principles of the Register. The breaking of any one part can be replaced by the purchase of others that will fit in the designed place. If either coil gets injured, another can be procured. With this arrangement, there will be no necessity for continual re-supplying lines with magnets at full cost. Many times a magnet is laid aside, because a screw or coil is damaged. Such need not be the case in future.

We now give a diagram of the Oblong Magnet, showing the exact size of the helices.

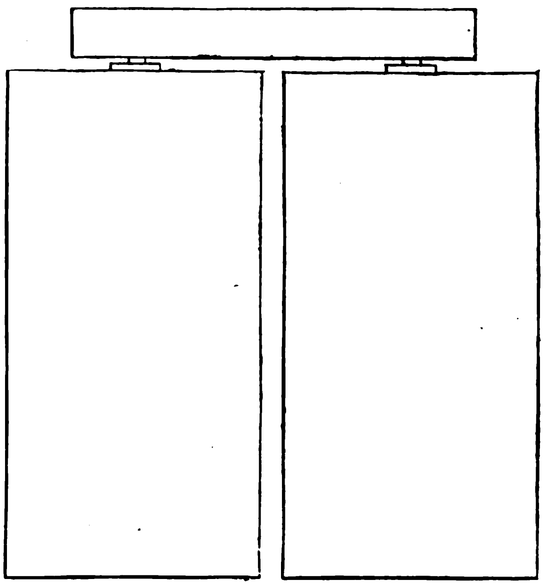

PLATE V.—OUTLINE OF LARGE MAGNET.

THE ROTUND MAGNET.

This Receiving Magnet is smaller than the one just described, but answers, in the minds of many, the same ends. On a circuit of one or two hundred miles, we presume it is equal to the

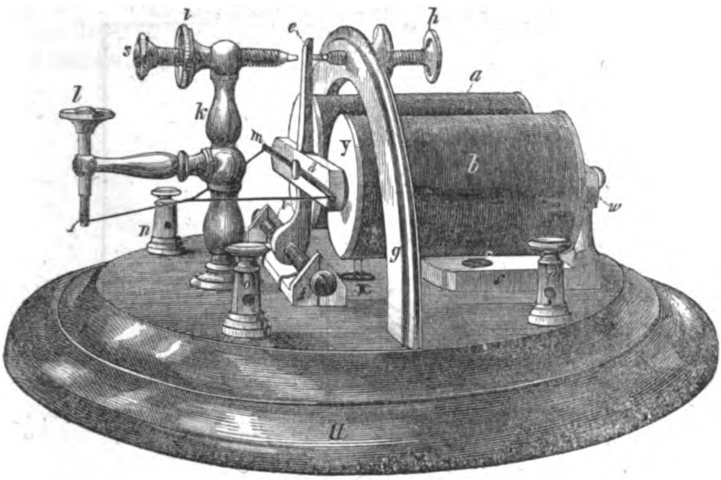

PLATE VI.—ROTUND MAGNET.

oblong magnet, and perhaps better; but, on a circuit of great length, where the electric force is greatly reduced, scarcely sufficient to be felt by the most delicate series of adjustments, the increased heliacal auxiliaries of the larger magnet will, doubtless, prove more effective. We are now acting in concert with some gentlemen, aiming at a fixed point as to the requirements of circuits, and ere long we hope to be able to present to the enterprise important facts as to the kind of magnets each circuit requires to accomplish the desired end.

The coils *a* and *b* are arranged as in Plate IV., being attached to supporter *c*, with connecting bar *w*. The armature *d* or upright lever *e*, with axle *v*, acting in screws fixed in lever frame *f*. The spring *m* is steel, adjusted by screw *l*; *k* is an upright standard. The screw *s* has an insulated point, and *i* holds firm the adjustment; screw *h* has a platina point, to cause good metallic and durable point of contact. The crescent *g* is a brass bar, acting as auxiliary to upright standard *k*, and greatly adds solidity to the whole. The binding screws *n* and *o* are for the local circuit wires, and *p* and *q* for the main wires. At *x* the main wires descend through the base *u*, running under base to binding screws *p* and *q*.

Plate VII. is a full-sized diagram of this magnet, and the outlines will give the reader an idea of the relative proportions.

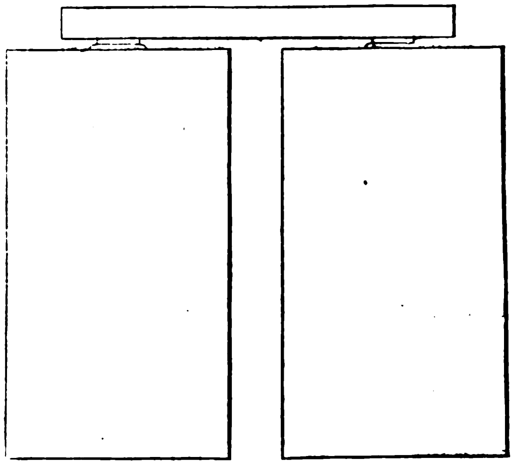

Plate VII.—Outline of Small Magnet.

THE KEY AND CIRCUIT BREAKER.

The key given in Plate VIII. is arranged with a circuit breaker, which is so fixed that the faults of others are avoided. When closed, the circuit is perfect. It is not liable to wear and cause

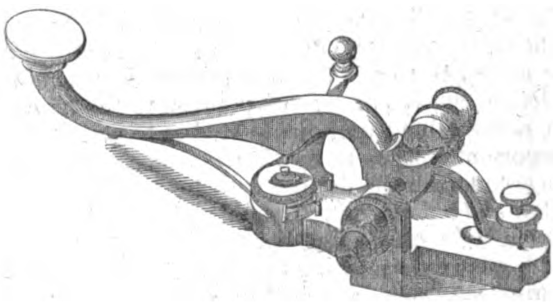

Plate VIII.—Key with Circuit Breaker.

a doubtful connection. We have seen much loss result from accidents of this kind, that is, the wear of the connecting points. The whole arrangement is designed to avoid the evils heretofore existing, and perfect every questionable part. The anvil of the key is well made, firm, and capable of hard wear, regardless of the adjustment of the key lever. The hammer of the key lever is also firm, and made of good platina wire, and securely made fast in the key lever. The adjusting screws of the axle are arranged according to the best mode, to secure the greatest good. The elevation of the key lever can be adjusted to suit

the operator, by elevating the key frame, or otherwise. We regret the engraver omitted to place letters on the different parts of the key, so that we might be more particular in the descriptive names.

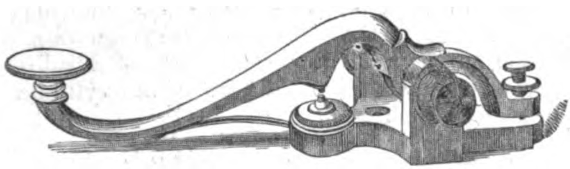

PLATE IX.—KEY WITHOUT CIRCUIT BREAKER.

This is a key without a circuit breaker. Of course it contemplates the use of another kind of breaker—a button, a spring, or other equivalent. Among the best circuit breakers separate from the key that we have seen, is a sash spring, originally and first used by Mr. Eugene L. Witman, a very talented and superior operator, formerly on one of the Louisville lines. It is convenient, and of sufficient power to cause a firm and sure contact. We deem it unnecessary to say anything particular pertaining to the key represented by this plate, as what we said relative to the key as represented by Plate VIII. will apply to this also. Although the subject of the key may, to some, seem of little consequence, yet we know from our experience, that faulty keys have caused more damages than can be attributed to any other part of the machinery. The utmost care should be taken in preserving the key perfect in every particular, and unless care is taken to enable the key to perform its functions faithfully, the best of operators will fail to be comprehended by a distant receiving station. We could tell many incidents of keys, whereby losses most "sad and weary" have fallen on

"The old folks at home."

In the next number of the COMPANION we will give the price of each of the parts of the Register, Magnets, and Keys, complete or single, so that a company can, after once purchasing one of these series, supply themselves with duplicates at pleasure of any needed part to fill breaks or faulty members. The price of the whole will not exceed $60; that is, we have desired to place on them work enough to be worth that amount, confident at the same time they will be worth double the value of any other series usually sold to the lines by manufacturers; though we do not wish to blame the manufacturers for presenting cheap plunder, as it has been the fault of purchasers, many of whom do not know the difference between a good register and a bad one; except, the one that looks the prettiest and

glitters the most, with them of course is the best machine ever made. Not long since a President of an important line asked, if we "designed to work the paper guide with one acid?" totally ignorant of the relations of the battery and the adjustible parts of the machine. This very same President would spend a day in hunting for a register a few cents less than may have been asked for a better. He who is so totally ignorant of the worth of a good article, and the worthlessness of a bad one, we know not how to convince him of the merits of anything. We place him in a niche by himself, like

"Ephraim of old, joined to his idols,"

and we let him alone. Let him rejoice in his own folly, and if lured off, yielding to the charms of the tinsel, the evil lies with him who makes the choice. If good judgment prevails not, and a glittering, but worthless, register is chosen to save a few cents, and the line sustains heavy damages thereby, who suffers? Not the President, but the stockholders.

MANUFACTURER.

We have omitted to say, elsewhere, that all the machines procured under the Secretary's arrangements are manufactured by J. W. Norton, of New-York, who is also agent for the Secretary, in procuring all materials for the different lines. Orders, when more convenient, can be sent direct to him.

Mr. Norton has an extensive machine establishment, and having the most expert mechanics employed, he can and will faithfully comply with the interests of the lines, in all matters intrusted to his care.

Art. VI.—ELECTRIC TELEGRAPHS OF ENGLAND AND IRELAND.

SUBMARINE LINES—TO FRANCE, BELGIUM, AND HOLLAND—ENGLAND TO IRELAND —DIFFERENT COMPANIES IN GREAT BRITAIN—WHEATSTONE, HENLEY, BRETT, AND HIGHTON'S SYSTEMS—LINE TO SOUTH IRELAND, CONNECTING WITH STEAMERS— SUBTERRANEAN LINES.

We now present the readers of the Companion with some information relative to the Electric Telegraphs in England, Ireland, and Scotland,—believing that every American telegrapher feels, as we do, an anxiety to know all about the enterprise, regardless of national boundaries.

For many months we have sought for the information, and after writing several long letters, relative to the American lines, hoping to receive the like from abroad, we at last addressed a gentleman who gave us, in detail, all the desired information.

In order to understand fully the extent of the lines on the islands of Great Britain, the reader must follow our descriptions with a map, and thus he can see to what extent the electric telegraphs have spread over that country.

SUBMARINE TELEGRAPHS.

There are three submarine cables connecting England with the Continent:—

1st. The cable crossing the channel from Dover, England, to Calais, France.

2d. The cable crossing from Dover to Ostend, Belgium; and,

3d. The cable crossing from Harwick, England, to the Hague, in Holland.

Lines run direct from London to Dover, and to Harwick, and with a good system, London can write direct to France, Belgium, or Holland, or across those kingdoms to others more distant.

There is a submarine cable running from Port Patrick, Scotland, across the Irish channel to Donaghadee, Ireland.

There was a cable laid across the Irish Channel from Holyhead to Dublin, but it failed in execution.

The cable laid down from Dublin to Holyhead, in 1852, was thus constructed:—A copper wire, No. 16, was covered with two coatings of gutta percha. In that part of the cable which was to lie in deep water, the gutta percha covering was merely surrounded by twelve No. 16 galvanized iron wires, forming a thin rope about the size of one's little finger. Near the shore the gutta percha was protected by a covering of six very thick galvanized iron wires. The weight of the rope was about 80 tons, and the length 80 miles. The cable from Dover to Calais was 24 miles, and weight 180 tons. The relative weights are quite different, as well as the strength of the cables, in favor of the Dover. Much of the Irish Channel cable was taken up, but never again put down. It proved a failure at the time.

Various reasons were assigned for its non-success, but from what we can learn, it was the fault of construction; and ere it could be corrected it became a victim to the illiterate sailor, who considered it a great prize from the sea, on finding it brought to the surface by the vessel's anchor. We understand the prize, thus found, was carried to distant lands, and was the theme of many conversations. For aught we know, the poor sailors have

at this day pieces of it laid away, hoping that sooner or later it may prove a pearl of great price. These reflections remind us of days gone by, when "amid storm and tempest," or in the burning sun, we struggled to span the dashing waters of the inland, and ere we had reached home, a monster boat, with towering chimneys, swept by, carrying away our slender wire, caring not for the toil we had. The sailors would get a piece, divide it among the crew, and now and then gaze with wonder at the tiny thread that was "filled with lightning news," hoping that they might see some of the "sparks" come forth. These fancied hopes were realized, as those of the man who

> "Writes his name in the sand, when the tide is low,
> And seeks the spot when the waters flow!"

There are at present in England and Ireland FOUR TELEGRAPH COMPANIES, and we will proceed to give the extent of each one, respectively, that the reader may be fully informed in the premises.

I.—THE ELECTRIC TELEGRAPH COMPANY.

This is the earliest and oldest Company in England, and, we presume, the first in Europe. It was established in 1846. It is the largest Company in Great Britain, and possesses a greater extent of wires than all others. The Hon. Lewis Ricardo is the enterprising President, and has invested in the Company many thousands of dollars. Its income exceeds $150,000 per annum. The cheapness of management makes the stock profitable. This line is generally called the "Old Company," owing to its seniority. The principal Board is in London, but there are local boards in different towns to aid in its proper management. Mr. Ricardo is a member of Parliament, and stands as an eminent gentleman of enterprise. The Company has great influence with the public, and largely shares in the confidence of the people. The charges are on the uniform principle, that is, two shillings and sixpence for twenty words, including address and signature, which makes a message about equivalent to the American—of ten words. This is the price for any distance under one hundred miles. If beyond one hundred miles, the price is five shillings for the first twenty words, including address and signature, and then one shilling for the delivery of a message. The cost of delivery in America is at the expense of the Company, either by the payment of fixed wages to messengers per month, or a given amount for each message delivered. This Company has purchased many patents, and holds the privilege of using nearly every mode known to the English patent laws; the system used, however, is the

Wheatstone Needle indicating instrument. The lines of this Company run along railroads, and by other good routes; some on poles, and some subterranean. The principal offices are kept open all night, and the latest news is vended to the newspapers, but upon what rule we are not informed.

The lines of this Company pervade nearly entire England and Scotland, diverging from London to the Continent, to Plymouth, Gloucester, Liverpool, Manchester, Scarborough, Fleetwood, Sunderland, Carlisle, Berwick, Edinburgh, Glasgow, and to some one hundred and fifty towns. This is the most extensive line in the world, *as to number of offices*, and excels any in America in that respect, though not near as long in extent of wire as many of the lines in America. We will now notice,

II.—THE SUBMARINE TELEGRAPH COMPANY.

This Company laid down the first subterranean and submarine wire, from Dover, England, to Calais, France, across the English Channel, in August, 1850. This cable consisted of one copper wire, simply covered with gutta percha. The covering of the gutta percha was one quarter of an inch thick. The wire remained perfect, however, only a few hours, as the action of the sea, rolling it about on the sharp rocks, at once destroyed the covering, and rendered the wire useless.

In September, 1851, another cable was laid across the Channel. This consisted of four copper wires, each incased in gutta percha, and then inclosed in a rope of galvanized iron. The length of the cable was 24 miles. It weighed 180 tons. The electric wires were No. 16 copper, covered with two coatings of gutta percha, making the insulation perfect. These four electric wires, as thus insulated, were bound together with spun yarn and hemp, saturated with tar. This bundle of insulated wires, with its hempen covering, was then surrounded by ten galvanized iron wires, each wire being five-sixteenths of an inch in diameter, all of which made a rope 1 1-8th of an inch in diameter.

On the 25th of September, 1851, the war steamer Blazer commenced paying out the cable. During the process of paying it out, many kinks or bends occurred, and the exterior covering every now and then torn off the insulated wires, as the cable passed through the opening made in the vessel. It was thought the elctric wires were left bare, but they proved otherwise.

On the 18th of October communication was found to be perfect; and at this period we may date the origin of this Company. A grant was obtained from the French Government in 1849, which gave the Company the exclusive right for ten years of

sending electro-telegraphic intelligence between England and certain defined points on the French coast.

The same Company procured a charter from the Belgian Government, for a term of fifteen years, for the connection from England to Ostend on the Channel coast.

This Company has on its directorate the most overwhelming array of royal personages, consisting of dukes, lords, chevaliers, ambassadors, admirals, and all the distinguishing characteristics of representation of kings, princes, and potentates. For what purpose these royal names are blended in the directorate we cannot divine.

Mr. Jacob Brett is the principal engineer, who, with several bankers and merchants of London, mostly own these lines, as joint stockholders. Shares, $25 each. The Company owns no line on land, except from Dover to London, but is laying down wires from London to Liverpool, and has lately opened an office in Birmingham. In order to extend their line into the interior of England, the Company procured a charter, with extended power, under the name of the "European and American Telegraph Company," with the right to connect the principal cities of Great Britain. The name we should judge to be rather a matter of fancy, though the intention to forward news from the Continent to Liverpool is very plausible, and will be of great utility. Messages are now sent from different parts of Europe, by telegraph, to John Hunter, Esq., No. 2 Paradise street, Liverpool, and, being prepared by him, are dispatched by steamer to Halifax, Nova Scotia, or New-York, as per especial instruction. When this line is completed to Liverpool, they rejoice in the hope of writing direct from Liverpool to London, a distance of about 210 miles! and then from London to Paris at another writing, a distance of about 230 miles!! The lines of this Company will all be subterranean and submarine. The system of telegraph used is the "Needle Indicating," and "Brett's Printing Telegraph;" this latter, however, does not in the slightest degree resemble either the Morse or House system of marking or printing telegraphs, as used in America, but is greatly inferior to either of them.

III.—THE MAGNETIC TELEGRAPH COMPANY.

This Company is generally called the English and Irish Telegraph Company. The head-quarters of this line is in Liverpool, and we presume mostly owned in that city and Manchester. The Company has a line to London, and our correspondent says it "works through from London to Liverpool!" Nearly the entire line is subterranean, and it is rapidly extending the wires to the extreme southwest point of Ireland—the said Company,

having the exclusive connection with Ireland, promises to be of great value. There seems to be much energy in the conduct of the affairs of the line, and in the extension of the wires the most eligible sites are occupied; and already the range of lines are nearly half in extent to those owned by the "Old Company." Every wire is laid in the most enduring form for permanent use. The wires of this line cross the Irish Channel at Port Patrick and Donaghadee, and works well. The system of Telegraph used is the Henley Patent of 1848, which may be described thus: Between the poles of an electro-magnet, a magnetic needle is placed, movable on an axle; to this axle a pointer is affixed; a stop is placed, so that the magnetic needle has motion only on one side from its normal point of rest; when a current of electricity in one direction is sent round the electro-magnet, the magnetic needle is attracted thereby, and moves from its normal stop to another, placed to limit its motion. Instead of the needle returning to its stop when the current ceases, the inductive influence of the magnetic needle on the electro-magnet causes the magnetic needle to remain in that new position until a current of electricity is sent in the contrary direction; and then the magnetic needle is moved from that position to its original position of rest. It thus remains at that stop till another current in the original direction is transmitted. By having two line-wires, and two magnetic needles and electro-magnets, and two pointers, the combination of the motions of the pointers represents the letters of the alphabet. The electricity produced is from the electro-magnetic machine, as was used by Dr. Steinheil in Germany, in 1837.

IV.—THE BRITISH TELEGRAPH COMPANY.

The lines of this Company are very limited in extent. There are offices of the Company in London, Liverpool, and Manchester. The "Old Company" and this, at an early day after the origin of the latter, got at law, and the power of the former nearly overwhelmed the latter, occasioning a heavy expense, amounting to many thousands of pounds sterling. The system of Telegraph used is Highton's Patent, being similar to the original Morse invention of 1832, based upon chemical action. This patent was granted 1844, the same year that Morse constructed and put in operation the forty miles between Washington and Baltimore, and practically working the first recording telegraph of the world.

There are divers other plans of telegraphs spoken of, and efforts are being made to put up lines under different systems. The fact is, as any practical telegrapher of America can see, the whole of those of Europe are totally worthless compared with

that of Morse; and why those lines adhere to their slow and inefficient modes, when they can use a better one without price, seems remarkably strange. National pride, however, may be the cause of this reluctance to adopting anything not legitimately of British origin; this pride may do in a world of fancy, but, in matters of pecuniary consideration, reason and common sense should prevail.

Art. VII.—THE AMERICAN TELEGRAPH CONFEDERATION.

ANNUAL CONVENTION.

PROCEEDINGS OF THE CONVENTION—REPORT OF THE SECRETARY—NEW-FOUNDLAND LINE—PACIFIC OCEAN CONNECTION—ATLANTIC OCEAN CABLE—REPORT OF THE COMMITTEE—ADOPTION OF IMPORTANT MEASURES—CONVENTION TO MEET IN NEW-YORK, OCTOBER, 1854.

Washington City, March 6th, 1854,
ALDERMEN'S CHAMBER.

IN accordance with the resolution of the Washington Convention of 1853, convening an assemblage of the Representatives of the respective Companies of America using the Morse American Telegraph System, the Delegates of the respective Companies assembled this day in 'the Aldermen's Chamber, in the City of Washington, D. C., when were present a representation from most of the principal lines in the United States.

On motion of Mr. Isaac M. Veitch, President of the St. Louis and Missouri River Telegraph Company, Mr. B. B. French, Representative of the Washington and New-Orleans Telegraph Company, was unanimously elected President of the Convention.

Maj. French took the President's chair, and thanked the Convention for the flattering manifestation of confidence of the members in re-electing him to preside over the deliberations of the Confederation.

On motion of Mr. Charles F. Wood, Superintendent of the New-York and Boston Union Telegraph Company, Mr. Tal. P. Shaffner, Representative of the St. Louis and New-Orleans Telegraph Company, was elected Secretary of the Convention.

On motion of Mr. Shaffner, Professor Samuel F. B. Morse was unanimously invited to take a seat in the Convention, and participate in its deliberations.

Prof. Morse accepted the invitation, and took a seat within the bar of the Convention.

The Secretary then read the Annual Report to the Convention, which was as follows, viz. :—

REPORT OF THE SECRETARY

TO THE AMERICAN TELEGRAPH CONFEDERATION, IN CONVENTION ASSEMBLED.

GENTLEMEN:—The last Convention of the Representatives of the respective Telegraph Lines of America,—using the Morse system of Electro-Magnetic Telegraphs,—adopted divers measures, which were calculated eminently to advance the weal of the common system. Unfortunately, however, much that was done at that Convention never has been made effective. Various reasons can be assigned for this apparent supineness upon the part of Companies.

Early after the adjournment of the Convention a limited number of copies of the proceedings were printed, not sufficient to supply each of the Companies. The Address of the Committee—which was acting in the recess, as authorized by the delegates assembled—was published in connection with the most important resolutions adopted by the Convention.

The Committee forwarded this address to many of the Companies; but, not knowing the names of many of the Presidents or Companies, not more than one-half of the lines of the United States received copies, and none of the lines in the Canadas, Nova Scotia, and New-Brunswick, have seen them. It was not possible for Companies to adopt rules they knew not existed.

Another difficulty presented itself in the adoption of the plans thus agreed upon. Many of the lines supposed that they were to commence operation immediately after the Convention adjourned, and therefore the resolutions were adopted, and remain so to the present time. Others, again, expected to receive notice, from the Executive Committee, of the time the resolutions were to take effect. That notice was never given, and thus, by these misunderstandings, there has been more or less confusion in the general adoption or non-adoption of the measures recommended.

The Executive Committee, finding the services of a Secretary necessary to aid in effecting a uniform system in the fulfilment of the plans of the Convention, the undersigned was elected to fill that office early in the summer of 1853, who, accepting, resigned the office of President of the St. Louis and New-Orleans Telegraph Company, and removed to Washington early in October.

The Secretary proceeded to make all the necessary arrangements for carrying out the resolutions of the Convention, particularly those relative to a general or uniform tariff and depôts of supplies. Relative to the former, the issue of the COMPOUND TARIFF SCALE seems to answer the ends more effectually than any other mode recommended. Concerning the supply of materials to the lines, the official circular of the Secretary, issued in December last, will more particularly exhibit the excellent plans adopted, and the successful arrangements made, to procure the diversified articles of consumption, at large gains. These contracts pertain to the furnishing of Nitric and Sulphuric Acids, Message-blanks, envelopes, mercury, tumblers, porous cups, platina, ink, pencils, pens, clocks, zincs, registers, magnets, keys, different parts of telegraph machinery, copper and iron wire, and all the different articles required in the management and conduct of telegraph lines.

The Secretary is rejoiced to report that nearly every line in America promises to unite in the arrangement. The details of the various contracts of supplies, the prices, conditions, and in fact everything pertaining thereto, are ready, and subject to your examination and direction. Whatever modification or change may be desired upon the part of the Convention for the Secretary to pursue in future, it is hoped instructions will be given definite and full, in order to avoid any irregularity in the management of the affairs by the Secretary.

It is proper, however, to remark, that the Secretary has endeavored to consult fully the Executive Board as to such matters as have been intrusted to his charge. The saving to the lines by the plans now adopted will be very large, and go far to aid in paying dividends. The estimated cost of materials per annum, heretofore, by the enterprise, exceeds $120,000. These can be purchased by the Confederation for $65,000, making a saving of at least $55,000, and also freeing the Company managers from many of the difficulties heretofore experienced in finding the proper articles of use.

The Secretary would report that he has been giving the subject of Galvanic Batteries much reflection, and hopes to recommend a series that will cost much less than the kind now generally adopted. Many have been presented to him, some of which were worthy of trial, and among them is one gotten up by Mr. Charles T. Chester, of New-York, though it is deemed best not to make any change from the present plan until a battery, certainly successful, is discovered.

Dr. J. Lawrence Smith, now lecturing before the Smithsonian Institute, holding one of the most eminent positions in the world as a chemist, also proposes to devise a galvanic series that will cost much less than the present Grove battery, and

have fully the powers of intensity and quantity required to create a proper electric force. Dr. Smith also proposes to aid in discovering the qualities of Electro-Magnets, needed for the use of long or short circuits. Cheerfully accepting the proposals of the learned Doctor, the Secretary entertains great confidence in the prospects of success, knowing the pre-eminent ability of the gentleman to master the various departments of physical science in the premises.

The Secretary would also report that he has received many communications from merchants and others relative to the rules of the lines west of Halifax, Nova Scotia, forbidding the transmission of dispatches until after the sending of other and preferred messages handed in later. Being requested by several Companies, which suffer by the policy, the undersigned endeavored to ascertain the correctness of the statement, and, if possible, urge the abolishment of a policy so seriously injurious to the different lines of America, which, too, is advantageous to none, not even those lines sanctioning or operating under the rule.

It appears that with a view to prevent private speculation, the Nova Scotia Company has agreed to transmit the news for the associated press of New-York before any other message handed in to the office *after the landing of a steamer*. If, therefore, there are one hundred private dispatches handed to the office on the arrival of a steamer at the port of Halifax, those messages cannot be sent until after the news for the associated press of New-York is prepared, handed in to the office, and sent. This policy the Company adopted to *prevent* private speculation. To the different lines of the country it has been a severe rule, greatly injuring their business, and lessening confidence in the impartiality of the telegraph. When the public knows that a line anywhere exercises the power of preference, they will believe the principle is generally adopted. That the intentions of the Nova Scotia line were good, we do not doubt; but that they fail in accomplishing the very objects intended, we have also not a doubt. That Company has the right to do as it deems best, however fatal to other lines.

It is to be hoped that, by proper representation to the above company, the universal rule adopted by every other line in America—sending all messages in the order they are received—will be adopted by that line; and that the earliest communication presented will be the subject of competition with the public. *No arrangement can be adopted to prevent speculation, and hope to accomplish that end for the public good is impossible of realization.* It will exist, in one form or in another; and in making any discrimination, it only decides who shall have the best opportunity. In speaking thus of this subject, it must not be in-

terpreted that we consider the agents of the press blamable in any manner whatever. They, doubtless, fulfil their contracts, and do just as all other honest men would do under like circumstances. It is the principle of preference that works so seriously against the welfare of the lines; and it is that which is so desirable to have modified.

The Secretary reports that, during the past year, many new lines have been built. Messrs. Smith, Crane, and others, are vastly extending lines in the State of Texas. Here the patents are free. When the noble and chivalrous people of that State were living under the uplifted flag of the Lone Star, as the Republic of Texas, Professor Morse nobly stepped forward and made the nation a free gift of his invention, for the promotion of the cause of freedom.

Messrs. Wade, Speed, Cornell, and others, have increased the range in the West.

Messrs. Snow & Co. have largely increased the lines in the Canadas; and side lines throughout the country have sprung up with great rapidity. The Nova Scotia Company is extending its line around the western promontory, embracing Cape Sable; also on the eastern islands of Cape Breton.

The Newfoundland Electric Telegraph Company constructed a line from Sackville, New-Brunswick, to Cape Torment, and thence, by submarine cable, across the Northumberland Straits to Prince Edward Island, to its eastern coast, Cape East. The company suspended operations during the fall; but has since resumed under the most favorable auspices, now embracing among its members gentlemen thoroughly skilled in the art and science of telegraphing, and some capitalists with ability sufficient to build the entire line singly, if desired. It is proposed to hasten the completion of the line across the Gulf of St. Lawrence, via the Island of St. Paul, to Newfoundland; and thence over the country by subterranean wire to St. John's, on the eastern coast; and thence southward, to Cape Race, where the Atlantic steamers will be hailed and the news sent or received, long in advance of the present time. In connection with this arrangement, the English and Irish Electric Telegraph Company have extended their wires from London to Ireland, crossing the Irish Channel near Belfast, and then running to Dublin, to Galway and the southern coast of Ireland, where steamers will be hailed, and the news procured or delivered, and sent or received, as the case may be. This company connects at London with the lines to Calais, (France,) Ostend, (Belgium,) and the Hague in Holland, through the three submarine cables crossing the English Channel. By this arrangement, America will be within five days of the Eastern Continent, a consummation of the greatest magnitude.

While these efforts are being made in the East, the far West, to the Pacific, is not forgotten. Efforts are being energetically made to induce Congress to grant the right of way and small appropriations of lands to aid in the building. Judging from favorable interviews with Congressmen, we are induced to believe that the grants and appropriations will be made. If so, in less than two years a substantial line will be constructed across the plains, giving a continuous wire from ocean to ocean! That the line can be made to be serviceable, there can be no question among practical telegraphers. That it can be shielded from the harm of Indians, there cannot be a doubt! There may be trouble at first, but that is experienced everywhere. The lines now run five hundred miles west of the Mississippi River, to the Indian border. In California, there are some two hundred miles of lines east of the Pacific, so that there is not much to build to complete the connection.

It is proposed to run a line of steamers from San Francisco to China, and when established the trip will be made in twelve days. News from China will then be twelve days in transit to San Francisco, thence one day to Cape Race, Newfoundland, taking the steamer to the southern coast of Ireland in five days. The continent of Europe will be brought within eighteen days of China. The time now is sixty-eight days, and the great saving thus attained will be most startling!! Under these circumstances, who can doubt the value of the lines in this range of connection? But this is not the end of enterprise! The same restless spirit of the age is active for the greater perfection of this connection. As long as there is an opportunity to advance the prosperity of the people, man moves with patriotic energy for the closing of the last link in the grand chain of communication.

The cabling of the ocean is now under active arrangement. It will be successfully done in less than five years. When this is accomplished, Europe will be within twelve days of China, and the line of communication will be across this continent!

No one can entertain the slightest idea of the great amount of business that will flow over this great and gigantic range. The commerce of the ocean, the trade of nations, and the cause of science, will rejoice at the completion of such a magnificent desideratum.

Some gentlemen have regarded the best route for an ocean line to be from the eastern coast of Newfoundland, starting from Cape Race, and running to the Island of Flores, thence to Fayal and St. Miguel of the Azores, and thence to Gibraltar, or some point on the western coast of Portugal, in the Spanish dominion, and then running by land to France. While the policy of the Spanish government seems adverse to a grand international

communication across, or connected with its territory, the plan thus proposed is of questionable expediency, even allowing the basin of the ocean to be favorable, which really is not the case, because when you leave the Azores, eastward the ocean for some hundred miles is only about 1,000 fathoms, or 6,000 feet, and then suddenly descends to a rocky bottom, 2,700 fathoms, or 16,200 feet, probably forming a precipice in that part of the ocean of 1,700 fathoms, or about two miles sudden descent. This difficulty could be materially lessened by going to the Madeira Island, and thence to the coast of Africa, extending the line by land, connecting with the great Submarine Lines now in progress from Europe to Africa, across the Mediterranean Sea.

The next and most plausible route is direct from the eastern coast of Newfoundland to the western coast of Ireland. This is the most practicable route; and the only question to be settled is one of science, though of no ordinary degree. We refer to the extent that a galvanic current can be sent on an insulated wire, fixed as a cable would be in non-contact with other conductors of the electric current. Of course, experiments will soon settle this question. By some it is believed that on an insulated conductor, a current could be sent around the globe, and that there will be no induction therefrom, if properly and thoroughly insulated. On this point we express no opinion.

Granting this question of science as settled in the affirmative, and we see no difficulty in cabling the ocean at the points mentioned. Lieut. Maury, of the National Observatory, seems to be firm in the conviction that there is nothing in the way, so far as the ocean is in question. His judgment is pre-eminently to be relied upon. He has had great experience in the science of the ocean, has sounded the depths of its basin, calculated its currents, and the nature of its bed, giving him the rare power of advising on this subject with certainty, and scanning its wonderful contents and myriads of phenomena.

After we pass the grand banks of Newfoundland, some five degrees east of the coast of Cape Race, the bottom of the sea becomes of a uniform depth under two thousand fathoms, until you near the coast of Ireland, where the depth is some 2,000 fathoms. The span will be some 1,600 miles. The bottom of the ocean is even and regular on its surface, composed of earth, shells, or clay, enabling the cable to lie with ease and undisturbed, until the Creator shall call the sea to render up its jewels, and decrees a general dissolution of matter.

But, supposing that science decides adverse to laying a cable upon this beautiful plateau of earth across the ocean, just designated, we can run a cable from a favorable point on the coast of Labrador to Greenland, with a stretch of 480 miles, and enter a bay on its southern coast; and then by land, a subterranean

line northeastward, to a favorable point; and thence to Ireland or Scotland. If desirable to reduce that stretch, we can run to Iceland; thence to Shetland, Scotland, or other points. The practicability of this route is unquestionable, even if the air line route is deemed inexpedient.

These enterprises are of the utmost importance to the lines of America and Europe, and deserve the most liberal encouragement. Would it not be well for the lines throughout the country to offer, as premiums, a per centage of the tariff on the business transmitted over each line respectively, for the benefit of the line, to the extreme ocean coast in the east, to the Pacific in the west, and the great Atlantic Ocean line, on all business coming from or going to those Companies?

Having thus spoken of the increase of lines and the proposed extensions to the eastern coast, across the plains to the Pacific Ocean, and also across the deep sea of the Atlantic, we now propose giving the aggregate extent of the telegraph lines in America. Some have one or more wires, and in order to give a fair representation of the extent of business thereon, the length of wires will be given, regardless of the particular arrangement of routes:—

Morse line wires	36,972 miles.
House " "	3,850 "
Bain " "	570 "
Total	41,392 miles.

We have calculated the capital stock in this immense range of electric communication. Some of the lines cost double that of others, but we have taken up each line separately, and arrived at the facts as they really are. The estimate may be a little under, but not over the legitimate amount:—

Morse lines, capital	$5,545,800
House " "	955,000
Bain " "	171,000
Total capital stock	$6,671,800

These estimates show the amount of capital invested in the electric telegraphs of America. Only ten years ago Professor Morse was building the experimental line between Washington and Baltimore. That forty miles was the longest telegraph line in the world. Since then the web has been spread from city to city, and the people throughout the entire land enjoy the blessings of this element of nature, subdued to the utility of man, by the industry, genius, and inventive powers of Morse.

The telegraph companies of America must perceive the existence of one fact, that is, the old lines are not paying larger dividends than they did years ago, notwithstanding the more rigid economy and greater extent of "feeding lines." There is a cause for this loss. The commerce and trade of the country increase, and the revenue of the lines ought to be greater. With but few exceptions, they are not. Why is this the case? We are confident in our opinion, after carefully investigating the question during the past half year, that it results from a general loss of confidence in the telegraph to subserve the purposes of trade as is is now and has been managed. The fault lies with the Companies. Want of concert is the main evil causing this unfortunate state of affairs. Could the lines be brought under one uniform responsibility throughout the country, there would be ten-fold more telegraphing done than at present. When a patron can present a message for a distant place, with a reasonable prospect of its reaching its destination within proper time, then, and not until then, can better times be realized by the existing Companies.

This is a matter of serious import, and the application of some uniform remedy,—to meet the case as far as practicable under the present arrangement of lines,—will prove serviceable and beneficial in the end. In connection with this, the policy of adopting a mode to guarantee the prompt and correct delivery of a message, ought to be considered as a very important question for consideration. Whether or not Companies are responsible for losses sustained by individuals,—resulting from errors in transmitting the message,—is a question at law not settled. If they are, it is time they should know it, and have prepared the proper checks for safety. If not, good faith to the public demands better fulfilment of the trusts reposed in lines than has been generally realized. The public have certainly great cause for complaint, and for withholding patronage. It is time that the entire enterprise throughout the country should be concordant, and unite in one great effort, not merely for the welfare of each company, but also of the public, in devising measures equally conducive to the interest of both. Let them be united, and peace and prosperity will flow therefrom. They can be so, if they will, and, at the same time, as *distinct as the billows;* yet, ONE AS THE OCEAN!

Respectfully submitted.

TAL. P. SHAFFNER,

Secretary, &c.

The following resolutions were presented for the consideration of the Convention, by Mr. James Eddy, Superintendent of the Maine Telegraph Company:—

Resolved, That messages of inquiry, relating to others, previously sent, or calling for answers thereto, shall be sent only in case of importance, and shall be as brief as possible; but they shall have precedence over all other messages.

Further Resolved, That when parties to whom a message is addressed are absent, and to be so long absent as to affect the value of the message, or if such parties refuse to give a reply which the message calls for, it shall be the duty of the person in charge of the Telegraph Office to send notice of such facts to the sender of the message, and charge regular tolls on such notice. But if he is promptly notified by the office receiving the notice that they cannot collect on it, no charge shall be made by any of the lines over which it passes.

Further Resolved, That the line in fault, in case of serious delay or error in a dispatch, shall refund the whole amount originally paid or collected thereon.

Further Resolved, That messages to be collected upon shall be sent only in answer to those marked "answer paid," except in cases where the office sending guarantees payment in the event of failure to collect. And all such messages are to be considered as guaranteed, prompt notice being given if they are not collected.

Further Resolved, All dispatches to be sent from any one office, on any line, to any other office on the same line, either for delivery there, or to be forwarded by any other line, shall be transmitted in the same and exact order of their reception.

Further Resolved, Plain, fair copies shall be given of all dispatches where they are to be re-written, and all unusual words, such as names of persons, foreign ports, and vessels, shall be written with *extra plainness*.

And further Resolved, If a prompt reply is not given to any message of inquiry, the Superintendent or Manager of the line complaining shall report by mail to the Superintendent of the line next connecting with his, and it shall be the duty of that officer to trace out and report back the facts in the case.

On motion of Mr. J. N. Alvord, Superintendent of the Ohio and Mississippi Telegraph Company, the President was requested to appoint a Committee of five members of the Convention, to whom shall be referred the report of the Secretary, the resolutions of Mr. Eddy, and such other questions as may be referred to them, and also that said Committee be requested to report to the Convention upon any other subjects of interest to the enterprise, which they may deem right and proper.

The President then appointed Isaac M. Veitch, President,

ent,

Charles F. Wood, Superintendent, J. N. Alvord, Superintendent, Amos Kendall, Representative of New-Orleans and Ohio Telegraph, and William M. Swain, President of the Magnetic Telegraph Company, to be the Committee contemplated by the resolution offered by Mr. Alvord.

Prof. Morse presented a sample of a new mode of insulating wires, by Mr. J. M. Batchelder, of the Crystal Palace; the insulation being fitted for office wires, damp sections of country, and for submarine purposes, and recommended by gentlemen as superior to gutta percha, not being so liable to injury from heat, air, or abrasion.

On motion, the Convention adjourned, to meet to-morrow, Tuesday, the 7th, at 9 o'clock, A. M.

Aldermen's Chamber, March 7th, 1854.

The Convention met, pursuant to adjournment.

The Hon. Amos Kendall, from the General Committee, submitted the following report, which was read and adopted unanimously, *seriatim*:—

The Committee, to whom were referred the several communications presented to the Convention by the Secretary, have considered the same, and agreed upon the following report:—

The resolutions offered by Mr. Eddy present several interesting questions for consideration. Some of them were acted upon at the last Convention, and further consideration thereon is deemed unnecessary. The Committee are rejoiced to find the resolutions of the last Convention proving so acceptable and useful in the management of the lines, as evidenced by members of the Convention, and so fully illustrated by the resolutions of Mr. Eddy. With a view to further remedy the evils resulting from failure to get answers, or refusal, negligence, or other causes in the premises, the following resolution is submitted for adoption, viz.:—

1. *Resolved*, That every party sending a message be requested to state if he desires notice of its delivery or non-delivery, from the office to which it is sent. If so, the signal XX, indicating such, shall accompany the message, which shall warrant the office in sending the notice at his cost.

The responsibility of Companies for errors in messages delivered, and the means of further securing correctness in the transmission of dispatches, are questions of great importance, and require the most careful consideration of all the points involved. With the hope that the ends may be attained in the most satis-

factory manner, the Committee recommend the adoption of the following resolution, viz.:—

2. *Resolved*, That the Executive Committee be requested to devise some mode by which customers sending messages can be better assured of their transmission and delivery in proper form by repeating the messages back, or otherwise, with an extra charge for the extra service.

The Committee learn, with much regret, that the resolutions of the last Convention have never been seen by many of the Companies, and consequently the excellent principles of management then agreed upon and recommended to the enterprise in America, have been unknown; and at the present Convention appeals are presented for the adoption of rules already existing, having been unanimously adopted by the Convention of 1853. In order, therefore, that all the Companies may fully understand what has been adopted by the Confederation, the following resolutions are submitted, viz.:—

3. *Resolved*, That the Secretary of this Convention, acting under the supervision of the Executive Committee, be instructed to communicate the recommendations of this Convention, together with those recommended by the Convention of last year, to the Presidents of all the principal Telegraph Companies in the United States and adjacent British Provinces, with the request of this Convention, that they will, on the first convenient occasion, submit the same to their respective Boards of Directors, or meeting of their stockholders, for their consideration, and immediately inform said Committee of their action thereon.

4. *Resolved*, That as soon as said recommendations, or any of them, shall have been adopted by any three of said companies, connecting with each other, those so adopted shall become binding rules on the companies so adopting them, and shall in like manner be binding on all companies by which they may hereafter be adopted; and it shall be the duty of the Secretary aforesaid to inform each company adopting said rules, by what other companies they may have been adopted.

It appears that much has been done by the Secretary towards organizing a regular system of supplies, as recommended by the resolution of the last Convention; and the Committee most heartily approve of the plan of concentrating the purchase of materials from one source, thereby securing the best articles at the cheapest rates, so essential to the efficient and economical management of lines. Deeming this to be a subject of more than ordinary importance, your Committee recommend the annexed resolution, viz.:—

5. *Resolved*, That this Convention recommend to all lines to

procure their supplies from the Secretary of this Convention, not doubting that they will find it their interest to do so, in relation both to the cost and the quality of the articles supplied.

Relative to the change in the alphabet, as proposed by the last Convention, the Committee learn that its fulfilment was early found impracticable, endangering the correctness of messages, without the hope of any ultimate good. With a view to comply with the universal opinion of the practical telegraphers, the Committee recommend the repeal of the resolution, and, at the same time, express the opinion, that any change of the alphabet, however small, would evidently prove injurious to the business.

6. *Resolved*, That the resolution adopted at the last meeting of the Convention, substituting the letter K for C, and C for K, is hereby rescinded.

Under the resolution of the last Convention, Mr. Shaffner has issued a COMPOUND TARIFF SCALE, gotten up with much labor and care. Believing the work to be eminently useful and meritorious, the following resolution is submitted, pertaining thereto, viz.:—

7. *Resolved*, That the several Telegraph Companies of America be requested to adopt a uniform system of tariff; and believing SHAFFNER'S COMPOUND TARIFF SCALE proximates nearest the desired object, this Convention recommend its general adoption.

8. *Resolved*, That the Managers of all telegraph lines be requested to report to the Secretary any changes of tariff that may be made, from time to time, and to aid all in their power in establishing uniform rates.

The question of granting exclusive arrangements, and a monopoly of the lines to any person or persons, has been presented to the Committee. While they deem this a question of local power, at the same time they look upon the practice as improper in itself, and injurious to the interests of all the lines throughout the country; and with a view to ascertain the extent of the abuse, and endeavoring to correct it, they submit the following resolution, viz.:—

9. *Resolved*, That the Executive Committee be requested to ascertain whether any telegraph company in America grants exclusive privileges, a monopoly, or other preference to any person or persons in sending messages, and if so, to use their exertions to procure the repeal of the same, and the placing of all patrons of the telegraph upon an equal footing.

The Committee would also present the following resolutions for adoption, viz.:—

10. *Resolved*, That when the Convention adjourns, it adjourns to meet in the city of New-York, on the second Tuesday of October next; and that it be recommended to all telegraph lines, using Morse's system of telegraphing, in the United States and the adjacent British Provinces, to choose delegates to said Convention, and that said delegates be empowered to bind their respective companies in all matters pertaining to the appropriate action of said Convention: *Provided*, that the power of said Convention shall extend only to regulating intercommunication between the several lines, uniformity of working, and their accountability to each other, and that all the actions of the Convention beyond these objects shall be recommendatory only.

11. *Resolved*, That the Secretary of this Convention shall be Secretary of the Executive Committee, and it shall be his duty to perform such services as may be prescribed to him by the Convention, or by the Committee: *Provided*, that he shall not be authorized to do any act involving the Convention, the Committee, or any individual thereof, or any company represented therein, in any pecuniary responsibility.

12. *Resolved*, That the Executive Committee be instructed to ask of each Morse Telegraph Company in the United States and British Provinces, a contribution towards defraying the expenses necessarily incurred in carrying out the instructions of this Convention.

The Committee having thus considered the respective questions submitted, so far as they deemed necessary, they respectfully recommend the adoption of the preceding report and resolutions.

Mr. Veitch presented the following resolution, which was unanimously adopted:—

Resolved, That the Convention recommend the "TELEGRAPH COMPANION," published by Tal. P. Shaffner, Esq., to the patronage of the telegraph companies, believing that it is ably conducted, and will prove a valuable exponent of the objects and interests of the enterprise, and deserving a liberal support from all identified therewith.

Prof. Morse offered the following resolution, which was unanimously adopted, viz.:—

Resolved, That the thanks of this Convention be tendered to the Board of Aldermen, for the use of their Chamber by this Convention, and that the Secretary communicate this resolution to the President of the Board.

On motion of Mr. Alvord, of Mo., the Convention proceeded to elect the Executive Board for the ensuing year, which resulted in the unanimous election of Major B. B. French, of Washington City, Hon. Amos Kendall, of Washington City, Wm. M. Swain, Esq., of Philadelphia, Pa., Hon. J. D. Caton, of Ottawa, Ill., and Gen. J. K. Morehead, of Pittsburg, Pa.

On motion, it was *Resolved*, That the powers conferred on the General Committee at the last Convention be regarded as permanent rules of authority for the Executive Board, until repealed by the Confederation.

On motion, it was *Resolved*, That in the opinion of the Convention, the Secretary ought to reside in the City of New-York.

No further business appearing, the Convention adjourned *sine die*.

B. B. FRENCH, *President.*

TAL. P. SHAFFNER, *Secretary.*

Editorial.

MORSE *vs.* O'RIELLY.—DECISION OF THE SUPREME COURT OF THE UNITED STATES.—Since the organization of the United States Government, there has not been a case considered by the Supreme Court of the nation of more consequence to the American people than the late one, from the Circuit Court for the District of Kentucky, wherein Prof. Samuel F. B. Morse was granted an injunction against Henry O'Rielly, for an infringement of his American Electro-Magnetic Telegraph, for which he was granted a patent June 20th, 1840, and for an improvement thereon April 11th, 1846.

The questions involved in the consideration of the case by the Court were not confined to the particular infringement of the machinery, as that was so palpable as to require but a moment's observation; but embraced also the discoveries of the sciences involved in the art of telegraphing, and to the determining of the true and original inventor of this ART, and his privileges springing from the letters patent granted, awarding and confirming all the rights and immunities guaranteed by the laws of the United States to the worthy and meritorious inventor, whether for an improvement

in the simplest department of mechanics, or for that most brilliant achievement in the known arts—the ELECTRO-MAGNETIC TELEGRAPH!

A few of the points settled by the honorable Court we propose to briefly consider. And first:

Who was the Inventor of the Telegraph?—The Court has determined the claims as to priority of invention in favor of Morse, and in a manner to allow of no controversy in future. Morse's claims have been assailed in the most unwarrantable manner. There were those who felt jealous of his pre-eminent renown, and, ambitious for the commendation themselves, were zealous in their efforts to deface that escutcheon upon which the name of Morse was written with golden capitals, as a benefactor of his fellow-men, unrivalled in splendor of inventive genius. Others, again, who sought to gather the golden grain for their own weal, disregarded all principles of honor in assailing the rights of him to whom unceasing gratitude should have been bestowed for their elevation among men.

Morse was the inventor of the Telegraph. The solemn decree of the Supreme Court awards to him that honor. Comparing his system with those of Europe, invented by Steinheil, Cooke, Wheatstone, Davy, and other philosophers, the Court very justly remarks, that no one can examine them "without perceiving at once the substantial and essential difference between them, and the decided superiority of the one invented by Professor Morse." The consideration of the subject is closed in the opinion in Chief, by "regarding Professor Morse as the first and original inventor of the Telegraph." The opinion read by Justice Grier is stronger, but fully sustains the opinion read by the Chief; and we may safely say that it is the united and unanimous opinion of the entire Bench of the Supreme Court. The Justice thus spoke, viz.:—

"The word 'Telegraph' is derived from the Greek, and signifies 'to write afar off, or at a distance.' It has, therefore, been applied to various contrivances, or devices, to communicate intelligence by means of signals or semaphores, which speak to the eye for a moment; but in its primary and literal signification of *writing, or recording at a distance*, it never was invented, perfected, or put into practical operation, till it was done by Morse. He preceded Steinheil, Cooke, Wheatstone, and Davy, in the successful application of the mysterious power or element of electro-magnetism to this purpose; and his invention has entirely superseded their inefficient contrivances. It is not only 'a new and useful art,' if that term means anything, but a most wonderful and astonishing invention, requiring tenfold more ingenuity and patient experiment to perfect it, than the art of printing with types and press, as originally invented."

The honorable Court carefully considered the claims of the respective inventors of the telegraphs of Europe and America, and the evidence sustaining Morse seems to have been unquestionable. He now stands high above the petty assaults of an envious world, and can smile with composure at the weak and unprincipled attacks of a restless ambition for fame, groping through the world, hoping to attain distinction by assailing the just and pure in heart.

We have said that the Court has decided "that Morse was the first and original inventor of the Telegraph." The word means, to write at a distance. Morse was the first to accomplish that desideratum, and therefore he is justly the inventor of the Telegraph; and, as there is a star of the first magnitude that shines from the firmament with more brilliancy than all the combined constellations that beautify and adorn the handiwork of the Creator, so will the Morse Telegraph be, unrivalled in grandeur, without a twin to share the praises of generations in future, which will be conferred upon it, until Time shall be wrapped in the folds of his winding-sheet, and ceases to exist, by the decree of the will Infinite.

Next, and *second*, viz.:—

Should the Patent date from the French Patent?—Morse applied for a patent in the United States in 1838. Before it was granted in 1840, he procured a patent from France. The Court decides that the American patent is not void because it does not bear date with the French issue.

The next and *third* is,

Ratification of the Seven Claims.—The Court was unanimous in the ratification, in the most unqualified sense, of the Patent of 1840, so far as relates to the seven claims. The Chief said, "We perceive no well-founded objection to the description which is given of the whole invention, and its separate parts, nor to his right to a patent for the first seven inventions set forth in the specification of his claims," consisting of a *galvanic battery*, or any known generator of galvanism or electricity, *a galvanic or electric circuit*, composed of *any known conductors of electricity*, a *Port Rule* and *Signal Lever*, or *other contrivance* for closing and breaking the circuit, all in combination with an *Electro-Magnet* or *device* by which the *motive power of the electric or galvanic current*, which I call *Electro-Magnetism*, may be developed and applied to give motion to other machinery, for the purpose of *marking* or *imprinting* intelligible characters, signs, or letters, at any distance." This is what the Court has decreed to Morse as his right, and in which he will be protected. The Chief not only unqualifiedly sustains the seven claims, and

the specifications entire, but also in the most positive manner interprets the extent of those claims and specifications, and declares that

"The substitution of marks and signs differing from those invented by Professor Morse" cannot be a defence; and that

"His patent is not for the invention of a new alphabet; but for a combination of powers composed of tangible and intangible elements, described in his specification, by means of which *marks* or *signs* may be *impressed* upon paper at a distance, which can there be read and understood. And if *any marks*, or *signs*, or LETTERS are *impressed* in that manner by means of a process substantially the same with his invention, or with any particular part of it covered by his patent, and those marks or signs can be read, and thus communicate intelligence, it is an infringement of his patent. The variation in the character of the marks would not protect it, if the marks could be read and understood."

It will be perceived that the Court has most fully sustained the Morse patents, to reach all variations; and the use of the Roman letter, or any other, or even a *sound*, capable of being interpreted, is an infringement of his patents. If any part of Morse's mode, process, or the "substitution of well-known equivalents," in the language of the Court, "the rights of the patent are infringed." The confirmation of the seven claims with the specifications establishes the Morse patent to its fullest extent. Every material element and material part of the patent of 1840 is ratified in the most positive sense, all that Morse has ever presumed to claim as his rights in those letters patent. With a view of discussing this point further, we shall notice next, and *fourthly*,

The Eighth Claim too Broad.—This claim the honorable Court declared was too broad. Why? In a few words we shall condense the lengthy argument, and demonstrate that, in declaring this claim too broad, it is not consistent with the ratification of the seven claims and specifications. The eighth claim is merely declaratory, and does not really extend further in substantiality than is attained by the rights guaranteed to Morse in the seven. But the Court says it is too broad! and the reasoning is based upon an entire misconstruction of that claim, extending its force beyond the conception of Morse, or its language. The Court says, that "*he claims the exclusive right to every improvement where the motive power is the electric or galvanic current*," &c. In this, the Court erred in the interpretation. Morse claims no improvement whatever, unless that improvement is his own, as was that embraced in the patent of 1846. If Morse intended to reach that end, by the claim in question, there would have been no ne-

cessity for his procuring the patent of 1846, as an improvement on the invention patented in 1840. Suppose that the improvement embraced in the patent of 1846 had been the invention of Mr. O'Rielly, and not Morse, would not O'Rielly have been entitled to the patent for that improvement? On what would it have been an improvement? Unquestionably, it would have been an improvement on Morse's invention of 1840; but, in order that Mr. O'Rielly might avail himself of that patent, he must first get the right from the patentee of 1840. But Morse was the inventor of the patent of 1846, and the Court says, that "there is nothing in the act that forbids him to take out a new patent for the improvement, if he prefers it. Any other inventor might do so; and there can be no reason, in justice or in policy, for refusing the like privilege to the original inventor"—and that "he must stand on the same footing with any other inventor of an improvement upon a previous discovery," but, "that he shall not claim as new what is covered by a former invention, whether made by himself or any other person." Under these restrictions of the law, Morse procured his patent of 1846. If the eighth claim had been considered as broad as the honorable Court has seen fit to interpret it, there would have been no necessity for his procuring a patent for the improvement. Buckley obtained a patent for an improvement in the art of telegraphing in connection with Morse's patents. Morse did not claim that improvement as being covered by his eighth claim; but, on the contrary, a company, in which Morse is a large stockholder, paid Buckley $10,000 for that improvement. Cornell has a patent for an improvement in connecting a series of circuits. Speed has invented improvements, and so have many others. Morse never claimed those improvements as his property, but he has actually participated in purchasing such to be used with his system. With these facts existing, we unhesitatingly assert, with due respect to the high and august tribunal deciding, that in the interpretation of the eighth claim to mean that Morse "claims the exclusive right to every improvement where the motive power is the electric or galvanic current," the Court defines the claim to extend far beyond the objects and purposes designed by Morse; and his course demonstrates the fact. The single reference to his procuring the patent of 1846, we presume, is sufficient in the premises.

The claim in question is merely declaratory, and his disclaimer will not weaken the full force of his rights as contemplated by him in his eighth claim as it exists, especially taken in connection with the present complete ratification of the seven claims and specifications, which the Court has awarded him as his just and legal property, and in which he is to be protected.

What is the Eighth Claim?—Before closing our remarks upon this subject we shall say a few words relative to what is the eighth claim, which declares the right to the exclusive "use of the motive power of the electric or galvanic current, however developed, for marking or printing, &c., at any distances, being a *new application of that power*," &c.

Now, the Court have found in the first claim of the patent of 1840 this fact, viz.:—

"The only ways in which the galvanic current had been proposed to be used prior to my invention and improvement, were by bubbles resulting from decomposition, and the action or exercise of electrical power upon the magnetized bar or needle," &c.

Finding this to be so, of course the honorable Court could not but find that Morse was the first to apply this motive power to write, mark, *print*, &c., as the eighth claim expresses.

But the eighth claim does not aim at the use of any particular process of machinery for making this application. It leaves that to future inventors, who may get as many patents as they deserve. But what the eighth claim sets forth is, that any improvement in this *new method of applying* the motive power to *write*, *print*, &c., which shall be patented to himself or any other person, is an improvement of *his invention of that use*, and cannot be made available although patented, except in subordination to his patent or eighth claim.

The Court have not touched this real and only interpretation, that Morse or any of his assigns have ever put upon this claim. But the Court describes it as "a claim to any improvement where the motive power is the electric or galvanic current." After this construction of the meaning of the eighth claim is disclaimed, we do not doubt, that whenever this part of the patent shall again come to the consideration of the Court, it will be settled in favor of the eighth claim, as the inevitable sequence of the prior claims.

Of course Prof. Morse will disclaim so much of the eighth claim as is too broad. Without intending any disrespect to our friends of Erie, or lessening the gravity of the question under discussion, we would say, that if the claim is too broad, then it must be narrowed to a legitimate guage. If it be six feet *now*, and four feet ten be correct, then so be it. Therefore, Prof. Morse has only to disclaim so much of it as is *too broad*, and assert that he *does not* "claim the exclusive right to every IMPROVEMENT, where the motive power is the electric or galvanic current," and thus he can reduce it to a legitimate guage, as decreed by the honorable Court, and place his patent, including the eighth claim, where he always designed,—embracing his

original full interpretation of its force and effect. With these convictions, we are firm in the belief that not only are the seven claims and specifications adopted, but also the eighth in its legitimate sense, and the Morse Patents most triumphantly sustained.

The opinion of Judge Grier, concurred in by Justices Nelson and Wayne, is a paper unparalleled in power of argument, and overwhelming in demonstration of the views therein contained. While we admire the opinion in chief as a learned and eloquent piece of argumentation, we cannot but be charmed with the force, clearness and supremacy of argument in the dissenting opinion.

RAILROAD TELEGRAPHS.—We have heard of many plans of Telegraphs designed for railroad convenience. Mr. W. D. Wesson informed us, a year ago, of a valuable invention he had perfected. We have heard of others. We have seen a crude model of a plan for the car-wheels to be the operator, by pressing a connecting button in the centre of the rail, causing the circuit to close by the pressure, which gave the alarm at a distant office. We copy the following from the *Racine* (Wis.) *Advocate*, relative to a new invention of Mr. Cushman; and it is considered to be all that is necessary to accomplish the desired ends:—

"TELEGRAPH ON RAILROADS—A NEW INVENTION.—One of the uses to which the electro-magnetic telegraph is beginning to be applied, is that of facilitating the operations of railways; and securing greater safety, by obviating the danger of collision, accidents, and so forth. Several Companies at the East have erected a line of telegraph along their roads, with 'registering apparatus' placed at convenient distances, where, on the arrival of the train, the operator may report himself and his whereabouts to head-quarters at either end of the route, or to another train that may happen to be at another point on the road. Thus, a train leaving the depot at eight o'clock, is due at a station thirty miles distant at nine, but by some accident is detained midway between the points for several minutes. This fact is immediately telegraphed to the station ahead, and thence to all other stations; whereby trains going in an opposite direction are informed of the fact, and the danger of a collision entirely obviated.

Accidents frequently occur to trains, whereby it becomes necessary to dispatch an express to a long distance for another locomotive. The time and detention required in doing this are shortened to one half, by the use of the telegraph; thus rendering a valuable service to passengers as well as trains. An accident to the track is in like manner made known to a distant station, or train, and the necessary precaution taken to avoid any accident that might occur. Thus, by the use of the telegraph, railway travelling is rendered eminently more secure than it could be without it.

There is still a difficulty, however, attending the use of the telegraph on railroads. The registering machines must necessarily be at a considerable distance from each other, as their cost and the difficulty of keeping a great number in perfect order would render the plan unavailable. Much time and attention would also be required in adjusting and arranging batteries; and, indeed, we do not see how it can be managed at all, without an ope-

rator stationed constantly at each machine. This difficulty is about to be obviated, and the manner it is to be done is what we wish more particularly to speak of. The plan is the invention of Mr. S. D. Cushman, of the Telegraph Office of this city. It consists in the use of but a single registering machine, which, instead of being stationed on the line, is within the railway carriage, and by a very simple and cheap contrivance is thrown into the circuit at convenient distances. A relay magnet and key are placed in one of the cars, at which place the circuit is used; so that the operator, who is inside the car, can call the home office the instant the train is near the station. The circuit is left whole by means of a spring or key as soon as the train starts, the train throwing itself out of the circuit without assistance from any one.

The line may be constructed in three ways:—Placed upon the fence of the railroad, the posts running up one or two feet above the fence as often as necessary, to which the block and insulator are fastened. In this way the line is made a part of the fence. Or the wire may be put upon the ties of the roads, a piece of scantling being spiked to the tie to which the line is fastened. Or it may be constructed in the usual way, only nearer to the ground, upon posts not over twelve feet high.

From an examination of Mr. Cushman's plan, a model of which he has constructed, we are satisfied that it is an essential improvement upon the present mode of using the telegraph upon railroads, and that it will be adopted where such lines are made use of."

"New Publications.—We have received a copy of 'Shaffner's Telegraph Companion, devoted to the Science and Art of the Morse American Telegraph.' The important and intimate connection of telegraphing with the current business and general convenience of society, constitutes it a popular, as it is one of the most wonderful achievements of the age; and the general desire of the public to inform themselves upon all subjects in which they have a direct interest has led to the publication before us. It abounds with information, and contains the outlines of projects which are likely to advance the system infinitely beyond its present state of usefulness." —*Baltimore Sun.*

☞ We think the present number of the Companion will be found to be unusually interesting. We regret that illness has prevented more care in the preparation of the articles.

☞ Many subscribers write us that their numbers never come to hand. We are confident of their prompt mailing, and regret to find the fault in the mail department. The gentleman having charge of this department of the Magazines certainly stands unrivalled for promptness and ability in this branch of business. In all cases of failure, we will re-mail other copies.

☞ We will thank some friends for copies of the decision of a Court in New-Orleans, on responsibility of telegraphs for errors; and also of the case in Michigan, with particulars of the cases.

☞ Henry S. Faxon, late operator at Nashville, Tenn., and now of Buffalo, has invented a superior repeater, working "both ways," without local aid from an operator.

☞ One of the most complete fire alarm telegraphs in the world is that of Boston, arranged by Moses G. Farmer, on the Morse system. One of the most consummate humbugs in that line, is the fire telegraph put up in New-York.

☞ We get many letters, asking information as to the best insulators. We hope to give a review of the many now in use, and prove which is best. Until then, however, we advise our friends to shun iron and brimstone.

☞ We are rejoiced to hear that our old familiar friend, Charles L. Bobb, formerly of the St. Louis office, has become an army official, and now flourishes with a handsome salary.

SHAFFNER'S

TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. I. MAY, 1854. No. 5.

Art. I.—ELEMENTS OF THE MORSE TELEGRAPH.

THE SYSTEM AS AN ART—THE ELEMENTS OF THE ART—COMMUNICATING TO THE SENSES OF SEEING, HEARING, AND SMELLING.

BY GEORGE GIFFORD, ESQ.

Before Supreme Court of the United States.

THE functions of the parts of apparatus are the things required, and the employment of the apparatus is a consequence of this demand. The function of the part may be a necessary element in the invention, and it is only by virtue of this necessity that the part of apparatus is required at all, and it is quite immaterial as to its form, so long as it has that function, and thereby brings that element into the series of elements. The apparatus is necessary only because its function is indispensable, not the function because the apparatus is indispensable. It is that the demand for the function begets the necessity for the apparatus, and not that the demand for the apparatus begets the necessity of the function.

The function is therefore the essential thing as a part of the invention, and forms a part of its metaphysical constitution or principle, while the apparatus is an incident. True, the function may be inseparable from some form of apparatus, but that form may be greatly varied, and still, under all its varieties, fill the same office and produce the same intermediate result in the chain or succession of intermediate effects, which form the identity and principle of the invention as a whole; and in no such case will a change in the apparatus, without changing its function, effect a change in the principle of the invention.

But all this having been done by Morse, still, to complete his art of telegraphing, other means and instrumentalities remained

to be invented; a system of symbols or signs is indispensable, and they must be produced, else all that has gone before will be fruitless. He is now to invent a new vehicle, not to carry passengers, but, what is much more delicate and difficult, and demands a higher order of genius—a new vehicle of thought; and besides the other difficulties to encounter, he is now restricted in materials; not only must a system of signs be invented adequate to receive all the endless variety of thoughts to which mind can give birth, and to preserve them unimpared in their transit from mind to mind, but it must be constructed out of a single element, a continuous line; to this single material he is restricted, and although the genius of men for centuries has been exhausted in the construction of alphabets, and all the changes, angles, curves, and circles have scarcely been adequate for the necessary varieties to complete an alphabet, and geometry has been rebuked for its meagre supply of forms to meet the demand; yet, discouraging as it is, there is no alternative—out of one form alone, one continuous line, the whole must now come, or the telegraph is a failure; and it must be done, or Morse's last hopes are gone, for against such result he had hypothecated all his other prospects in life. Genius again rallies to his rescue, and, admitting no impossibilities, assails the straight line, and ere it escapes from her mighty grasp the victory is won. The simplest form known is wrought into a capacious storehouse of thought, to be employed as a receptacle for telegraphic messages, but with a capacity ample for the reception and dispersion of all human knowledge.

And now this done, Morse's telegraph, in its simplest form, is complete, and now his new art is launched, and from this its age begins, a thing that was not, but ever after is to be; destined to be the faithful servant of all, but especially faithful in perpetuating the name of its author.

Having now attempted to develop the character and kind of Morse's inventions, as exhibited in the simplest form of his telegraph, by a brief notice of his process and the instrumentalities devised for putting his process into operation, I now come to the consideration of his art; and notwithstanding the supposed difficulty in distinguishing and identifying a patentable art, I shall endeavor to select Morse's art from the other parts of his invention, and to ascertain, and definitely and particularly, what it is and of what it consists, and to show that this art is not, as is alleged by the other side, a mere abstract or barren principle, incapable of description; not an abstract, speculative idea of something which does exist, or may exist in nature, independently of the inventor's genius; not a mere general law of nature, or a property of matter unharnessed and unembodied; but that, on the contrary, it is a specific, organized thing, a crea-

tion of genius, brought into existence and made fruitful by invention, originating, not in unassisted natural laws, but in the brain of Morse, and is practicable and capable of the most accurate description and well-defined limits, and is so described by its author in great detail—is new, and eminently useful. Having done this, I shall then attempt to show that it is practical as an art, and shall point out which claims of Morse's patent apply to this new art, and endeavor to correct the errors of my learned friends on the other side, committed in their misapplication and misconstruction of the claims in relation to this part of Morse's invention.

* * * * *

In maintaining this proposition, and to do it by full argument, I submit,

1st. That every systematized means of communicating thoughts from mind to mind by symbolical representations of ideas, when such minds are separated by either time or distance, includes an art.

2d. That all such means of communication require, and have, an intermediate *representation of the thoughts;* and in every case, this intermediate representation is, and on a careful analytical test will be found to be, an art.

Such means may, and in many cases do, embrace many things which accompany the art, and which, or substitutions therefor, are indispensable to its practice, but which, nevertheless, form no part of it, and which, to distinctly identify the art, must be distinguished from it.

To illustrate. Communication by mail is one systematized means of communicating ideas between minds distant from each other, and it will be found that this means contains an art. The art does not embrace all of the means employed, but among the means is *an art*, distinct from the many other accompaniments.

The art which it contains does not consist of the locomotive, the railroad, the mail-bag, nor the organization of the Post-office Department, employed in the transmission; but, in case the communication be by a *manuscript letter*, it consists, specifically, in the *writing* of the letter, and in the *art of writing;* but, if the communication be made by *printed* documents, then the art consists in the execution of the *printing*, and is the *art of printing;* each being a peculiar intermediate representation of the ideas communicated, and each being, by universal acknowledgment, a distinct and leading art, and constituting an indispensable part of the means to effect the communication.

And thus we see that no communication is made by mail, even, without the exercise of an art.

So with Morse's telegraph, which is another systematized means of communicating thoughts from mind to mind which

are separated by distance, and which system, although it contains many other things, also contains a distinct *art*, susceptible of identification and of a clear distinction from its accompaniments, or the apparatus employed to practise it; and this art, too, is also a peculiar and symbolical intermediate representation of thought between the mind imparting and the mind receiving, and is distinguishable and different from all other arts.

I propose now to select that part which I consider the *art*, from the other inventions in other classes of patentable matter in Morse's telegraph, and to trace its identity, define its peculiarities, and, holding it up to view separate and distinct from the other inventions, to show that it stands as firmly upon its own novelty, and is as strongly fortified by its own distinct peculiarities, and is as firmly and justly entitled to a distinct place among the arts, and to a rank of equality by the side of the two standard arts, and to the protection of the patent laws, as any other art which has ever come to the knowledge of man.

In doing this, I shall give my own views in reference to the true definition, meaning and purport of the word "Art," as employed in the statute; others may, and undoubtedly do, honestly differ with me in these views. I claim no weight for my positions when they are not self-evidently right, except so far as I maintain their correctness by demonstration. To avoid any confusion of ideas, resulting from the indefinite and vague, habitual and commonplace use of the word art, and to bring the thing itself within the definite and proper meaning of the term as employed in the statute, I shall resort to analogy. I shall do this, and perserve the analogy by instituting a comparison between Morse's art and certain other things which are acknowledged to be, not only arts, but leading, standing arts; and show that it is not only equal to, but even surpasses them in distinguishing characteristic features, constituting the qualities of a standard art, and an art within the limited sense of that word, as employed in the statute.

For such comparison, I have selected the arts of printing and writing. And I will here premise, with respect to these two arts, that they would clearly be patentable, if new. That if printing had never before been known, and were now for the first time invented, with a patent law as it now stands, no lawyer could deny that it would be patentable as a new art; and that the same would be true with respect to writing.

* * * * *

Let us, then, pause here a moment, to first analyze the art of printing, to identify it and determine precisely what it is, so that an analytic comparison may be better understood. And first, negatively, by determining what is not of the *essence* of the *art of printing*, and of what it *does not* consist:—

1st. It does not consist of the printing press, for if any other machine be applied to print the words, it would still be the art of printing.

2d. It does not consist of the coloring matter, for if any other be substituted, it would still leave the art of printing.

3d. I does not consist of the material upon which the printing is performed, for if any other material be substituted, it would still be the art of printing.

4th. It does not consist alone of the working of the printing press; for if one operate the press, in the exact manner of operating it to form letters, and yet without the material in, on which to form them, or with the material so placed as to prevent contact between it and the type, and therefore not form letters, or any product, it is evidently *not* exercising the art of printing.

5th. It does not consist of the letters or the product alone, for a printed book, being a product of the art, is obviously not the art itself.

Thus, then, it is apparent that the machinery employed does not constitute the art; and it is also evident that neither the act nor process alone, nor the product alone, constitutes the art.

And having thus relieved the subject from the mass of burdensome matter which is of a negative character, and not of the essence of the art, we are brought to the proper stage to inquire affirmatively, What is the art of printing? For it must be the art alone which is patentable, as such. To this the answer must have become obvious, to wit: that it consists of the peculiar act of forming the letters, and of the letters thus formed; that both the peculiar act of forming and the letters formed are component parts of the art, and form its identity; and that these component parts cannot be separated without destroying its *identity*; or, in other words, that the art of printing consists of the process of forming the letters and the letters formed.

The same is true of writing. The art of writing does not consist of the instrument used, nor of the material used to write with, or to write upon. Nor does it consist alone of the peculiar manipulation or act of forming the letters; for if one move a pen over paper in the precise manner to form letters, but without forming them, he certainly is not writing, nor exercising the art of writing. Nor are the manuscript letters, after made, collectively or separately the art. If one hold in his hand a written document, he clearly does not hold in his hand the art of writing, but only a product of that art.

It is apparent, then, that the art of writing, as well as that of printing, consists of the peculiar act of forming and the product formed, or in other words, of the process and its product jointly, and that both, as component parts, are indispensable to consti-

tute the art, and cannot be separated without destroying its identity.

This analysis prepares us for a like analytical examination and test of Morse's art in telegraphing.

Morse records his telegraphic alphabet at a distance, being a symbolical intermediate representation in communicating thoughts or ideas between distant minds; and that is exactly his art, and the art contained in his telegraph, and it is specific and certain.

First, then, negatively, his art does not consist of the machinery or apparatus employed, any more than the art of printing consists of the printing press and machinery employed; or the art of writing, of the instrument by or upon which the writing is done.

Nor does his art consist alone of the lines and dots made, any more than a printed book is the art of printing, or a piece of manuscript is the art of writing. The lines and dots constituting his telegraphic characters are only the product. Nor does the art of Morse consist alone and separately of the manipulation or manner of operating his telegraph, any more than the art of printing consists of operating the press without forming letters; or the art of writing consists of performing the movements of the pen without the formation of letters.

Morse's art, according to my view, like both the art of printing and the art of writing, consists of the peculiar act of forming and of the product formed, or, in other words, of the process and the product; both being component parts of the art, and jointly constitute it, and which parts cannot be separated without destroying its identity. There are others, I am aware, who think that the art consists merely of the doing of the thing or performing the act, and does not include the product or things made; and, indeed, I am not aware of what are the views of my colleagues on that point.

Having now shown that there is an art in Morse's telegraph, and that this art contains the same number of peculiar component parts as is contained in the art of printing and the art of writing, and thereby established its right to the rank of a distinct art and of equal consideration and honor with either of those two old and time-honored arts, that of printing and writing, I will now attempt to show wherein this art of Morse's invention differs from either of the other two, and that it so differs more than they differ from each other; and in which differences will be found, also, its telegraphic character, and by which differences it is enabled to perform what neither the art of printing nor the art of writing can perform—subserve a purpose which they are incapable of, and minister to certain wants of mankind which they cannot supply. And that although the arts of writing and

printing may be substituted for each other, for certain purposes, and that Morse's art could be substituted for either of them for certain purposes, yet that neither the arts of printing nor of writing are capable of being substituted to perform the achievements of his art.

In order to establish these positions, and to maintain that Morse's art is fully equal to either the art of printing or the art of writing, in the corresponding peculiar characteristic features which constitute them arts and different arts, and that Morse's art not only possesses an equal *number* of such peculiar features, but also an important additional characteristic, to which neither the art of printing nor the art of writing has any corresponding feature, and by which Morse's art is rendered more peculiar than either of them, and more unlike each of them than they are unlike each other, and in this respect has ascended the highest in the scale of novelty and individual identity, I will here submit a comparative analysis.

1st. The arts of printing and writing each contain an intermediate symbolical representation of thoughts or ideas in communicating between distant minds, and to this extent those two arts are alike. But Morse's art also possesses this character, and in that respect is equal to either of them.

2d. This symbolical representation in both the art of printing and the art of writing is a permanent record of the thoughts, and to this extent, also, they are alike. But the same again is true of Morse's art, and in that respect, also, his is equal to either of them.

3d. The symbols or signs, by which the intermediate representation of thoughts or ideas is made in the exercise of the arts of *printing* and *writing*, differ; each system of symbols being peculiar to itself, possessing distinctive characteristics, and is adapted to the particular process by which the signs are formed, and in this the arts of *printing* and of *writing* differ. But this is true also of Morse's art, his system of symbols or characters is peculiar in itself, possessing distinctive characteristics, and is adapted to the particular process by which the signs are formed, and in that respect, also, his art is equal to either of the other two.

4th. In the arts of printing and writing, the *processes*, or acts of forming the peculiar symbols or product, differ, as well as the product itself, each *process* being peculiar to itself, and in that respect they are also dissimilar. But this, again, is true with Morse's art, his process in forming his symbols or signs is peculiar to itself and dissimilar to that of either writing or printing, and in this respect, also, his art maintains its equality with either of the other two.

5th. The exercise of either the arts of printing or writing requires machinery or apparatus peculiar to each, and although

this machinery or apparatus is not the art in either case, but only belongs to the conditions of its exercise, yet they differ in that condition. But this is also true of Morse's art, and in that respect his loses nothing in a comparison with either of the other two.

6th. In both the art of printing and the art of writing, the intermediate permanent *representation of thought is made at the place of the communicating mind*, and not at the distant place of the receiving mind; and in this peculiarity, *those* two arts are alike, both being *exercised* at the place of the mind *imparting* the thought, and have no ability to do otherwise. But in Morse's art the symbolical representation is made, or in other words, the result is developed at the distant place of the receiving mind, that is, at the place of the mind to which the thoughts are communicated; that is, it records its characters telegraphically, and in this it leaves the other two arts, with which it is being compared, in the accomplishment of achievements by this additional novel characteristic, which neither of the other two have ability to perform, or are of a nature to perform.

And now assuming, what of course cannot be denied, that printing is an art, and that writing is an art, and that they are different arts, and supposing that I have succeeded in showing that they differ from each other, as patentable arts, only in the product and the act or process of producing it, and that Morse's art in telegraphing is equal to either of them in both of those respects, both in the number and novelty of the features, it then must follow, from this alone, that his art is complete and perfect as a patentable art, and is entitled to a rank and a sisterhood with the art of printing and the art of writing.

But his art possessing, as it does, the third new characteristic, being the function or ability of recording its symbols or characters at the distant place of the mind receiving the communication, his art becomes, not only equal, but far superior to either the art of printing or the art of writing, and this too in distinctive characteristics peculiar to itself in kind, in function, and in results, and which are of great utility.

But great lamentation comes up to this Court from these infringers, because Morse claims his mode of making and employing sounds, and it will be, therefore, proper to notice here the subject-matter of this part of Morse's invention. This system of sounds does not imply the use of sounds in general, but it is a peculiar production, and use of systematized interpretable sounds, and not only so, but the sounds constituting the system, are the product of the same process, and from the use of the same apparatus as is employed in the exercise of Morse's art of recording; and these sounds are so strictly allied to, and so uniformly accompany the formation of the record, that each may be employed as an interpreter of the other; in short, the one is

the *written* and the other the *spoken* language of his messenger of thought. It is a twofold expression of the intelligence communicated. His system of sounds, therefore, will be found to be an accompaniment of the process of recording; and its use as a substitute for the record will be found to be only a modification in the art which I have already illustrated.

Art. II.—COPPER BATTERY FOR TELEGRAPHING.

DESCRIPTION OF THE BATTERY—DIRECTIONS FOR ITS USE—ADVANTAGES DERIVED AS COMPARED WITH THE GROVE.

We give below the plan and directions for building and maintaining the Copper Battery, as adopted by Judge Caton, President of the Illinois and Mississippi Telegraph Company. This battery is now in use on that line, and has been for several months. Thus far it serves the purposes very well. Judge Caton thinks that it will excel the Grove Battery in many points, and being less expensive, not requiring rebuilding as often, equally as simple, and with other considerations, will ultimately, in a great degree, supersede the Grove Battery.

THE COPPER BATTERY.

Directions for setting up and maintaining the Copper Battery.—The materials which we use for this battery are a glass or glazed stone jar, a sheet copper cylinder, a porous cup, a zinc cup, sulphate of copper, and rain water. First, within the glass jar place the copper cylinder, and within that the porous cup, and within that the zinc cup. The copper cylinder may be left open at the sides and both ends,—the copper of one jar is then connected with the zinc of another, and so on through the series. This I usually do by soldering a strip of sheet copper, half an inch wide, and six or eight inches long, to the arm of the zinc cup. Another similar strip is attached to the copper cylinder. The detached ends of each of these strips should be turned over for half or three-fourths of an inch, in the form of a close hook, the one up and the other down, so that they can be hooked together, and make a close connection.* All the coppers and zincs being thus connected, and the conducting wires (either ground or line wires) being connected at one end of the battery with the zinc, and at the other end with the copper, the porous cup should be nearly filled with pure rain water, and the outside jar should be filled, to within say half an inch of the top of the porous cup, with a strong solution of sulphate of copper, and into this solution should also be placed some crystals of

* A soldered connection is preferable.

sulphate of copper, from time to time, so as always to be certain that there are some not dissolved remaining in the jar. When the battery is thus set up, and the poles are connected so as to complete the circuit, it must stand about one day before it will attain its proper strength. If it is necessary to use it immediately, add a few drops of sulphuric acid to the water in the porous cup; but this should not be done if it can be avoided, as I think the battery is better without it after a day or two.

The sulphate of copper has a tendency to work over, both the edge of the porous cup and of the outside jar, so much so as to form a connection between the jars, if they are not very well insulated from each other. To guard against this, before the battery is set up melt some beeswax, and with a small brush spread a thin coat around the top of the porous cup, and also around the inside of the upper edge of the glass jar. This coat of beeswax will remain for a considerable time, and will present an impassable barrier to the sulphate of copper, and must be renewed whenever necessary. Tallow or other fat will answer, but will want renewing oftener.

The water in the porous cup will soon become a solution of sulphate of zinc, and in say a month, will become so strong a solution, as to impede the working of the battery. As often as once a month, at least, one-third of the contents of the porous cup should be poured off to be retained, and the balance thrown away. The portion saved should then be returned, and the cup again filled with fresh water.

As often as once a month the zinc should be taken off, and a black crust or scale will be found on the outside of the unconsumed zinc: this should be knocked or scraped off. Some of the porous cups are liable to crack, so as to allow the two liquids to run together. When this is the case, they must be replaced with new ones. Sometimes they will receive a deposit of copper; but those made of Ottaway clay are not liable to this, or to crack to any extent.

Although this battery may sometimes work well for several months without any attention, except to keep it supplied with sulphate of copper, yet it should never be allowed to stand more than a month without being overhauled as above. It may, indeed, work tolerably well till the zinc is entirely consumed, while the zinc-cup still retains its full size and form, which on examination will be found to consist of a residuum resembling hard black clay. This, however, should be removed occasionally, as above suggested.*

* Saturday night should always be selected for cleaning the battery, and the circuit left on over Sunday, and by Monday morning it will have attained its proper strength.

There is no gas arising from this battery, as there is from the Grove battery; hence the local may be placed as close to the table as possible. This, like the Grove battery, should never be allowed to get frozen. It requires about one-third more cups than the Grove, with the same zinc surface, to attain a given strength of current, but is more economical. The only material consumed is the sulphate of copper and zinc, and it affords a much more uniform working circuit. I usually allow three cups for a local battery.

If the above directions are well understood, and carefully followed, no trouble need ever be experienced in working this battery.

Art. III.—EARLY HISTORY OF GALVANIC ELECTRICITY.*

GALVANI AND VOLTA—OERSTED AND AMPERE—ELECTRO-MAGNETISM—BATTERY EXPERIMENTS—DISCOVERER OF THE ELECTRIC TELEGRAPH.

It was reserved for accident to lead to the discovery of two distinct primary properties in electricity. How much do we not already owe to accident for beneficial results! We are informed by concurrent testimony, that the lady of Galvani, Professor of Anatomy in Boulogne, was seized (1790) with a severe cold, for which her physician advised frog-soup, or broth. Some frogs were obtained, and by chance were laid near an electrical machine, in the Professor's laboratory. An assistant had occasion to use the machine, and he observed that as often as sparks were emitted, the limbs of the dead frogs would move as if instinct with life. Astonished at what he saw, the assistant hastened to inform the Professor of the wonder, and the latter attended to witness the fact for himself. Becoming deeply interested in a phenomenon so perplexing, and entirely new to him, Galvani tried other experiments, and ascertained that the results which followed the use of the conductors were similar to those which followed the use of the apparatus. Galvani was now satisfied that he had touched the spring of a profound secret, and he resolved to prosecute the study of its key at once. For this purpose he had a number of the legs prepared and electrified, which he hung up by copper hooks in front of an iron balcony. To his utter amazement, the limbs were thrown into strong convulsions, and continued to labor violently so long as they were kept in this situation. From this additional circumstance, Galvani proceeded to propound his theory, which was the doctrine of *animal magnetism*, or *galvanism;* in other words, the

* From De Bow's Review.

existence of a nervous fluid, which, in the minds of nine-tenths of the masses, experiment had demonstrated beyond the shadow of a doubt.

But there *were* still some who doubted. Volta, the author of the Voltaic Pile, was not of the number who gave in their adhesion to a doctrine so preposterous. He visited Galvani, examined closely into the outward merits of his discovery, and returned to Pavia, where he shut himself up, and proceeded to analyze the scientific problem which had been propounded to him. He ascertained, at length, that the agitation of a nerve or muscle, when touched by two pieces of different metals, was greater than when touched by one; and, consequently, that instead of there being a nervous fluid resident in the organism, the electric property was confined alone to the metals. He had now overcome the difficult part of his task. His next step was to construct an apparatus, which should not only accumulate, but render continuous, the power that had puzzled Galvani, and which the latter had, without due investigation, at once ascribed to be a resident property of the nerves.

Volta's discovery was accepted as the true theory. The sydamic property was known to exist in contradistinction to the statical property, and all philosophy had to do, was to make that distinction by mechanical agency. Oersted, the Dane, was the man for the emergency. Ritter, of Munich, had already shown that metal could be magnetized by the Voltaic battery; but Oersted proved the existence of more remarkable phenomena relative to the action of the magnetic needle. He demonstrated how that, by the meeting of two electric currents, a new development of power ensues, which attracts or repels the needle of the North Pole, as it may be positive or negative, and that the direction of this power is not in a *right*, but in a *spiral* direction. Experience has confirmed the correctness of this view. Ampère, who was contemporary with Oersted, co-operated in shedding light upon the science. He simplified Oersted's system, and gave to it a more practical character. Ampère was in turn aided by M. Arago, who ascertained that, by plunging the wires of a battery into steel filings, the latter adhered to the wires so long as the electric current remained complete. If a wire could thus be magnetized at will, why, he argued, could not huge bars of iron? and acting on the suggestion, he caused a number of magnets to be forged, varying in size, which he tested, and satisfied himself that the opinion he had formed was well founded, in both principle and practice. Thus, we perceive, cloud after cloud was dispelled, until at length the auspicious light was to dawn upon the intellect.

But let us hurry on, and overtake those who have profited by Oersted's discovery, as simplified by Ampère. It is now 1811.

Soëmmering, of Munich, had, meanwhile, endeavored to apply voltaic electricity to telegraphy. His scheme was much the same as Le Sage's, that is, it comprehended as many wires as there are letters in the German alphabet, with the addition of numerals, from 0 to 9, all of which terminated in 35 golden points, in a vessel partially filled with water. Decomposition of the fluid took place when the fluid passed from the pile, and a bubble of oxygen or hydrogen gas appeared at the letter or numeral to which attention was desired. To this contrivance Schweigger added an alarm wire, by which signals by the operators were conveyed. He likewise proposed a reduction of wires to two; demonstrating the superior advantages of a less number than 35.

The deflection of the magnetic needle next became the subject of learned disquisition and eager research. The magnetic current, when passed along the line to any great distance, was found to be incapable of producing any well-defined movement, and Schweigger set about remedying this defect. He produced in time his multiplier; and the main drawback was rectified. This instrument deserves to be described. The principle on which it is constructed is, "that a current returning upon itself, acts in all its parts, and causes a powerful deviation of the magnetic needle placed with it;" and a "conducting wire, twisted upon itself, and forming a hundred turns, will, when traversed by the same current, produce an effect a hundred times greater than a wire with a single turn; provided always that the electric fluid pass through the circumlocutions of the wire without passing latterly from one contour to another." "This," adds the description, "is a condition easy to fulfil. To make a multiplier, you take a silver or copper wire of any length or size, closely enveloped in thick thread, and wind it round a small frame, within which the needle is suspended on a pivot, and leaving a few inches free at each extremity. These are called the two wires of the multiplier, and when in work, the current enters by one end, and passes off at the other."

We perceive that genius was rapidly accumulating all the practical elements of the synamic electro-telegraph. One more discovery would complete the triumph—that was, thermo-electricity, and science and enterprise soon conquered the sole remaining difficulty. Seebeck, of Berlin, stood forth, and successfully contended for the prize. He rightfully claimed the authorship of the theory, though Becquerel and Daniell improved and practically adapted it. Becquerel had shown, in carrying out the theory propagated by Volta, "that a pile might be constructed with a constant though feeble current," and it was of the first importance to find a stronger power. The pile was removed by Daniell, and substituted by batteries of various

forms. The zinc was plunged in a solution of chloride of sodium, and the copper in a solution of the sulphate of copper. The products of decomposition were ingeniously disposed of and the loss of power admirably guarded against, so that the action maintained its full force for a considerable duration of time. We have now all the elements of the electro-magnetic telegraph before us. Who, among the philosophers of the age, is it that comes forward and combines them? *Morse*, the American. *Franklin*, the American, had long before demonstrated the identity of electricity with lightning. It remained for Morse to group the combined wisdom of two ages in one grand and practical test, and to exhibit to mankind the novelty of lightning doing obeisance to every impulse of the human will. All improvements that have since been made, either by Professor Morse or his agents; by House and Bain of the United States; by Wheatstone and Smee of England; by Steinheil of Munich; by Voorsselman of Derenter; by Baron Schilling of Russia; by Puninge of France, and others, are all new adaptations or modifications of the same principle. But Professor Morse stands alone as the discoverer and the illustrious founder.

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The battery, or generating power, is a simple apparatus. Let us imagine ourselves standing by the side of a wooden trough, which is divided off into twenty or forty cells, according to the power required. The partition walls are commonly of slate; they should always be of an incorrosible substance. Two plates of metal, one of zinc and the other of copper, laid alternately, are placed in each cell, in such a manner that all the plates of one kind face together towards one end of the trough; and those of the other face together on the opposite end of the trough. A ribbon of copper unites each pair of plates in the centre of the upper edges, "forming, as it were, so many curved handles, by which they can be lifted in or out. As soon, then, as the remaining vacant space in each cell is filled with an acidulated fluid, the action commences; the acid begins to act upon the zinc by dissolving it; the water contained in the solution is decomposed, and hydrogen is thrown off from the surface of the copper plates; while, by a combination of oxygen, oxide of zinc is formed, and this, dissolving in the acid—which is commonly sulphuric—sulphate of zinc is produced. These effects are the consequence of the general law established in relation to voltaic electricity, 'that by the contact of dissimilar metallic bodies, a partial transfer of the electric fluid from one to the other invariably takes place.'" A "positive current is generated at the zinc, and passes to the copper through the intervening fluid in all the series of cells, and continues to flow as long as contact is maintained between the wires which depart from

either end, whatever be their length." The cells of telegraph batteries are sometimes filled with well-washed sand, instead of a fluid; and this sand undergoes moistening by pouring in dilute sulphuric acid, which prevents a needless waste of the plates, while their full power is undiminished. The zinc is specially liable to oxydation and dissolution, to guard against which, it is only necessary to dip the plates frequently into a vessel of mercury. Persons who use the Leyden jar in their families, are well aware that their silver coating thus obtained prevents the wasteful effervescence that would otherwise ensue. The earth itself has been made to furnish a supply of the electric force, by a pair of zinc and copper plates being buried in a damp or wet subsoil. When saturated with water, the ground represents the sand, saturated with acid water, in the ordinary battery. A current of low intensity is thus obtained, notwithstanding that miles may intervene between the deposits of the plates. The earth acts as the return wire to any given number of wires, without in the least affecting the regularity of the action of any of them. The battery universally adopted in this country is that by Grove, "of cups of zinc, with strips of platinum in an earthenware or porcelain cup, which cup is filled with nitric acid, which is placed inside the zinc cup, in a tumbler filled with dilute sulphuric acid. The main battery on a line (from 30 to 50 cups) requires renewing only once in every two weeks, and daily in local batteries of two or three cups." Grove's battery, besides being the most consistent and economic, is the most powerful in use.

From the battery, which is kept in a remote and secure place, we proceed to the operating room. Here the battery wires meet the telegraph wires in what is called the electro-magnetic machine. This apparatus externally resembles the works of a mantel-clock; but their operations, how similar, and yet how different! One computes, the other commutes, time. To describe the electro-magnetic machine is a difficult task. We have presented to us, for our inspection, manipulators, hieroglyphical characters on circular plates or planes, or rollers through which a strip of puncturated white paper is passing, and wheels innumerable, and a complication of other co-operating agents; but to the uninitiated the whole is a perplexing mystery. We perceive externally two needles, which are the tongues of the instrument, and the action of these is the language of the machine. The operator, with a message in writing before him, places his finger on a lever, and by compressing and relaxing this, the medium of correspondence is established. Within the machine are placed other needles to correspond with the external tongues, and are so situated that the South Pole of one and the North Pole of the other are in the same position, by which means the influence of the fluid is neutralized, or, rather, the action of the

magnetism upon them. They are kept in a perpendicular position, and are obedient to the slightest impulse from the battery. The inner needle is suspended within a multiplier, which intensifies the power of the electric current at this spot, and which deflects the needle to either side by the outward movement of the handle or lever, which opens or closes the electro-magnetic circuit. The secret of working the apparatus is easily acquired. The art, indeed, in many of the rural districts, is principally in the hands of women; and thousands, by this discovery of science, now earn livelihoods at the electro-machine, who otherwise might be, or have remained, drudges in less intellectual employments.

Art. IV.—MAGNETIC BATTERY FOR TELEGRAPHING.

NEW INVENTION OF MR. CARPENTER—MAGNETIC BATTERY PROPOSED AND CLAIMED AS SUPERIOR TO THE GALVANIC BATTERY.

We have, on several occasions, spoken of the necessity for improving the present battery arrangements of the electric telegraphs of America, and have expressed the hope that, at an early day, a mode would be devised to generate electric power, consummating the purposes at reduced expense.

Various plans have been suggested, and many experiments have been made, and some have apparently proved successful. Whether or not they would answer the purposes of telegraphing we are unable to say, as the question can only be settled by actual application in the premises.

We give below a very interesting communication from Mr. Calvin Carpenter, of Rhode Island. We have seen his battery, and it seemed to fully sustain all the gentleman claims for it. It is worthy of trial; and if it does answer, the economy in its use will be very great. We hope the subject will be well considered, and the merits of this, as well as all other plans, have a fair and practical examination.

The plan of Mr. Carpenter, to have batteries at leading points to charge a range of lines, of course we consider wholly impracticable. His limited acquaintance with the management and operation of lines deprives him of a proper basis of calculation. It is not economy for lines to operate in long circuits; and the plan proposed would not be economy. But this is not a material point in the consideration of the subject in detail. If these batteries do answer, it would be a great saving to have them at every office. Once supplied, there will be no more cost.

While we wish the subject of batteries to be fully examined, we do not recommend the abolishment of those existing, until there is a certainty of success in those which may be substituted. Too much care cannot be taken as to proper electric force;

and therefore we advise the observance of caution, and holding fast to the Grove series until another is invented of unquestionable superiority.

PROVIDENCE, *March* 30*th*, 1854.

MR. TAL. P. SHAFFNER:

Dear Sir:—Your letter of the 25th inst., in answer to mine, I have received;—please receive my thanks for the kindred spirit which you manifest in relation to my invention. I should be very much pleased to have a visit from you.

I think it would be of great advantage to you to become better acquainted with my invention, in relation to its application to telegraphing. You may be sure that telegraphing is to be carried on through the agency of magneto-electricity, instead of galvanic; and if a cable is ever laid across the bed of the Atlantic, it will require the magneto-electric battery to furnish the electric current for telegraph communication, on account of the greater intensity of current (which can be developed from magnets, than can possibly be developed from any arrangement of zinc and acid whatever), which you know it would require to work a long line without intermediate batteries.

In my last letter, wherein I hinted at the mode which telegraphing could be carried on, by the magnetic batteries of my invention, to a better advantage than with the galvanic battery, I would like to call the attention of thoroughgoing practical telegraphers in relation to facts which must be necessarily known, to fairly consider the adoption of my new battery for telegraphing purposes.

1st.—It would be necessary to know how many miles of telegraph line there are in operation in the United States in each of the modes of telegraphing—viz., Morse's and House's; for this would determine how much battery power would be required for working all of the lines, so far as relates to the line circuits. The number of Grove's battery cells used would also afford a comparison by which to determine how large to build the several magnetic batteries that would be required to take their place. This latter method would probably afford a more correct data in connection with the former, than could be obtained any other way, because the House lines of the same length require more battery power than the Morse lines; therefore it would be necessary to know the given number of cells used per certain number of miles for each system, to know how to adapt the magnetic batteries to each system.

2d.—It would be necessary to know how many independent circuits of telegraph lines there are in the United States under both systems, and what principal cities the greatest number of the whole of those lines emanate from; for this would deter-

mine how many batteries would be required, and what places to locate them in—whether it be New-York, Washington, New-Orleans, St. Louis, or any other central city in the United States. Then the length of those independent circuits emanating from each central city or locality, and the number of battery cells employed for each circuit, would determine the size and power of each magnetic battery for each of those central localities.

With this information, I could at once calculate the cost of furnishing such a system of batteries for telegraphing throughout the United States, so as to lay before those pecuniarily interested in telegraphing the merits of it in point of economy.

I could also dètermine the aggregate amount of power required to operate those batteries to develop the electric current, and make a very exact estimate of the whole expense required to put such a system into practical operation. There are a great many advantages in the use of my magnetic batteries, for telegraphing, that cannot be had on any conditions in the use of the zinc and acid battery. The point developed is more steady, constant, and uniform in its power than the current of the zinc battery; as the uniform power of the current depends upon the uniform speed with which the battery is rotated; which speed can be regulated with as much precision as a clock, if required, while with the zinc battery the current becomes weaker and weaker as the acid loses its strength, and the uniform strength of the current can only be maintained by renewing the acid; which never can be regulated so practically exact as the current developed from my battery. This point is of great practical importance in telegraphing, to always have a uniform reliable current to depend upon, which is always ready (without nursing with acid) to use when the lines are in a working condition. Then the construction of my batteries is so simple, that the only care required to keep them in an operating condition is simply to keep the journals of the shaft which rotates oiled, as this is the only point of friction and wear to the battery. Consequently, a battery well constructed would last any number of years, with no other repairs than to renew the boxes once in ten or twenty years. This little expense, together with the power necessary to rotate them, is all that is required, over and above the first cost, to keep them in operation for hundreds of years, to furnish electricity for telegraphing; and, in comparison, they would shed their streams of electricity to convey human intelligence to all parts of the earth for the purposes of man, as the sun in the heavens sheds its streams of light and heat to promote the growth of vegetation, and inspire life and animation to the tenement of flesh and blood which human intelligence inhabits. The magnetic battery is well calculated every way to take the

place of the galvanic battery to furnish electricity for telegraph purposes; and it is bound to be the instrument chosen, both in point of utility and economy, as well as for reliability.

After obtaining all the facts and information necessary to put this system of magnetic batteries into operation which I have cited, so that I shall be enabled to make a just and proper estimate of the expense required to construct and put into practical operation such a system, and for which information I beg leave to ask for your co-operation in rendering me such part as you may have, I have in contemplation a plan for putting into execution the project, and which I think, with proper and judicious management, will be the best method to adopt. The position which you occupy would enable you to become one of the most prominent co-workers in accomplishing this great project.

I think, Mr. Shaffner, you will consider this plan politic, and the most judicious to be adopted. It will be opening a door for increasing the profits of telegraphing, and cheapening to an enormous extent the expenditure. For, in my system of magnetic batteries, there would be but one first cost for at least two hundred years; while with the zinc battery, saying nothing about the first cost of the platinum used, and other essentials, there is a first cost for zinc three or four times a year, and in some cases oftener, which would in a few years overgo many times the first cost of the magnetic batteries. Therefore, it is obvious that the magnetic batteries, as a substitute for the zinc battery, would in a few years be hundreds of thousands of dollars in the pockets of Telegraph Companies; and it becomes a question of momentous importance whether the magnetic battery shall be adopted or not. To say it shall be adopted, is speaking for the best interests of all who are engaged in telegraphing. The zinc battery has had its day, now let it be cast aside and abandoned in toto for telegraph purposes. Let the magnetic battery take its place; it is adequate to the task in every instance. Not only on line circuits, but local circuits used in the Morse system, can be beautifully worked with a small magnetic battery attached directly to the register, and run by the same weight which operates the register.

There is no longer any need of the zinc battery for telegraphing, after a full supply of magnetic batteries to take its place.

I feel that it is possible to lay a cable across the bed of the Atlantic, which will permit the transmission of electricity through the bowels of the mighty deep, for telegraph purposes. If the condition of the bed of the ocean between Newfoundland and Ireland is, as Lieut. Maury represents, a plateau from fifteen hundred to two thousand fathoms in depth, and at the bottom as calm as a mill-pond, there is no reason why it could not be accomplished; and there is no reason, if such a line of

communication be established, that it may not be filled with the lightning from a magnetic battery located one at each end of the line, sufficient to operate the beautiful and sensitive instrument of Professor Morse's invention, and thereby bring Europe and America within speaking distance of each other; so that the thoughts of two great divisions of human beings, thousands of miles apart, shall be interchanged with each other as though space did not intervene.

I will write to you again at another time, when I will give you some description of my new battery, and the ends which I claim to accomplish when I shall have completed my invention.

Very truly, yours,

CALVIN CARPENTER, JR.

Art. V.—AN ELECTRIC TELEGRAPH AROUND THE WORLD.*

A CABLE ACROSS THE ATLANTIC OCEAN—THE CABLES IN EUROPE—A LINE ACROSS BEHRING'S STRAITS—THE GIRDLE AROUND THE GLOBE CONSIDERED.

"THE project of establishing a telegraphic communication all round the globe is one upon which public attention on both sides of the Atlantic is fixed with growing interest, and which will cease to be considered impracticable as soon as no other difficulty remains than such as may be overcome by the union of science, industry, and capital. The remarkable progress of the present age, which has been brought about by the harmonious combination of these three mighty agencies, leaves little room for doubt as to the ultimate accomplishment of the project. It is only a question of time. Sooner or later, we may rest assured, the world will be girt round with an electric wire, by means of which all the principal cities and courts, as well as all the chief seats of commerce and homes of science, will be indissolubly united. What has been effected within the recollection of many, renders this glorious consummation quite within the bounds of possibility. Public opinion, enlightened and encouraged by the past achievements of human industry and skill, will ere long believe in the feasibility of the grand project, and call for its execution, though the conviction is not yet so widely spread and so firmly established as could be desired. The project is, however, already looked upon by many as an inevitable result of the numerous lines of steamboat communication which span the world, and the innumerable railways with which every country is now interlaced. Both in America and Europe the prevalent idea appears to be, that the next step towards the re-

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alization of the mighty scheme must be a submarine telegraph across the Atlantic. And the history of past efforts shows that there is reason in this. The first short line of communication across the English Channel has, after some little interruption arising from accident, been made to work well; a second attempt, on a larger scale, to connect England and Ireland, has proved equally successful, in spite of similar obstacles at first; and the third line, which was laid down last summer between Doverand Ostend, is also in full operation. These successes have convinced many that a submarine telegraph may be laid down across the Atlantic, connecting Halifax with the most westerly promontory of Ireland.

Another circumstance also requires to be taken into account in connection with this subject. A wire laid down across the Atlantic could only serve for the conveyance of communications to and from two points at a distance of 2,000 miles apart. At no intermediate point could messages be received or dispatched. Along the whole line no accessory advantages could be reaped. It would be like an extra line of railway from New-York to Boston, without any intermediate station.

There is, however, a course round the globe by which both the danger of interruption from one cause or another, and the useless expense attendant upon a submarine telegraph across the Atlantic, might be avoided. The government or people of the United States will soon extend the main line of their telegraph, via California, to Oregon. On the other hand, the telegraphic lines of Europe stretch towards the East nearly as far as the Uralian mountains. The necessity of a speedy communication with her Asiatic provinces will soon induce Russia to extend the line of telegraph in this direction. Certainly she will, for her own ends, carry it quite up to the Uralian mountains. The whole of the territory between this point and California is in possession of the United States, Great Britain, and Russia. It would not be necessary to ask a right of way for the telegraphic wire from any other government between these two distant extremities. Why, then, should not a combination be entered into for the establishment of a line across Behring's Straits? What physical or pecuniary difficulty could there be in such an undertaking which these three powers might not easily overcome, if united? Is the mere distance to be considered an insuperable difficulty? Telegraphic wires have already been established along a greater distance among ourselves, and that too by a private company, through a country with few large cities to encourage such a project. Ought there to be any difficulty about stretching a line across Behring's Straits? They are reckoned to be not more than thirty or forty English miles in breadth, with two or three islands between, which might serve as

intermediate stations, and would leave no greater width of water than that between Dover and Calais. The Russian government might easily keep a watch upon the part of the line in its dominions; and the governments of the United States and Great Britain might do the same in their respective territories. Any damage done by accident to any part of the line might be as easily repaired as if it had happened between New-York and Albany. Hence this route would always be free from such dangers as would constantly threaten a line connecting Halifax with the Irish coast. This is a great advantage; and besides, a line from St. Petersburg to San Francisco would establish a connection between two important places. The telegraph would pass through all the principal provincial towns between the capital and Behring's Straits, and would doubtless be daily employed for forwarding government dispatches to and fro. On the Continent of North America an important communication would be kept up between Behring's Straits and San Francisco, leading to a large increase of mercantile and other intercourse. Over all this vast space would the telegraph be usefully employed in many ways by the two governments of the United States and Great Britain. It would pass through the British possessions in North America, including the Hudson's Bay district, and become a most valuable means here of forwarding mercantile communications to England, as well as along the coast from one station to another. Stations would also be formed on the borders of the lakes, for the conveyance of messages and news from the British vessels which ply in these waters. The great whale-fishing interest, which carries on its operations in the north, would also derive much advantage from this part of the line. During the years 1849 and 1850, as many as 199 of our whalers passed Behring's Straits, with a larger number of men on board than is usually employed by the whole marine of our country; and during the same period the total value of oil procured amounted to somewhere about three millions and a half sterling. It is needless to say how greatly so numerous a body of men, exposed to all sorts of dangers, would be benefited by an instant communication between Behring's Straits and San Francisco.

Thus, a telegraph between San Francisco and St. Petersburg would be the medium of numerous communications to and from all intermediate points, in addition to those which could be conveyed by a submarine line across the Atlantic. And it is easy to see that it might soon become a main line of telegraphic communication all round the habitable globe; for, having connected two places separated by so vast a space and such a variety of apparently insurmountable obstacles, it would be a matter of comparatively little difficulty to carry on lines from

Petersburg to all the principal cities of Europe. In time, branches might be extended over the civilized regions of Asia, the vast territory of India, and ultimately even to the inhospitable empire of China.

By some one of these methods we cannot but think the idea of an electric telegraph round the world might be reduced to practice, and thus a great system of international intercourse, carried on with all the rapidity of thought itself, might ultimately pervade the whole earth, banishing discord, and bringing about that happy millennium of universal peace and prosperity for which humanity is ever sighing."

Art VI.—DECISION OF SUPREME COURT OF THE UNITED STATES.

F. O. J. SMITH *vs.* H. B. ELY, HENRY O'RIELLY, *et al.*

Decision was rendered February, 1854.

THIS suit reached the United States Supreme Court from the Circuit Court for the District of Ohio, on a division of opinion of the Judges therein. The case originated on an application for an injunction by F. O. J. Smith, representing Morse patents for the American Electro-Magnetic Telegraphs, against Henry O'Rielly and associates, requiring the said defendants to desist from the use of the Morse patents, on the lines built by said O'Rielly, under his contract with Morse of 1845. The case was argued below fully, and the two judges presiding differed in opinion on some points at issue; this non-agreement placed it in the Supreme Court for a decision in the premises. The case involved all the points that were in the case from Kentucky, and this decision refers to that case for further particulars.

The cause was ably argued in the Circuit Court, and for this and other reasons, the Supreme Court denied the defendants the privilege of re-arguing it before that body. The counsel for the defendants presumed they had some technical advantage of the plaintiffs in the pleadings, and therefore hoped to re-argue the case; but the Chief Justice very justly rebuked that disposition of the counsel, which will be seen in the latter part of the decision. We presume it will have a good effect upon members of that bar, deterring them in future from seeking the technical advantage of justice within the pale of that sacred temple. We did intend to give a definition of the legal terms in the decision, but in order to do that we should have to extend our number to several hundred pages. We therefore give it without any further remarks. EDITOR.

Mr. Chief Justice TANEY delivered the opinion of the Court.

The plaintiff in error is the assignee, within a certain tract of country, of the two patents granted to Morse for his Electro-Magnetic Telegraph—one in 1840, and the other in 1846, and both re-issued in 1848. And this action was brought in the Circuit Court for the District of Ohio for infringements of both of these patents, within the limits assigned to the plaintiff.

The defendants did not proceed in their defence in the manner authorized by the act of Congress, but pleaded the general issue, and seventeen special pleas. Upon some of these pleas issue was joined, and others were demurred to; and upon the argument of the demurrers, the judges of the Court were divided in opinion on the following questions, which they have certified for decision to this Court:—

I. Upon the demurrer to the sixth and seventh pleas, respectively, whether the said letters patent to the said Morse are void, for the reason that the same do not on their face respectively express that they are to run for fourteen years from the date of the patent issued to said Morse in the kingdom of France.

II. Whether upon the demurrer to the eighth, ninth, and eighteenth pleas, said letters patent to said Morse assume, as to the matter alleged in said eighteenth plea, to patent a principle, or a thing which is not an art, machine, manufacture, or composition of matter, or any improvement on any art, machine, manufacture, or composition of matter; and if so, whether, and to what extent, said letters patent, or any part thereof, are void in consequence thereof; and also whether said pleas are bad, respectively, for the reason that they assume to answer certain material and substantial parts of the plaintiff's claim, without averring that there are no other material and substantial parts embraced in his claim, which can be distinguished from the other parts averred to be so claimed without right, and on which he would be entitled to recover.

III. Whether, upon the demurrers to the fourteenth and fifteenth pleas, said patent, issued April 11th, 1846, and re-issued June 13, 1848, is void; and if so, to what extent; for the reason that it embraces as a material and substantial part thereof, a material and substantial part of a former patent issued to said Morse.

IV. Whether upon the demurrers to the eighth, ninth, fourteenth, and fifteenth pleas, said letters patent issued to said Morse are void, for the reason, as averred in said pleas, that he was not the original and first inventor of the several matters in said pleas respectively set forth; but the same had been, prior to said invention by said Morse, known and used in a foreign country.

The questions certified, so far as they affect the merits of the case, have all been substantially decided in the case of Morse and others *vs.* O'Rielly and others at the present term. But several questions are presented by the certificate upon the construction of the pleas and the extent of the admissions made by the demurrers, and the legal effect of such admissions upon the plaintiff's right of action.

In relation to the questions which go to the merits, as they have been already fully heard and decided in the case above mentioned, they are not open for argument in this case. And it would be an useless and fruitless consumption of time to hear an argument upon the technical questions alone. For, however the points of special pleading might be ruled by this Court, they could have no material influence on the ultimate decision of the case. Because if it is found that errors in pleading have been committed by either party injurious to his rights, an opportunity ought and would certainly be afforded him to correct them in some subsequent proceeding, so as to bring the real points in controversy fairly before the Court.

For these reasons, the motion of the counsel for the defendants for leave to argue the points certified is overruled, and the case remanded to the Circuit Court.

Under such circumstances, we deem it proper to remand the case without argument to the Circuit Court for the District of Ohio, where either party may amend his pleadings, and where the defendants, if they can distinguish their case from that above mentioned, will have an opportunity of being heard.

Art. VII.—A NEW TELEGRAPH BATTERY.

THE ELEMENTS OF THE GROVE, DANIELL, AND SMEE BATTERIES—THEIR RESPECTIVE POWERS—BATTERY OF QUANTITY AND OF INTENSITY—A NEW BATTERY PROPOSED.

BY CHARLES T. CHESTER.

THE battery has not received from telegraphers the attention due to its importance as generator of electrical power—that fountain-head of the subtle fluid, which courses over wires, and animates our machinery. Innumerable varieties of instruments, insulators and conductors, have been tested, and improvements are being constantly made upon them; but the battery now generally used is the same that was employed during the infancy of the telegraph enterprise. Its power and general reliability have made its friends lose sight of the fact that its expense is altogether disproportioned to the work it accomplishes. It is

troublesome, unhealthy, and inconstant, requiring frequent attention and renewal.

My attention was called, some years since, to the great waste of battery power, and to the means of preventing it. From many experiments, I was led to infer that the amount of electricity used on lines was exceedingly small, and that the great consumption of battery material was due to some other cause than the demands of the line, and that if a perfect battery could be constructed this fact would be proved. In submitting the battery that is the subject of the present sketch to the most severe practical tests, these ideas have been entirely sustained.

Without entering upon any history of the forms of galvanic batteries used in the early history of electrical science, I will briefly describe those now used for telegraph purposes in the United States, premising a notice of the principle on which they all generate the electric current. They all demand the presence of two metals and an exciting fluid—one metal acted upon by the fluid, the other negative to its influence. Place in a tumbler containing an exciting fluid, say sulphuric acid and water, two metallic plates, zinc and platina. Upon touching these plates together, an electrical current passes from one to the other, and through the fluid. The water is resolved into its two elements—oxygen going to the zinc, forming oxide of zinc, and hydrogen to the platina, and thrown off in bubbles of gas. In all galvanic batteries this same decomposition must take place. The oxygen of the water going to the zinc, and its hydrogen being disposed of at the platina plate, or its substitute or equivalent. Upon the different modes of disposing of the hydrogen thus set free depends one important element of power in batteries. I say one element of power. They may possess the power due to *quantity* or *intensity*. The *quantity* of electricity developed by any galvanic battery depends practically upon the size of the plates used. The *intensity* is the force with which this quantity is brought to bear upon anything to produce a given result—its *energy* in overcoming obstacles, impediments to the free passage of the electric current. And this intensity is generally acquired by increasing the number of cells, and is proportioned to that numerical increase.

I will now briefly describe the construction and operation, the anatomy and physiology, of the three batteries that have been used on telegraph lines, with particular reference to showing the different modes adopted to dispose of the element hydrogen. In Grove's battery, a tumbler holds a dilute sulphuric acid; within this stands the zinc cylinder; within the zinc a porous cup, holding nitric acid, into which dips a slip of platina. In this arrangement, the hydrogen of the decomposed water enters the nitric acid cell, decomposes an equivalent of the acid,

forming water with one equivalent of its oxygen, while deutoxide of nitrogen is given out as a gas, and, coming in contact with the air, is converted into nitrous acid fumes. Thus, hydrogen is absorbed, as it were, by the nitric acid, and the battery is efficient or intense in proportion to the strength of the nitric acid. In Daniell's battery, a cylinder of copper is immersed in a solution of sulphate of copper. Within the copper cylinder is a porous cup, and within the porous cup a very weak sulphuric acid, into which a cylinder of zinc is immersed. In this battery, the hydrogen from the decomposed water unites with the oxygen of the decomposed oxide of copper, forming therewith water, while metallic copper is deposited upon the copper cylinder. In this operation, hydrogen is absorbed, as it were, by the sulphate of copper, and the stronger the solution of sulphate of copper, the greater is its absorbing capacity, and, as in Grove's, the battery is efficient and intense in proportion to the strength of this absorbing agent; and here is to be found the source of the superior constancy of this arrangement over Grove's. The sulphate of copper solution acquires its greatest absorbing capacity when it is a saturated solution. Now, by keeping up this saturation, the strength is sustained, and this is accomplished by keeping a constant extra supply of crystals in the sulphate cell. In Smee's battery only one solution is used, dilute sulphuric acid, and into this both plates of the battery dip. They are zinc and platinized silver, or platina. The efficiency of this battery depends upon the peculiar platina coating of the negative plate, which enables it to throw off hydrogen easily in the form of gas. The better this surface, the more intense the battery.

Since, then, the intensity of all forms of galvanic batteries depends upon the ease with which the hydrogen of the decomposed water is disposed of, their efficiency is lost when from any cause this theoretical consideration is neglected. Allow a Grove's battery to remain up a few days without any renewal, and then join the poles by a good conductor and short circuit, and you will hear a violent hissing within the porous cups, and notice bubbles of gas clinging to the platina foil. This is due to the fact, that the nitric acid, having been weakened, ceases to act as an absorbent of hydrogen, and the gas is thrown off. Cease feeding a Daniell's battery with crystals of sulphate of copper, and its strength goes, because there is nothing to absorb the hydrogen, and a common old form of copper and zinc battery might just as well be substituted at once. These facts are well enough known practically to all who take care of telegraph batteries.

A battery's *quantity*, then, depends on the size of its plates, its *intensity* upon the number of cells, and the ease of hydrogen

absorption. The minute *quantity* necessary to work the sensitive magnets of a telegraph line is not generally understood, although on some lines the same battery is used to generate the current for very many different and diverging lines. I have worked a telegraph line of eighty miles with a battery exposing plates about one quarter of a square inch in surface. Probably the present telegraph battery could, if properly constructed, work well if only one fortieth of its present size. The local circuit, however, requires a large *quantity*. The *quantity* is proportioned to the volume of hydrogen liberated or absorbed in any form of battery that liberates hydrogen. It is easy to measure this quantity. If the battery is thrown into the local circuit, violent ebullition ensues; the platina plate is covered with a cloud of gas; but in the main circuit not the minutest bubble can be detected for many minutes; and this is true on a comparatively short line, embracing only two relay magnets and a few miles of wire. These facts lead us to the inquiry, What is the real cause of the immense decrease of power in ordinary telegraph batteries, and the immense consumption of material to supply this very feeble quantity current? The quantity that should be drawn from the use of the battery force consumed during one year, would, if properly economized, suffice for the working of our lines at least two hundred years. This assertion can be easily proved. A former number of the TELEGRAPH COMPANION gives as an estimate of the average durability of Grove's battery: zincs, three months. Say they last six months, then half a pound of zinc a month is consumed, with its equivalent of expensive acids. In another form of battery, however, during one week's use, supplying the current upon one of the wires from New-York to Boston, a zinc was found to have lost but six grains. At this rate, one pound would last about twenty years. Other experiments, carried on through twenty-two months, confirm this astonishing result. With only ordinary care, and on very active service, they have been in use constantly twenty months, and yet in fine order, and ready for another year's work. The question again comes up, whence the great consumption in ordinary batteries? It is chiefly due to *local action*. In the construction of Grove's battery, two acids are used, separated by a porous vessel. The nitric acid passes through this, and corrodes not only the zinc, but also the mercury. The sulphuric acid also passes into the nitric cell, weakening that acid, and making it incapable of absorbing hydrogen. After a time, the two acids become completely mixed. Nor is this all. The zincs touch the porous cups, the flange of the cups is covered with acid. The arms of the zincs frequently come in contact with the cups, and so, a cross-fire in each cell, a little separate current in each tumbler is set up, destroying

the battery, and opposing the main current. In Daniell's the effects are analogous; but rather worse, as the cells are so large, and copper commences forming on the porous cup thirty-six hours after the battery has been at work, destroying its structure, increasing local action by freer percolation, and making it ruinously fragile.

In Smee's arrangement, the wooden supports become saturated with moisture, from the creeping up of the acid salts, and cross-fire is soon set up, rapidly destroying the zincs. Another difficulty, only partially remedied, is incident to telegraph batteries. The inside of the glass becomes covered with moisture, forming a slight external connection from cell to cell. To test the decrease of power from local action and the relative intensity of various batteries, an electro-dynameter was used, so constructed as to show by degrees on dials the force of powerful electric currents. This instrument was applied to Grove's battery the instant it was set up with fresh acids, again after twenty-four hours, and after two and four days. The results were very variable. This battery is most intense immediately after it is set up. It declines very rapidly at first; then, after twenty-four hours, more slowly; but, at the end of four days, it generally dies off very suddenly. But the number of cups in the series affect these results very sensibly, since a series of eight or ten will take three times as long to lose one-half their force as a series of fifty. The figures below show the power of the current at different times, and represent the degrees upon the dynameter scale.

Number of Cups.	Fresh.	Two days.	Three days.
10	35°	25°	13°
20	56°	41°	23° 30′
30	71°	49°	29°
40	85°	58°	37°
50	95°	67°	47°

But it is impossible to say what is to be the strength of the battery, after a certain time; and two batteries cannot be depended upon to give the same results; at least, I have found the most unequal power from different batteries that should have performed equally well.

I now pass to a consideration of a new form of battery, for which a patent was applied for by the writer of this article, February 10th, 1854. This battery, while it does away entirely with local action, employs the cheapest materials and the most convenient arrangement of parts. Its cells are large, of strong glass, and they are insulated from the shelves by a partial coating with electrophorus. Its metals are amalgamated zinc and a peculiar platinized and peculiarly insulated plate, the result of

much study and experiment. The plates are supported by metal clamps and thoroughly insulated wood. The construction is such as to secure perfectly against any cross-fire. The plates can be removed and cleaned separately, without stopping the working of the battery. The solution used to excite it is a dilute sulphuric acid. How free it is from local action may be inferred from the fact, that it has been in constant use for five months without being taken down, and that the zincs last such an unprecedented time. The relative cost of working these three batteries, without taking local action into consideration, supposing each equally free from local action, is as follows; and the estimate is made up from actual experiment, by computing the destruction of battery material in each, necessary to accomplish a given equal amount of work—say the deposition of a pound of silver in the decomposition trough. To accomplish this, Grove's consumes—

$1\frac{1}{2}$ pounds nitric acid, at 12c.	18 cents.
$1\frac{1}{4}$ pounds zinc, at 10c..	$12\frac{1}{2}$ "
1 pound sulphuric acid	2 "
	$32\frac{1}{2}$ cents.

Daniell's consumes—

4 pounds sulphate copper, at 11c. .	44 cents.
$1\frac{1}{2}$ pounds zinc	15 "
1 pound sulphuric acid	2 "
	61 cents.

The new battery—

$1\frac{1}{2}$ pounds zinc	15 cents.
3 pounds sulphuric acid	6 "
	21 cents.

Such is the ratio of expenditure to produce a given result within as short a time as possible. But, extend the same operation through a long time, say six weeks, and Grove's and Daniell's would be powerless, the former giving out within a week, the latter in two weeks, or as soon as the sulphate of copper should be used up. The new battery would have lost but half its strength—no more, indeed, than should be due to the power derived from it.

To speak more particularly of the peculiarity of this battery, as regards economy and convenience—

First—It admits of using a quality of zinc altogether better than the cast zinc in common use. The experience derived

from casting ten thousand zincs, convinces me that it requires the greatest care and experience to secure a perfect and sound casting. Zinc can only be rolled at a temperature between 250° and 300°; and it must be cast, too, at a certain temperature. Hence, any battery-keeper will tell you that some of his zincs last twice as long as others. The zinc used in this battery is rolled, and is much more dense and homogeneous in structure, and must be of the best quality.

Secondly—The acid is the cheapest that can be used, being a mixture, costing only one cent per cup for a month's supply.

Thirdly—Mercury is not consumed. Every particle more than necessary for amalgamation is recovered, falling clean and pure to the bottom of the tumblers.

Fourthly—The ease with which the battery is managed renders unnecessary the employment of rooms especially for its accommodation, since no poisonous fumes are evolved, and it is perfectly cleanly.

Fifthly—All the attention required being about one hour every week, and two or three hours at the end of a month, the battery-keeper's services can be performed at any time, and during the day instead of at night.

Sixthly—No expense nor dirt accompanies broken vessels.

The conveniences of this battery are worthy of consideration.

First—It comes into active play the moment it is put together.

Secondly—It can be renewed with greater speed than any other form of battery.

Thirdly—It can be entirely renewed without interruption to the current. Each plate can be taken out separately, and replaced by a fresh one by a very simple contrivance. So also all the acid, or the denser portion of the used-up acid, is removed easily with a syphon and replaced by new. Thus, one-third can be drawn off and fresh supplied, without affecting the current; and thus the battery may be rendered constant for years without taking down.

Fourthly—It is so clean that the operators would have little objection to take care of it.

Fifthly—It gives evidence of the work it is performing, as well as any error in connection, or any accidental cross-fire, by the appearance of the plates.

Sixthly—Its current is uniform and constant. During the first week it diminishes slightly in power. After this it retains this power of the first week for about three weeks, without any change. If renewed a little every week, it remains absolutely constant.

Seventhly—Being so easy of management, it can be more dif-

fused through lines, if thought best, avoiding the necessity of keeping up immense batteries at terminal stations.

Eighthly—It also enables the operator, in a short time, to vary at pleasure the *quantity* of battery-force he may desire to use, since larger or smaller plates can be used, or the same plates can be immersed more or less in the solution.

We now come to consider its value as regards intensity, in comparison with Grove's. And here we must ask, What is a Grove's battery in use upon telegraph lines? It certainly is not the battery as first put up with fresh nitric acid, for, to keep up that strength, you must put in entirely new acid every twelve hours; and in practice, this is only supplied once in two weeks. A battery that has been used three days is considered, by most experts, of average power. The degrees below exhibit the power of the new battery after four days' use, and are degrees of the dynameter dial:—

Number of Cups.	Degrees.
10	6°
20	15° 45′
30	22°
40	31°
50	37°
60	41°
70	44° 30′
80	48°

A comparison of these figures with those representing the power of Grove's, establishes the remarkable fact that the new battery increases faster in intensity as the series progresses than Grove's; and hence the power of the two batteries in ascending series approximates. But while the new battery requires a much greater number of cups to accomplish a given intensity than the nitric acid arrangement, this intensity, no matter how great, can be obtained to any extent, and much more rapidly, as the series extends; and once obtained, it becomes a fixed fact. A series of one hundred and twenty-five cups had not lost one-twentieth of its power in four days; and the extent of the series has not the slightest tendency to produce cross-fire, one hundred and twenty-five cups in one series being as quiet as five cups. Whereas, the number of cups in a series of Grove's effects cross-fire in a geometrical ratio, as we have before seen. As practical test of the battery, it has worked from New-York to Boston twenty-three days, under my supervision, supplying the current night and day during that time. Two hours' time has been spent in taking care of it since first setting it up; and about three ounces of zinc have been used. It has also worked from New-York to Philadelphia, without taking down for two

months, only demanding a trifling attention once a week. It is also working the extended circuit from New-York to Buffalo with perfect success. Its practical working has confirmed the theory, and realized the most sanguine expectations of its inventor.

Art. VIII.—RAILROAD BRIDGE AND SWITCH TELEGRAPH.

We give below some extracts from the "Journals of the Franklin Institute of the State of Pennsylvania," relative to a telegraph system invented by Mr. William C. McRea, of Philadelphia, for railroad purposes. We understand that the inventor is one of the practical and well-informed telegraphers, and is worthy of the most liberal consideration of gentlemen engaged in that science and art.

While we entertain the expectation of early witnessing the application of the art of telegraphing to the purposes of railroads, we cannot well understand how the measure can be consummated at the small expense we have frequently seen estimated. With proper care, and perfectly insulating the conductors, the telegraph can be made to subserve the most commanding wants of the railroad enterprise, by preserving life, economy, and regularity of running.

We shall be pleased to hear of the experiments in railroad telegraphs, and hope Mr. McRea will favor us with all the particulars.

EDITOR.

"HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, *October* 13*th*, 1853.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Railroad Drawbridge and Switch Safety Telegraph, invented by Mr. Wm. C. McRea, of Philadelphia, Pennsylvania,

REPORT:

That in this contrivance, an electric current is arranged so as to be closed when the drawbridge is in proper position, and to be broken when this is not the case. The wire terminates in a rail carefully isolated from the rest of the track, and at such a distance from the bridge as to allow ample room for stopping the train of cars between them. The next rail to the one spoken of is also isolated from the track, and connected with one of the ground plates of the circuit. On the locomotive is placed an electric magnet of the ordinary construction, whose keeper controls the works of an alarm, so that the bell, stopped while

the keeper is not attracted by the magnet, is released, and allowed to ring the moment that this attraction takes place. The wire of the coil terminates in metallic connection with the front and hinder axles of the locomotive. And it will be easily seen that when the locomotive reaches such a point that the fore wheels are on one of the isolated rails, and the hind wheels on the other, the electric circuit (provided the drawbridge is closed) is completed through the magnet and the bell rings, indicating that it is safe to proceed; but if the drawbridge or switch is open the bell will not ring, for the electric circuit is not closed, and the conductor is warned to stop, or to proceed with caution.

The means proposed for obtaining this important end are simple and not expensive, and the idea is certainly a very ingenious one—and it will be observed that the result of any failure in the apparatus is simply to excite the cautiousness of the conductor—the safety signal cannot be given unless everything is in order. This constitutes, in the opinion of the Committee, the very great merit of the contrivance.

In practice, the difficulties which suggest themselves will be in perfectly isolating the rails, especially in low situations, or in very wet or icy weather; and secondly, the arranging the extremities of the magnetic coil so that the current from the wire will pass through them. There can be little doubt that the grease on the well-oiled axle of a locomotive will prevent the passage of an electric current of such feeble intensity; and if it did not, it would pass through the pedestals and iron work of the engine to the other axle, and thus escape the magnetic circuit; but the avoidance of this objection will probably be easy; and the simplicity of the apparatus, and importance of the result to be obtained thereby, recommend Mr. McRea's invention to a practical trial.

As soon as these objections were proposed to the inventor, he suggested a mode of obviating both of them, by terminating one end of the magnetic coil on a rod projecting downwards from the cow-catcher, the other on a rod projecting similarly from the hinder frame of the engine, and setting the insulated rails on the middle of the track, where they can easily be completely insulated. It would also be advisable that a signal be given to the switch or drawbridge tender, to prevent the possibility of his opening the switch or bridge after the engine had passed the signal station, but before reaching the point of danger.

Mr. McRea has also proposed a modification of the apparatus for avoiding the collision of trains on a single-track road. At the turn-out at each extremity of the part of the track on which the trains may meet, the insulated rails are prepared as before, but at each point the wire is provided with a "circuit-changer,"

as shown in the accompanying drawings; the battery has a double circuit, each including one of these "circuit-changers." The ordinary position of the "circuit-changer" is such that the current to which it belongs is interrupted. Now, the conductor of the train who first arrives at one end of the prepared track, shifts the "circuit-changer" by a simple motion, and thus passes a current from the distant station through his magnet, and the ringing of the bell indicates that he may proceed in safety. In proceeding, he leaves the circuit-changer in its new position, by which the circuit at that end is broken. If now, while he is on the doubtful ground, the other train arrives, and the conductor shifts the *changer* at that end, he can get no circuit, and consequently his bell is silent—for it will be seen by the drawing that the current must come from the far station, and that has been thrown out by the first train in passing. He must, therefore, wait. As the trains pass off the ground, they must stop to re-adjust the "circuit-changers" in their first position. It will be seen here, again, that any failure of the apparatus, or negligence in its adjustment, can only produce delay, and that provided the first conductor performs his duty a collision is impossible. These changes may, it is manifest, be easily made by the locomotive itself, if that be deemed desirable.

The Committee therefore report that the invention of Mr. McRea appears to present a simple and not expensive means of adding materially to the safety of railroad travelling, and that it is in their opinion worthy of trial in practice, which is the only thing which can finally decide upon its utility; and they recommend that a description of the instrument be published in the Journal of the Institute.

By order of the Committee.

W. Hamilton, *Actuary*."

Art. IX.—THE GROVE ELECTRIC BATTERY.

REMARKS ON BATTERIES—WARNING TO COMPANIES TO BE CAREFUL IN ADOPTING ANY NEW BATTERY—RULES FOR BUILDING AND KEEPING UP A GROVE BATTERY.

This battery is in general use over America, though on a few lines the copper battery—commonly known as the Dutch battery—is in operation. Whether or not any other battery now known is superior to the Grove series, is a question that we are unable to decide. We do not advise any line to abandon a well-tried battery to enter the field of experiments. Nearly every telegrapher in the United States has invented an insulator, and many lines have been ruined forever by the sad

experiments. Fortunately for the enterprise, there has been but little effort to change the battery. There is a feeling prevailing throughout the country, tending to encourage experiments, however, and we now timely warn the managements of lines to stand aloof from any untried battery. Let them be well tested, and thoroughly established as better than the Grove, before adopting them.

That there will be devised a galvanic battery of equal powers and of less expense than pertains to the one now in use, we have not a doubt; but, that every one recommended will subserve the ends in view, we do not for one moment believe. Many of the managers of lines know but little as to batteries, and do not pretend to be experts in the science. They leave such questions to their operators, and unfortunately an occasional indiscretion brings with it sad results.

In writing thus, we do not wish to be understood as uttering one word against those batteries mentioned in the present number. The battery proposed by Mr. Carpenter, of Rhode Island, has not been applied, and therefore it remains a question, requiring demonstration, as to its efficiency in telegraphing. The one proposed by Mr. Chester, of New-York, has progressed in experiment for some months, and has proved, thus far, quite successful. It has been put on a circuit form New-York to Boston, some two hundred and forty miles, but its application has been conjunctively with the Grove battery at other places on the line. How it would work on a line with circuits of four and five hundred miles we know not, nor can we express any opinion about it. We hope it will answer, and if so, the economy in its use will be many thousands of dollars per annum. We can see nothing preventing its success; but electricity is an element of nature so little known, that facts cannot always be obtained by abstract reasoning—practical experiments are the sure tests. We do not know the constitutional parts of the battery proposed by Mr. Chester, and therefore cannot speak as to its cost further than he has seen fit to give in a preceding article. We have seen it operate and admire it very much, and earnestly hope it may succeed.

In conversation with Dr. J. Lawrence Smith, at the Smithsonian Institute in Washington, we learned that a Smee battery would answer for telegraph purposes on short circuits, and with some alterations, might be made very serviceable. Instead of having platinized silver, lead, and various other less valuable metals, may be platinized, and thus a very cheap Smee battery can be made. In a few months, we feel confident, some plan will be devised to rid the lines throughout the country of much of the expense and trouble now incurred in the use of the Grove battery, either by the substitution of a new,

or of some improved arrangements connected with the known science.

Many gentlemen have peculiar plans for maintaining the Grove battery. We give below the manner of building and renewing it, at one of the principal offices on a line of which we were acting as President, deeming it about the most economical mode in the premises. EDITOR.

BATTERY-KEEPER.—The battery-keeper shall have charge of the battery of each line, and see to its construction according to the following system, and to be in readiness at the required working hour in the morning.

Before using zincs in battery, they should be well amalgamated with crude mercury. The mercury penetrates immediately if zincs are first immersed in water strongly acidulated with muriatic, sulphuric, or other acids.

To the water in tumblers, add about 1-30 part sulphuric acid for ordinary use. To prevent freezing, and to remove the oxide which may form very rapidly from having strong ground connection on line, add a larger proportion of acid. The *excess* of oxygen corrodes zincs, and soon destroys the efficiency of the battery.

When the battery is once set at work, the following rules shall be observed in taking care of it:—

Empty acid of porous cups into a vessel every night, and keep closed until morning. Remove zincs from the tumblers, and set them in water slightly acidulated (with sulphuric), to remain over night; if not bright in the morning, make them so.

In the morning, add a porous cup full of nitric acid, for every ten cups used in battery, having first poured out a portion of the old, if there be an excess.

To make the battery still stronger, add more pure nitric, and make water in tumblers stronger with sulphuric.

The water in tumblers should be changed twice a week.

NEW-YORK, *April 28th*, 1854.

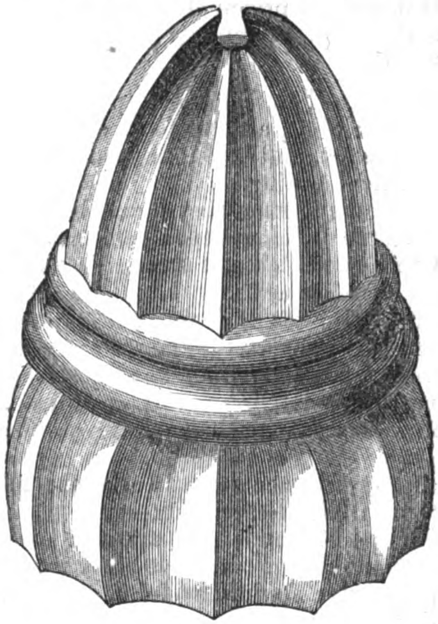
MR. TAL. P. SHAFFNER:

Dear Sir:—A specimen of the nitric acid sold by the American Telegraph Confederation was given to me a few days since, for qualitative examination. I subjected it to the usual chloride of barium and nitrate of silver tests, for the presence of sulphuric or muriatic acids, without detecting a trace of either. I then compared its strength (by the alkalimeter) with that of the best commercial acid I could get at a drug store, (price 18c.), and found it only 5 per cent. weaker. Baumer hydrometer gave 42°, specific gravity 1·414.

Very respectfully, &c.,

CHARLES T. CHESTER.

Art. X.—WHITE FLINT INSULATOR.



INVENTED BY E. B. ELLIOTT.

The importance of good insulation is not likely to be overestimated. It is, in fact, the prime and essential requisite of a successful telegraph line. Without it, however well a line may be constructed and operated, it can never attain to permanent prosperity.

The ——— line was built at an expense quite adequate to the construction of as perfect a line as any in the Union. From the start, it worked very irregularly—never during a continuous rain—and its unfortunate reputation was soon thoroughly established. It lingered on in this way, never half paying expenses, till it was sold under the hammer for debt—the original stockholders realizing a dead loss. The purchasers re-insulated the line, and made it comparatively reliable, and it soon improved in reputation, and secured a profitable and constantly increasing business.

This, with slight variations, is the substantial history of many telegraph lines. Whatever other defects of materials or construction may have contributed to these untoward results, the

great leading and ruinous defect in all these instances has been *imperfect insulation*. No one conversant with the history of telegraph lines will fail to confirm this statement, by instances occurring under his own observation. That these evils should have been so general heretofore, is not perhaps remarkable, when we recollect that contractors and builders of lines have often been ignorant of practical telegraphing, and have had no other interest in the lines but to make the most out of their contracts.

Latterly, there has been decided improvement in this respect; but we have not yet reached perfection, nor even a very near approximation to it. Those who make the most constant use of the telegraph do not trust to it in rainy weather. They have learned by experience that it is then always slow, and often quite uncertain. This is not a mistaken prejudice. It is a fact, that many lines—perhaps the majority—do not work successfully through ordinary storms, on account of defective insulation.

What is the best insulator is, therefore, a question of some importance. The earthen, wooden, and other insulators, whose non-conducting capacity is wholly superficial, and easily destroyed, have come to be correctly appreciated, and we need not enlarge upon their defects.

The plain glass is a good insulator while it continues whole, but it is fragile, and needs to be often replaced. An experienced line-repairer estimates that, while passing regularly over one hundred miles of line, put up with large glass insulators, he finds ten or more broken at every trip; showing that the line, though constantly attended to, can never have a perfect insulation without a more durable insulator.

Glass, protected by an iron cap, is extensively used, and has its advantages. But I find a growing distrust of this insulator among experienced telegraphers, on account of the difficulty of determining when they are defective. In many cases defects can only be detected by a close examination of each insulator—a slow and expensive process. I confess I prefer the smallest and poorest plain glass insulator, to the best iron-capped insulator I am acquainted with.

The White Flint Insulator, invented by E. B. Elliott, Esq., of Boston, has recently been brought into favorable notice by the medals and diplomas conferred upon the inventor, by the Crystal Palace Exhibition in New-York, and the Massachusetts Mechanics' Fair in Boston. The following figures represent some of the most approved patterns of this insulator.*

* The figure at the head of this article gives a front view of the heaviest pattern. The other figures give sectional views of the different patterns, and the numerals show the measurements, in inches, of the sockets, etc.

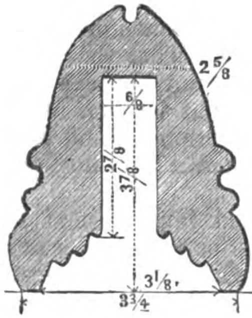


Fig. 1.

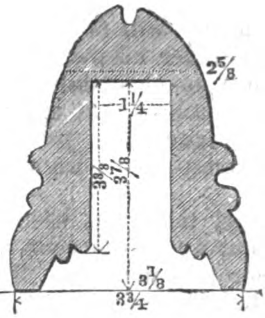


Fig. 2.

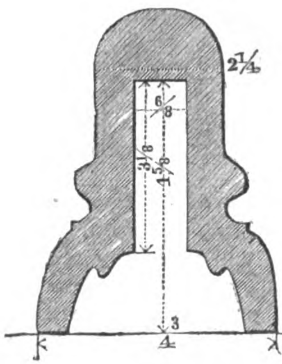


Fig. 3.

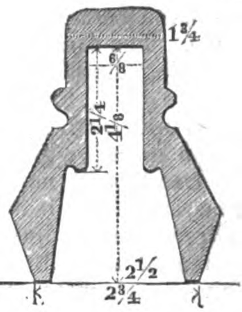


Fig. 4.

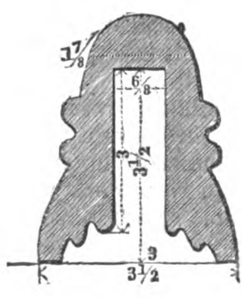


Fig. 5.

The great excellencies of this insulator are, that the material is anti-porous, is vitrified throughout, and is as perfect an insulator as glass, while it has many times the strength of the best flint glass, so that it needs no iron protection. Indeed, you may strike it against the ordinary iron-capped insulator, and the iron and glass will be shivered to fragments, while the White Flint is uninjured. Bullets fired against the outer surface are flattened, without fracturing the insulator. Of course it *can* be broken. But it is unquestionably very tough, and not liable to be broken under ordinary circumstances. In this respect it is a superior insulator. The interior corrugations prevent the accumulation of continuous lines of moisture in damp weather.

This insulator is cheaper than any iron-capped insulator of equal strength, and although the first cost is rather more than glass, it is in the end much cheaper, because its durability obviates the expense of frequent renewal, and the still greater loss consequent upon the imperfect working of lines in rainy weather. I have not seen *one* upon the line so broken as not to remain a good insulator. None of No. 1 have been broken, and a few only of the smallest pattern, that had been frequently assailed with missiles, had lost fragments of the rim, but were still whole for half an inch or more below the groove, to which the wire is attached. Line-repairers also mention as an advantage, that the contrast of the white flint with the wire shows at a distance the exact position of the line and the wire, making it easier to examine the line while passing over it rapidly. This is specially important to lines built upon railroads, which must, of necessity, be examined with great rapidity when interruptions occur.

If I were about to build a new line, I would use No. 2 of the above on a pin of hard pine. This would afford an insulation *practically perfect*, and as cheap as any good insulation can be. I should expect to see a line thus insulated, working well in weather when most lines entirely suspend operations, or are worked with extreme difficulty.

The use of wooden pins instead of iron, besides the additional insulation, would also avoid the frequent splitting of poles by lightning, from which many lines suffer severely in the hot season.

For the reasons imperfectly alluded to above, and others that will be obvious to the candid reader, I prefer the White Flint Insulator to any other, and I invite the attention of telegraphers to its merits. It seems to me to possess all the essential requisites—perfect insulation, strength, durability, and economy.

J. E. H.

Boston, April 22.

Editorial.

OUR ABSENCE TO EUROPE.—Ere the present number reaches many of the subscribers, we shall probably be in Europe. We sail about the middle of May, and will be gone about six weeks or two months. Owing to this absence, the June and July numbers of the COMPANION will be issued together, immediately after our return. We hope the subscribers will be satisfied with this arrangement. We promise to tell them much news about the telegraph, in numbers to be issued after we get home. We go to Europe on telegraph business, and expect to be able to inform the American telegraphers all the news pertaining to the art, that can be gathered from the practice and experience of those engaged in the business across the ocean. Adieu.

MR. REID ON THE OCEAN LINE.—In the January Number of the *Review*, the Editor, Mr. Reid, expresses himself very frankly that he will not give the subject of the Ocean Telegraph any "serious faith." We do not object to his determination. But let us look at his reasoning for a moment.

He says, viz.:—"Would Mr. S. risk a cable, such as that found necessary to span the inland waters of a mile in width, under which a soft and protecting bottom is so easily found, to the caprices and unknown powers of an under-ocean, *where the heaviest cable may float, without gravity to reach the ocean bed?*"

Now Mr. Reid may be very correct; then, again, he may be as far from the facts in the case as the poles of the earth are from each other. Above, we have given Mr. R.'s opinion of the ocean, that the "cable may float without gravity," &c. Lieut. Maury has for many years studied the ocean currents, and probably understands the question better than any other gentleman. Here is what he says, viz.:—

"From Newfoundland to Ireland, the distance between the nearest points is about 1,600 miles; and the bottom of the sea between the two places is a plateau which seems to have been placed there especially for the purpose of holding the wires of a submarine telegraph, and of keeping them out of harm's way. It is neither too deep nor too shallow; yet is so deep that the wires, but once landed, will remain for ever beyond the reach of vessels' anchors, icebergs, and drifts of any kind, and so shallow that the wires may be readily lodged upon the bottom."

Here we have the opinion of Mr. Reid, that the cable "would float," and the opinion of Lieut. Maury that it "would sink to the bottom of the ocean." The former gentleman has certainly spoken before his time on this question.

Whether or not the scientific world will cease all efforts to cross the ocean with a cable, influenced by the arguments of Mr. Reid, time alone will determine.

Again Mr. Reid says—

"To connect this mighty cable on the high seas, though apparently of small matter, may have in it the elements of great danger."

From these remarks, we judge that he contemplates great storms, and high seas; but is he not aware that the storms of the seas have become a matter within the computation of man? Do not vessels now make their voyages in much less time than in years gone by? Is not this grand consummation the result of a knowledge of the localities of the storms, and of the time to avoid them? In this, Mr. Reid is far behind the age. He started with the telegraph; but science has passed him, while perhaps he was sitting beneath some stately pine in the sunny South, "while the gentle zephyr wafted the tiny leaves of the fragrant rose by his side." While he gazed upon the rose, admiring its beauties, science passed, thinking him a wearied and worn-out pilgrim by the wayside.

Mr. Reid says:—

"The British cable was made in twenty days and nights. Our transatlantic cable would therefore be completed, at the same rate, in twelve hundred days—say four years."

In answer to this, we have the opportunity to say that a substantial firm stands ready to finish the 1,600 miles in three months. We hope this will dispel his fears on the question as to time required in making the cable. Here again our friend is behind the age, particularly in the mechanic arts.

The shipping of the cable presents in the mind of Mr. Reid an impossibility. He says:—

"We find that 24½ miles of this cable (the British Channel) weighed 180 tons, or, say seven tons per mile. Our cable would, therefore, weigh 10,500 tons!"

Now, the cables may not be alike; and, to increase his powers of wondering, we will inform him that the proposed ocean cable is expected to be one-fourth larger than the one from which he has taken his data. We do not suppose that there will be any trouble whatever in the employment of a sufficient number of vessels. But Mr. Reid goes still further, viz.:—

"Shall they be sail or steam vessels? Sail vessels evidently cannot be relied upon. The sure decay (?) of steam is indispensable. This being so, how many tons of wire cable, laid in the coiled form necessary for easy paying out, could a vessel hold? Could a vessel of 1,000 tons carry over 500 tons of coil? We think not. If so, it will require nearly twenty-five steam-vessels to carry our Atlantic cable!"

As to the use of steam-vessels, and the number of tons each may carry, and the number of vessels, we do not feel inclined to dispute, though in tonnage Mr. Reid is in error. Suppose he is correct in his views on this point, is it any obstacle to putting a cable across the ocean? We care not if it requires fifty vessels to transport and lay the cable! They can be had, even if they have to be built for the purpose; and if it be necessary to build the vessels, they will be most certainly constructed.

Mr. Reid thinks that neither he nor ourself is skilled with engineering talent for so stupendous an undertaking. In this we agree. But does it follow that because neither of us is endowed with the talent, it cannot be obtained in others? Just think of the world standing still, waiting for Mr. Reid and Mr. Shaffner to become capable to manage the progress of science! Such opinions as those uttered by Mr. Reid—a telegraph man—is enough to make the earth groan, the seas froth with anger, and the thunders of heaven descend to the earth and so impregnate his system with brimstone, that old Satan himself will be afraid to admit him within the portals of his laboratory!

J. H. Wade.—An Ohio paper, copying our remarks relative to Mr. Wade, which appeared in the January number, thus endorses what we said of that noble, generous, and sterling gentleman. If the telegraph had none but such, jealousies and ambitious scheming would not curse the system. It has been wisely said, that "the want of concert has been the greatest curse of the telegraph:"—

"Merited Compliment.—The deserved tribute paid in the following paragraph to one of the most energetic and excellent telegraph managers in the Union, we copy from the January number of the Telegraph Companion, an able work, devoted exclusively to the large and growing interests of that important invention, now so essential in the common business and social transactions of everyday life.

Mr. Shaffner, the Editor, and writer of the article, is an old telegrapher himself, and every way competent to give an opinion on the subject worth something. After an intimate and agreeable business connection of several years with Mr. Wade, we are proud to consider him as our personal friend, and prepared—glad of the opportunity—to endorse all that is said of him."

Merited Compliment.—We copy the following from a Wheeling paper. The compliment was well deserved, and we are glad to see such a manifestation of good feeling from a noble body of young gentlemen to one of the worthiest of Telegraph Presidents.

"A Handsome Compliment.—We mentioned the other day, that the operators of the Western Telegraph Company had presented their President, George R. Dodge, Esq., with a handsome token of their esteem, in the shape of a gold-headed cane. The cane is appropriately inscribed, and bears the names of all the operators, viz.:—W. H. Heiss, Freeman Brady, George W. Anderson, George M. Deetz, B. F. Kendall, George M. Williams, James Patrick, G. A. Hall, O. Tweedy, and Wm. Barrett.

The presentation took place at the Sprigg House, in this city, by Mr. Heiss, Superintendent, who spoke as follows:—

Sir—A maxim founded in truth is, that *merit* wins its *reward*. I have been selected as the instrument of presenting you some slight testimonial in proof of this *truism*. My fellow-companions and associate operators of the Western Telegraph Company, over which you preside, have appointed me, in their behalf, to tender you this small, but truthful, evidence of their esteem and regard. The occasion of your re-election, as our presiding head, has seemed to me an appropriate one for the discharge of this agreeable duty. The past has been prolific in its evidences of the deep interest you have

taken in this Company, and of the success which has ensued. You have, sir, triumphed over difficulties almost insurmountable, and now we find the adverse picture transferred into one of prosperity. Patience, long-suffering, and endurance, are the pre-requisites of ultimate success in a new enterprise. These you have endured, and the triumphant result is a crown to your merits. A ship tossed and buffeted at sea, amid storm and tempest, will labor and strain her timbers, but when winds lull and waves cease, the heart is tenfold compensated in beholding a tranquil sea.

You have not now only gotten through the wilderness, and in sight of—but passed over into—the promised land. Having, therefore, had a wearisome journey, I present you, in behalf of my companions, with this cane, as a mark of our sincere esteem. May it be a staff to your declining years, and one upon which you may lean, in the full confidence that those who presented it will cherish the recipient's memory, as a green spot in the weary pathway of life.

To which Mr. Dodge replied:—

Gentlemen—I accept, with the most pleasurable emotions, this beautiful token of your esteem and approbation, with which you have honored me, and will ever cherish it in remembrance of the kind feeling which has prompted it, rather than from any consciousness of merit on my part.

We have been in intimate association for more than five years, and in all that time you have faithfully performed your duties, sometimes most onerous, and with such cheerfulness and alacrity as to elicit the encomiums of your officers in repeated instances.

To this prompt performance of your duties is, in a considerable degree, the more prosperous condition of the affairs of the Company ascribable, and by your cheerful compliance with its behests we have triumphed over difficulties, as you say, which seemed well-nigh insurmountable; those difficulties are now, I trust, among the things that were, and because we have been earnest in performing our duties.

Let us always, gentlemen, present duty as our motive and goal. Be assured we shall experience our reward while we live, and when death approaches to perform his stern duty, we may meet him, measurably disarmed of his terrors, by the consciousness that we have well performed our duties"

House's Telegraph.—A friend writes to us that we "ought to show up the House concern in their proper light, and let the world see the barrenness of their claims for public favor."

Now, this is making a request that we cannot comply with, for several reasons.

We might write the Companion full on that subject, and avail nothing. It would be going beyond the objects of the Magazine. It is true, we profess to be devoted to the Morse Telegraph, and we presume no one will question our fidelity on that point; but in this we did not promise to quarrel with other systems of telegraph.

We hope this will be a sufficient explanation to our friend in the West, and that he will agree with us that there is in our own system enough to engage all the pages of the Companion, to bring about a proper and efficient system, calculated to advance the interest of those engaged in the Morse Telegraph.

Rogers' Telegraph.—On a recent visit to Baltimore, we had the pleasure of witnessing the operation of a new telegraph improvement, invented

by Mr. Henry J. Rogers and C. Westbrook. The improvement consists in tracing the dot and line upon a metallic disc, revolving under a pen point, composed of asbestos. The mark is a distinct black, and the formation of the letters can be perfect.

Its use in connection with the Morse Register might prove of material benefit; of this, however, we could not decide without actual experiment. Mr. Rogers is confident of its great utility, and he certainly is capable of judging, having been in the service long enough to be entitled to great confidence.

THE FIRST TELEGRAPH.—We have frequently said the Morse Telegraph was the first in the world. This assertion is based upon the legitimate meaning of the word.

Morse invented his recording telegraph in October, 1832.

In November, 1835, he had it in practical working order in the building of the New-York University, witnessed by many people.

In the spring of 1837 his combined circuits were in operation.

Early in the summer of 1837, it was worked on a longer wire, and fully demonstrated to the public.

In October, 1837, he filed his caveat.

In October, 1838, he obtained the French Patent.

In 1840, he was granted his American Patent.

In 1844, and on the 27th day of May, the line from Baltimore to Washington was put in operation successfully. It fell to the lot of the amiable and interesting Miss Annie Ellsworth to send the first dispatch, viz.:—"WHAT HATH GOD WROUGHT?"

☞ The line from Portland, Me., to Montreal, is in successful operation.

☞ The Morse and House lines, between New-York and Boston, have raised the tariff between those cities to 40–3.

The Bain Lines in America are as follows, viz.:—From Boston to Portland, and from Boston to Montreal, Canada, with branches to Springfield, Mass., and St. Johnsburg, Vt., from White River Junction.

☞ W. H. Heiss, Esq., has resigned the superintendency of the Western Telegraph Line.

☞ Judge Caton continues as President of the line from St. Louis to Chicago. He has entirely rebuilt the line, and it now bids fair to make money. No one is more capable than the distinguished Judge for the position he occupies.

☞ The line from Louisville to St. Louis is being transferred to the railroad from St. Louis eastward, under the energetic direction of its accomplished superintendent, J. N. Alvord, Esq.

☞ Morse's patent of 1840 expires June 20th next, upon which he has applied for an extension. Of course it will be granted, if justice be the law in the case.

☞ The Captain-General of the Island of Cuba has ordered the completion of the telegraph lines contracted for by his predecessor.

☞ The Magnetic Telegraph Company between Washington and New-York recently declared a dividend equal to four per cent. on the capital stock in the line for the past quarter.

☞ The Western Telegraph Line, from Baltimore to Wheeling, recently declared a dividend. The line on the railroad between those cities is completed.

☞ The St. Louis and New-Orleans Telegraph Line has cleared, over and above all expenses for the past year, about two thousand dollars. Capital stock, $114,000. Col. William Tanner deserves the hearty thanks of the stockholders.

☞ A line of telegraph has been extended from Evansville, Ind., across the Ohio River, to Henderson, Ky.

☞ In the April Number of the COMPANION, we noticed the Fire Alarm Telegraph of New-York City. Since then we have been informed that the telegraph we alluded to was the Police Telegraph, and not for fire purposes. We have not seen the latter, and therefore make the correction.

☞ The Washington and New-Orleans Company is building two hundred miles of second wire, of the very best Swedish iron.

☞ The line from Chattanooga to Nashville, Tennessee, is now progressing, and will be speedily built on the line of the railroad. The poles will be of the best red cedar.

☞ The Morse Company has five wires from New-York to Albany and Buffalo.

☞ Passing over the railroad from Washington to Baltimore, a few days since, we observed that there were two wires on the House line poles, and that in Washington there were five wires. Will friend Talcot inform us where the extra three extend?

☞ The French Government has endorsed the bonds of the Submarine Telegraph Company from Spezzia to Corsica and thence to Africa, both for the principal and interest.

☞ The Emperor of Russia takes a great interest in the Atlantic Ocean Telegraph.

☞ There are about four hundred and fifty miles of telegraph in California.

☞ Dr. Goel is building several branch lines in the eastern part of New-Jersey.

☞ In California, the telegraph lines use a gum insulator. In dry seasons it works well, and in wet it does not.

☞ The Washington and New-Orleans Telegraph Company is clearing about six per cent., for the present fiscal year.

☞ The Maine Telegraph line, from Boston to New-Brunswick, has made, for the past year, sixteen per cent. dividends.

☞ The New-York, Albany, and Buffalo line has been paying for the past fiscal year 9 per cent. dividends.

☞ The first subscribers for stock in the Morse American Telegraph were Messrs. Corcoran and Riggs, of Washington City, for one thousand dollars. This subscription influenced others, and induced the people to examine into the practicability of the telegraph.

☞ The first earning from the sale of patents of the Morse Telegraph was *forty dollars*, which was contributed by Prof. Morse to the Methodist Episcopal Church, and paid over to Rev. Henry Slicer, in Washington City.

☞The Morse Telegraph has been chosen by the government of Australia as the most practical system for the official lines, in preference to the Cooke, Wheatstone, and other telegraphs.

☞ The National Telegraph lines, from Philadelphia to St. Louis, averaged about three per cent. dividends for the past quarter.

☞ We are rejoiced to hear that the Erie and Michigan Telegraph line, from Buffalo to Chicago, is now making money, and paying dividends on the stock.

☞ We understand, from Mr. Charles F. Wood, supt., that the line from New-York to Boston is in splendid order, and making money.

☞ The number of telegraph offices in America is 1186.

Extract of a Letter from H. T. Phillips, of the Augusta, Atlanta, and Nashville Tel. Co.—Your Telegraph Companion I shall recommend to all operators, for its great usefulness. We want your telegraph map as soon as completed.

Extract of a Letter from W. B. Ransom, Supt., San Francisco, Cal. —We use the Grove battery, for we know we can rely upon it. California in the dry seasons is the finest country in the world for telegraphing. I am very much pleased with the Telegraph Companion.

SHAFFNER'S

TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. I. JUNE, 1854. No. 6.

Art. I.—PROFESSOR MORSE—THE TELEGRAPH.

AMONG the distinguished men whose genius has irradiated some of the most intricate paths of modern science, or, rather, which has made valuable additions to the list of sciences, conspicuous stands the subject of the present sketch. Immortal fame has been won a thousand times in the same channel—won by plodding, imitative, secondary minds. The Englishman, or the Frenchman who writes as well as Horace, though Horace may have been his master, and even his daily tutor, is commended for his originality. The soldier, who fights like Alexander, though his ambition may have been aroused, and his courage stimulated by the lessons of Plutarch, will go down to future ages as a hero born. But, while honors like those await the rhyming multitude and the destroyers of mankind, even the name of our subject is not a familiar word, except among men of learning. Morse accomplished what neither the genius of ancient, nor that of modern times, attempted: HE MADE THE LIGHTNINGS OF HEAVEN THE VEHICLE OF THOUGHT: yet how few are aware that he still lives, or that he has lived at all. He is even alluded to by one of the biographers as "an American artist, better known, *perhaps*, as the inventor of the electric telegraph!"—as though an invention like this were not to be accounted a matter of particular importance.

Samuel Finley Breeze Morse is the eldest son of the first American geographer, Rev. Jedediah Morse, and was born on the 29th of April, 1791, in Charlestown, Massachusetts. His great grandfather, on his mother's side, was Dr. Samuel Finley,

a man of eminent learning, and once a president of Princeton college. The name of Breeze, he derived from his mother. He received an excellent education at Yale, under the tuition of the celebrated Dr. Dwight—graduating in 1810. Having, from early youth, exhibited a very strong inclination to the fine arts, and particularly to the art of painting, of which branch he was, indeed, passionately fond, his father determined to give him an opportunity to acquaint himself with the master-pieces of the old world; and he accordingly visited London, in the year 1811, in company with Washington Allston, Esq., one of the most talented artists of his time. Soon after Morse's arrival in London, Mr. C. R. Leslie came to the city for the purpose of prosecuting his studies in the same profession. Morse and Leslie roomed together at No. 8, Buckingham Place, Fitzroy Square, a house which, for thirty years, had been the residence of American artists. The warmest friendship grew up between them, which has continued until the present time. Morse was recommended to West and Copley, from whom he received every attention. The service rendered the youthful artist by the former gentleman, is strongly illustrated by the following authentic anecdote :—"Morse, anxious to appear in the most favorable light before West, had occupied himself for two weeks in making a finished drawing from a small cast of the Farnese Hercules. Mr. West, after strict scrutiny for some minutes, and giving the young artist many commendations, handed it again to him, saying, 'very well, sir, very well, go on and finish it.' 'It *is* finished,' replied Morse. 'Oh no,' said Mr. West, 'look here, and here, and here,' pointing to many unfinished places which had escaped the untutored eye of the young student. No sooner were they pointed out, however, than they were felt, and a week longer was devoted to a more careful finishing of the drawing, until, full of confidence, he again presented it to the critical eyes of West. Still more encouraging and flattering expressions were lavished upon the drawing, but on returning it the advice was again given, 'very well, indeed, sir, go on and finish it.' 'Is it not finished?' asked Morse, almost discouraged. 'Not yet,' replied West, 'see, you have not marked that muscle, nor the articulations of the finger joints.' Determined not to be answered by the constant 'go and finish it,' of Mr. West, Morse again diligently spent three or four days re-touching and renewing his drawing, resolved if possible to elicit from his severe critic an acknowledgment that it was at length finished. He was not, however, more successful than before; the drawing was acknowledged to be exceedingly good, 'very clever, indeed;' but all its praises were closed by the repetition of the

advice, 'well, sir, go and finish it.' 'I cannot finish it,' said Morse, almost in despair. 'Well,' answered West, 'I have tried you long enough; now, sir, you have learned more by this drawing than you would have accomplished in double the time by a dozen half-finished beginnings. It is not numerous drawings, but the *character of one*, which makes a thorough draughtsman. Finish one picture, sir, and you are a painter.'"*

The subject of the first portrait of Morse was his friend, and the subject of Mr. L.'s first portrait was Morse. They painted each other in dashing, fancy costume; both the portraits are at the house of their ancient hostess. Making rapid advances in his profession, he exhibited, in 1813, at the Royal Academy, his colossal picture of "The Dying Hercules." A plaster model of this subject, intended merely to assist the author while engaged upon the painting, was awarded the prize in sculpture the same year. When this model was shown to West, he called his son, Raphael, and pointing to it, said, 'look there, sir, I have always told you any painter can make a sculptor." In reference to the picture of Morse, one of the journals of the day remarks: "of the *academicians*, two or three have distinguished themselves in a pre-eminent degree; besides, few have added much to their fame, perhaps, they have hardly sustained it; but the great feature in this exhibition is, it presents several works of very high merit by artists with whose performances, and even with whose names, we are unacquainted. At the head of this class are Messrs. MONROE and MORSE."

Stimulated by his success to greater exertions than he had ever made, he determined to contend for the premium offered the following year in historical composition. The premium was a *gold medal and fifty guineas;* the subject, "The Judgment of Jupiter in the case of Apollo, Marpessa, and Idas." This composition was exceedingly difficult, and required intense application for a considerable length of time; but by great diligence the picture was completed several months before the period appointed for the decision. Our young painter, however, having been absent four years, found himself under the necessity of leaving England before enjoying an opportunity of competing with the other candidates for the prize; he did not come away, though, without an expression of opinion from

* "When Mr. West was painting his 'Christ Rejected,' Morse calling on him, the old gentleman began a critical examination of his hands, and at length said 'let me tie you with this cord, and take that place, while I paint in the hands of our Saviour.' Morse of course complied—West finished his work, and releasing him, said, 'you may say now, if you please, you had a hand in this picture.'"

West, that his picture was the best on file. The narrow-mindedness of those appointed to superintend the paintings, and award the prize, was strongly exhibited in their refusal to permit Mr. Morse to be *represented* in his absence. He was told that, by a rule of the academy, it was rendered necessary for the artist to be present to receive the premium.

In August, 1815, Morse returned to America. His picture was exhibited for upwards of a year in Boston, but no one offering to purchase it, he presented it to John A. Allston, Esq., of South Carolina, a gentleman who had frequently afforded him employment upon costly paintings. Morse's education had been very liberal, and upon his return to the Union, he indulged a reasonable hope of eminent success in the department to which he had devoted four years of hard study; but, like thousands of artists before him, he was doomed to disappointment. Opening his rooms in Boston, he was greeted by the citizens with all that hospitality for which New-Englanders are so remarkable; the old and the young, the rich and the poor, the high and the low, called upon him, and welcomed him as a guest; all the attentions of polite society were his; he was regularly invited by the principal families of Boston to the various entertainments of the city; but receiving not a single order in *historical composition*, to which branch of his profession he had particularly devoted himself, he resolved to try his hand upon *portraiture*, for which department he was only partially qualified. Turning his back, therefore, upon Boston, he made his way into New-Hampshire, where he found employment in painting small portraits at $15 per head. During this visit to the Granite State, he became acquainted with Miss Walker, and engaged to become her husband so soon as the sun of good fortune should shine upon his professional career. This event gave direction to his whole life. Falling in about this period with a southern gentleman who gave him assurance of regular employment in the south, at four times the price he was then receiving, he immediately wrote to Dr. Finley, of Charleston, South Carolina, his uncle, for advice in regard to a visit to that city. His uncle extending to him a cordial invitation to become his guest, he left New-Hampshire, and made his home, temporarily, in Charleston. Several weeks passing without his having received any thing to do, he proposed to the Doctor to paint his portrait, to be left as a memento, and then to quit the city. Before he had finished the portrait of Dr. Finley, however, three applications were filed by persons who had witnessed his success. In a few weeks, his list amounted to 150 names, engaged at $60 each. The sky of his future brightening, he determined to

labor hard, and with money in his pockets, and this list of subscribers, to return to New-Hampshire, marry, and return next winter to Charleston with a wife. For more than three months, he finished four portraits a week, leaving the city with $3,000, and a large number of engagements. Returning to New-Hampshire, he was very happily married, but he did not forget to visit regularly for years the scene of his earliest good fortune, and the home of many of his warmest friends.

About the year 1820, Morse conceived the idea of painting the interior of the national House of Representatives, with portraits of the members. He thought a painting of this description could be sent around to the various cities; and that the revenue he would derive from its exhibition would enable him to prosecute successfully the branch of his art for which he had prepared himself. Removing his family to New-Haven, he proceeded to Washington, made the necessary arrangements, returned, and executed his task. Instead of realizing any profits, however, from his picture, he lost several hundred dollars in exhibiting it.* Much of his money, too, being called for by his father, who had experienced a reverse of fortune, he was suddenly left without means, and with a family to support. About this time, he sought employment at New-York, and recommended by James Hillhouse, and Isaac Lawrence, Esq., an order was passed by the corporation of the city† to paint a full-length portrait of Lafayette, then on a visit to the United States. This portrait is truly said to have been "begun in misfortune, and prosecuted in sorrow." While Morse was engaged upon it, his father and mother died.

In the midst of these afflictions, Mr. Morse formed that association of artists which resulted in the establishment of the National Academy of Design, of which he was chosen President. His success drew down upon him the malignant vituperation of the jealous leaders of the American Academy of the Fine Arts. A few years, however, were sufficient to silence the voice of calumny; those who had been most prominent in denouncing him, finding their labors fruitless, endeavored to raise themselves by elevating Morse. As an evidence of the devotion of our subject to art, it may be mentioned that the first course of lectures read in America upon the subject, was delivered by him, before the New-York Athenæum, and afterwards to the students of the academy, of which he may be said to have been the founder.

* This picture was finally sold for a thousand dollars, and removed to Great Britain.

† 1824.

For the purpose of extending his acquaintance with his peculiar branch of art, Morse paid a visit, in the year 1829, to Europe, traveling through England, France, and Italy. Returning homeward, he stopped at Paris, and commenced his celebrated picture of the Gallery of the Louvre.* "On leaving Paris," says Dr. Dunlap, "he returned to London, and had the satisfaction of renewing former recollections and acquaintances, and particularly of enjoying the society of his friend Leslie. His good old friend and master, West, was no more, and his younger friend and instructor, Allston, was in America; but he had recollections of the latter brought to his mind very unexpectedly. Morse had brought a letter to a gentleman from Italy, whose direction was No. 11, Tinny street, London. After an absence of sixteen or seventeen years, he had no remembrance of the street, or thought that it was connected with any transaction of interest to him. He sought the street, and on entering it, he saw objects which appeared familiar to him; but which might only have reminded him of those dreamy sensations we experience through life, when entering a strange place we feel as if all the scene was merely a renewal of former impressions, made we know not how or when. He inquired for No. 11, of a gentleman passing, who exclaimed, 'surely I know you, sir.' 'My name is Morse.' 'And have you forgotten that house?' pointing to it, 'that is No. 11, my name is Collard, and there, with you and your friend Allston, and his friend Coleridge and Lonsdall, I have passed many hours in times past.' The reality now flashed upon Morse—he entered the house, and found himself in the apartment where he had witnessed such poignant scenes of distress in former days—the chamber in which his dear friend and mentor's wife had expired, and where he had seen that friend deprived of reason in consequence of the sudden bereavement."

Mr. Morse acquired a vast fund of knowledge in his European tour, having familiarized himself with the best models in the world; and he quit England, in 1832, with every prospect of winning, in a few years, a splendid fame.†

* This picture was finished in New-York and exhibited in that city and New-Haven. Every Artist and connoisseur was charmed with it, but it was caviare to the multitude.' Those who had flocked to see the nudity of Adam and Eve, had no curiosity to see this beautiful and curious specimen of art. It was purchased by George Clarke, Esq., of Otsego, and removed to Hyde Hall, on Otsego lake."

† "Mr Morse has told me that he formed a theory for the distribution of colors in a picture many years since, when standing before a picture of Paul Veronese, which has been confirmed by all his subsequent studies of the works of the great masters. This picture is now in the National Gallery, London. He

Up to this period, according to the most reliable information in our possession, Mr. Morse seems not to have indulged even a remote idea of such an invention as that which has since enrolled him on the list of the first scientific men of all ages. His whole mind appears to have been occupied upon matters bearing no relation even to the subject of electricity, in any of its various modes. It is doubtless true that his reading had been so extensive, and his habits of thought so rigid and methodical, he could easily have transformed himself from a painter to a sage, but it is not in evidence that any such disposition as he afterward made of lightning was a part of his daily meditation. Indeed, if he be constituted like the generality of the votaries of the "fine arts," a prophetic development of his future course would probably have subjected the scientific Elijah to silent imputations on the part of Morse not very creditable to the inspiration of the former. The privilege is not allowed even to genius in this world to inspect its own elements, and read its own destiny, and it is perhaps well for mankind that it is so. Could we lift the curtain which hides our future lives, and glance hastily at the misfortunes, the vexations, and the disappointments which await us, we should be discouraged from attempting the performance even of such deeds as are destined eventually to crown us with honor. Could Prof. Morse have foreseen the trials through which he has passed, and believed that he would be called to prove to the scientific world so obvious a fact as his exclusive right of property in the magnetic telegraph, this great invention would probably not have ranked among the improvements of the nineteenth century. But we have not space to digress from our subject.

The word *telegraph* is from two Greek words, *τῆλε* and *γράφῶ*—the former signifying "distant," and the latter "write,"

saw in it that the *highest* light was cold; the *mass of light* warm; the *middle tint* cool; the *shadow* negative; and the *reflections* hot. He says he has tried this theory by placing a white ball in a box lined with white, and convinced himself that the system of Paul Veronese is the order of nature. Balls of orange or of blue so placed, give the same relative result. The high light of the ball is uniformly cold, in comparison with the local color of the ball. 'I have observed in a picture by Rubens that it had a *foxy* tone, and on examination I found that the shadow (which, according to my theory ought to be negative,) was *hot*. Whenever I found this to be the case, I found the picture foxy.' On one occasion his friend Allston said to him, while standing before an unfinished painting, 'I have painted that piece of drapery of every color, and it will not harmonize with the rest of the picture.' Morse found the drapery belonged to the *mass* of light, and said, 'according to my theory it must be warm; paint it flesh color.' 'What do you mean by your theory?' Morse explained as above. Allston immediately said, 'it is so; it is in nature;' and has since said, 'your theory has saved me many an hour's labor.'"

referring to a contrivance by which intelligence may be communicated to a distance, and generally to a method of communicating by preconcerted signals. Different names have been applied in different countries. In France, the denomination *semaphore* is often used. Telegraphing is almost as old as the world, having been considered a very important adjunct, in every age, of the machinery of war. Perhaps a thousand kinds of signals have prevailed among the various nations of the earth, and a history of their gradual improvement, though void of value, would not be destitute of interest. One of the most complete and simple methods * which we remember, was practiced by John Smith, the "father of Virginia," while a prisoner of war in Turkey. Most of the telegraphs of olden times consisted of boards or wooden arms, which signified the letters of the alphabet, according to the positions in which they were placed. A singular telegraph was used in France towards the close of the last century, by which intelligence was communicated, letter by letter—only sixteen letters constituting the entire alphabet. A piece of machinery of this description was in operation between the Louvre, in Paris, and Lisle, enabling the Committee of Public Safety and the combined armies in the Low Countries to communicate with each other. So great were the advantages derived even from the use of this bungling apparatus, all Europe, and particularly the British Empire, set about effecting some radical improvement. A great number of plans was proposed, which may be reduced to two classes: first, shutters, which open or close certain apertures made to receive them; secondly, arms movable on pivots. A shutter-apparatus was adopted by the Admiralty in the first government line of telegraphs established in England, in the year 1796, between London and Dover. This machinery continued in use until 1816. In this year, it was determined to adopt the semaphores of France, which had been in use on the French coast from 1803; and, as materially improved by Sir Home Popham, they were found of very great service. Popham's telegraph consisted of two arms on one post; but, as they were mounted upon separate pivots, each could assume six different positions, and was capable of affording twenty-four signals. This apparatus, with some modifications, lasted until the introduction of the electric telegraph. The greatest facility perhaps ever attained in *signal* communication was by the method invented by Col. Paisley, of France, in 1822: "it consisted of upright posts of moderate height, having two arms moving upon a common pivot,

* Torch lights.

each of which could be put in seven positions, and each position indicated a word or sentence. The posts were placed from three to five miles apart; but each was visible to the nearest on either side. When the arm of the first was put in a given position, the man at the second put his in the same position, and the third, fourth, &c., did the same, and a word was thus run through the line at the rate of about a mile in a second; then another word was conveyed in the same way, and then another, and so on, till the whole message was communicated. It could be used, of course, only by day-light. There were twenty-seven of these signal posts between Calais and Paris, 152 miles; a word was conveyed through the line in three minutes, and a sentence of ten words in half an hour. There were eighty signal posts between Paris and Brest, 325 miles, through which distance a word was conveyed in ten minutes, and a sentence of ten words in one hour and forty minutes. It will be seen at once that this mode of conveying intelligence was very expensive; it required more than eighty men to convey ten words 325 miles, and kept them occupied one hour and two thirds. And yet it was deemed so important to be able to convey it in this speedy manner, the government of France supported them at the cost of $210,000 annually. England paid $15,000 a year to sustain 72 miles of telegraph, between Portsmouth and London."

Methods of telegraphic communication without machinery have, at various periods, been devised and used in conducting military operations; and these have been found particularly valuable in time of war. One is by "discs of wood held by men in certain positions; another by a white handkerchief, varied in position; another by two small flags; and another by stationing a few men in pre-arranged positions," &c. Naval signals have been found absolutely necessary at all times. They have consisted usually of flags of various forms and colors, sometimes numbered in signal books. The best system of flag telegraphing is perhaps that invented by H. J. Rodgers of Baltimore. But we must proceed at once to the consideration of the ELECTRO-MAGNETIC TELEGRAPH.

While on his way to the United States, in 1832, upon the packet ship Sully, a gentleman referring to the experiments which had just been made in Paris with the electro-magnet, a discussion arose in regard to the time occupied by the electric fluid in passing through a wire of a hundred feet in length. Upon the intimation that the passage is instantaneous,—recollecting the experiments of Franklin—Morse suggested that the electricity could be carried to any distance, and be made a means of conveying and recording intelligence. The idea

took deep hold of his mind, and before the end of the voyage, he had draughted and written a plan of the greatest invention of the age. "The electric telegraph invented by Prof. Morse of America, in 1832, was essentially a registering instrument, the various signals being traced on a strip of paper. An electro-magnet was so placed as to be within attracting distance of any armature fixed to the shorter arm of a lever, of which the longer end carried a pencil projecting sidewise from it, and pressed lightly against a sheet of paper. This paper was made to travel slowly beneath the pencil. So long as no attractive power was exerted by the electro-magnet, the pencil would continue to trace a straight line as the paper moved onwards: but on momentarily making the circuit, with the battery, the armature was drawn to the electro-magnet, and the pencil carried by the arm of the lever upwards, made an angular mark like the letter V reversed, on the paper. These angles might either be joined in groups, by rapidly succeeding completions of the circuit; or they might be separated by longer or shorter spaces of straight line. The nine digits were represented by corresponding numbers of angles, and these were combined so as to form all possible numbers. In the telegraph constructed by Morse in 1844, between Baltimore and Washington, a different mode of recording the signals was adopted. The use of the pencil was found objectionable from its so frequently requiring fresh pointing, and from the risk of breakage. The same arrangements were retained in regard to the paper, but it was made in its course to pass under a roller having a groove around it. The long arm of the lever carried a blunt steel point standing out from its upper surface vertically under the groove in the roller. When, therefore, the arm of the lever was elevated, by the attraction of the magnet upon the armature, the steel point pressed the paper into the groove, and produced an indentation. If the attraction were momentary, a depressed point was produced; but if the action were continued for a longer time, a lengthened depression was the result, as the paper was drawn on. The combinations of these two kinds of marks denoted the various letters and figures. In his first instrument, Morse produced the requisite groups of angles by means of type having as many projecting ridges, or teeth as there were to be angles. These being arranged in a frame, as required for the message, made the successive contacts with the battery as they were drawn under the lever or spring. Subsequently, however, a single key was used, by depressing which with the finger the circuit might be completed when necessary."

Wherever Morse's instrument has been carefully examined

it has been pronounced the best. Already, it has been approved by most of the governments of the old world. In 1851, at a convention held by Austria, Prussia, Saxony, Wirtemburg, and Bavaria, for the purpose of determining upon a uniform system of telegraphing for Germany, Mr. Morse's instrument, by the advice of Steinheil, was selected and declared to be superior to any other that had ever been invented. The first foreign acknowledgment of his invention was by the bestowal of a *nishan*, or order—the "order of glory"—by the Sultan of Turkey. Next comes a gold snuff-box, from the King of Prussia, containing the Prussian gold medal of scientific merit. Last, from the King of Prussia, the "Wirtemburg Gold Medal of Arts and Sciences." His system has also been adopted in Denmark, Norway, Sweden, Russia, &c., &c. In 1838, Morse went to England to secure a patent in that country, but was refused, upon the pretext, manufactured by Wheatstone and his friends, that his invention had been published. The only proof which could be adduced was the publication of an extract of the New-York "Journal of Commerce" in an English periodical devoted to science.

The first electric telegraph completed in the United States was erected between Baltimore and Washington, in 1844, and the first public message transmitted was the announcement of the nomination by the Baltimore Convention, of James K. Polk, as the Democratic candidate for the Presidency. More than fifty thousand miles of telegraph have since been erected in this country, and but a few years will pass until all parts of our vast domain will be bound together by iron wires.

Many important improvements have been made of late in telegraphing. Whether the system of placing the wire under the ground, or that of suspending it upon poles will ultimately prevail, cannot be predicted. The most interesting feature of telegraphing, and that likely to be attended by the most important results, is the Submarine. It has been satisfactorily demonstrated that wires can be so coated with gutta percha and other materials as to act under water.

Professor Morse still indulges the idea of returning to his old profession—painting; so much of his time, however, will necessarily be devoted to the business to which he has given so much attention for twenty years, an opportunity will probably never arise for him to gratify his ardent wish to become once more associated with the beautiful and classic models of Italy and the Louvre. We only do him justice when we assert, that he is one of the most intellectual and refined characters of the age. His genius, or his learning, alone, would constitute him an ornament to the proudest galaxy of literary

and scientific men in the world; and it is with pride and pleasure we claim them both as the property of our country. The period is near at hand when the universal voice will pronounce in his favor, and when the miserable pretenders of Great Britain that have attempted to usurp his honors, will sink to merited oblivion.

Professor Morse resides at Locust Grove, two miles south of Poughkeepsie, on the banks of the Hudson.

Art. II.—REPORTS TO CONGRESS ON THE SUBJECT OF ELECTRO-MAGNETIC TELEGRAPHS.

Letter from the Secretary of the Treasury, transmitting a Report upon the subject of a System of Telegraphs for the United States. December 11, 1837.

TREASURY DEPARTMENT, *December* 6, 1837.

SIR: I have the honor to present this report, in compliance with the following resolution, which passed the House of Representatives on the 3d of February last, viz. "*Resolved*, That the Secretary of the Treasury be requested to report to the House of Representatives, at its next session, upon the propriety of establishing a system of telegraphs for the United States." Immediately after its passage I prepared a circular, with the view of procuring, from the most intelligent sources, such information as would enable Congress, as well as the Department, to decide upon the propriety of establishing a system of telegraphs.

It seemed also important to unite with the inquiry the procurement of such facts as might show the expense attending different systems; the celerity of communication by each; and the useful objects to be accomplished by their adoption.

A copy of the circular is annexed, (1.)

The replies have been numerous, and many of them are very full and interesting. Those deemed material are annexed, numbered 2 to 18, inclusive.

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 expense attending it is estimated carefully in some of the documents annexed; but it will depend much upon the kind of system adopted: upon the extent and location of the lines first established; and the charges made to individuals for communicating information through it which may not be of a public character.

On these points, as the Department has not been requested to make a report, no opinion is expressed; but information concerning them was deemed useful as a guide in deciding on the propriety of establishing telegraphs, and was, therefore, requested in the circular before mentioned. Many useful suggestions in relation to the subject will be found in the correspondence annexed, and in the books there referred to.

The Department would take this occasion to express, in respect to the numerous gentlemen whose views are now submitted to Congress, its high appreciation and sincere acknowledgment for the valuable contributions they have made on a subject of so much interest.

I remain, very respectfully,

Your obedient servant,

LEVI WOODBURY,

Secretary of the Treasury.

The Hon. J. K. POLK,

Speaker of the House of Representatives.

No. 1.

Circular to certain Collectors of the Customs, Commanders of Revenue Cutters, and other persons.

TREASURY DEPARTMENT, *March* 10, 1837.

With the view of obtaining information in regard to "the propriety of establishing a system of telegraphs for the United States," in compliance with the request contained in the annexed resolution of the House of Representatives, adopted at its last session, I will thank you to furnish the Department with your opinion upon the subject. If leisure permit, you would oblige me by pointing out the manner, and the various particulars, in which the system may be rendered most useful to the Government of the United States and the public generally. It would be desirable, if in your power, to present a detailed statement as to the proper points for the location, and distance of the stations from each other, with general rules for the regulation of the system, together with your sentiments

as to the propriety of connecting it with any existing department of the Government, and some definite idea of the rapidity with which intelligence could ordinarily, and also in urgent cases, be communicated between distant places. I wish you to estimate the probable expense of establishing and supporting telegraphs, upon the most approved system, for any given distance, during any specified period.

It would add to the interest of the subject if you would offer views as to the practicability of uniting with a system of telegraphs for communication in clear weather and in the day time, another for communication in fogs, by cannon, or otherwise; and in the night, by the same mode, or by rockets, fires, &c.

I should be gratified by receiving your reply by the first of October next.

LEVI WOODBURY,
Secretary of the Treasury.

No. 2.

Letter from S. F. B. Morse, to the Secretary of the Treasury.

NEW-YORK CITY UNIVERSITY, *Sept.* 27, 1837.

DEAR SIR: In reply to the inquiries which you have done me the honor to make, in asking my opinion "of the propriety of establishing a system of telegraphs for the United States," I would say, in regard to the general question, that I believe there can scarcely be two opinions, in such a community as ours, in regard to the advantages which would result, both to the Government and the public generally, from the establishment of a system of communication by which the most speedy intercourse may be had between the most distant parts of the country. The *mail system*, it seems to me, is founded on the universally admitted principle, that the greater the speed with which intelligence can be transmitted from point to point, the greater is the benefit derived to the whole community. The only question that remains, therefore, is, what system is best calculated, from its completeness and cheapness, to effect this desirable end?

With regard to telegraphs constructed on the ordinary principles, however perfected within the limits in which they are necessarily confined, the most perfect of them are liable to one insurmountable objection—*they are useless the greater part of the time.* In foggy weather, and ordinarily during

the night, no intelligence can be transmitted. Even when they can transmit, much time is consumed in communicating but little, and that little not always precise.

Having invented an entirely new mode of telegraphic communication, which, so far as experiments have yet been made with it, promises results of almost marvellous character, I beg leave to present to the Department a brief account of its characteristics.

About five years ago, on my voyage home from Europe, the electrical experiments of Franklin, upon a wire some four miles in length, was casually recalled to my mind in a conversation with one of the passengers, in which experiment it was ascertained that the electricity travelled through the whole circuit in a time not appreciable, but apparently instantaneous. *It immediately occurred to me, that if the presence of electricity could be made* VISIBLE *in any desired part of this circuit, it would not be difficult to construct a* SYSTEM OF SIGNS *by which intelligence could be instantaneously transmitted.* The thought, thus conceived, took strong hold of my mind in the leisure which the voyage afforded, and I planned a system of signs and an apparatus to carry it into effect. I cast a species of type, which I had devised for this purpose, the first week after my arrival home: and although the rest of the machinery was planned, yet, from the pressure of unavoidable duties, I was compelled to postpone my experiments, and was not able to test the whole plan until within a few weeks. The result has realized my most sanguine expectations.

As I have contracted with Mr. Alfred Vail to have a complete apparatus made to demonstrate at Washington by the 1st of January, 1838, the practicability and superiority of my mode of telegraphic communication by means of electro-magnetism, (an apparatus which I hope to have the pleasure of exhibiting to you,) I will confine myself in this communication to a statement of its peculiar advantages.

First. The *fullest and most precise information* can be almost instantaneously transmitted between any two or more points, between which a wire conductor is laid: that is to say, no other time is consumed than is necessary to write the intelligence to be conveyed, and to convert the words into the telegraphic numbers. The numbers are then transmitted nearly instantaneously, (or if I have been rightly informed in regard to some recent experiments in the velocity of electricity, *two hundred thousand miles in a second,*) to any distance, where the numbers are immediately recognized, and reconverted into the words of the intelligence.

Second. The same full intelligence can be communicated *at any moment, irrespective of the time of the day or night, or state of the weather.* This single point establishes its superiority to all other modes of telegraphic communication now known.

Third. The whole apparatus will occupy but *little space,* (scarcely six cubic feet, probably not more than four;)* and it may, therefore, be placed, without inconvenience, in any house.

Fourth. The *record of intelligence is made in a permanent manner, and in such a form* that it can be at once bound up in *volumes* convenient for reference, if desired.

Fifth. Communications are secret to all but the persons for whom they are intended.

These are the chief advantages of the Electro-Magnetic Telegraph over other kinds of telegraphs, and which must give it the preference, provided the expense and other circumstances are reasonably favorable.

The newness of the whole plan makes it not so easy to estimate the expense, but an *approach* to a correct estimate can be made.

The principal expense will be the first cost of the wire or metallic conductors, (consisting of four lengths,) and the securing them against injury. The cost of a single copper wire 1-16th of an inch in diameter, (and it should not be of less dimensions,) for 400 miles, was recently estimated in Scotland to be about £1,000 sterling, including the solderings of the wire together; that is, about $6 per mile for one wire, or $24 per mile for the four wires. I have recently contracted for twenty miles of copper wire, No. 18, at 40 cents per pound. Each pound, it is estimated, contains 93 feet, which gives a result coinciding with the Scotch estimate, if $1 60 per mile be added for solderings.

The preparation of the wire for being laid, (if in the ground,) comprehends the *clothing of the wires* with an insulating or non-conducting substance; the *encasing them in wood, clay, stone, iron,* or *other metal;* and the *trenching* of the earth to receive them. In this part of the business I have no experience to guide me, the whole being altogether new. I can, therefore, only make at present a rough estimate. Iron tubes enclosing the wires, and filled in with pitch and resin, would probably be the most eligible mode of securing the conductors from injury, while, at the same time, it would be the most costly. Iron tubes of 1½ inch diameter, I learn, can be obtained at Baltimore, at 28 cents per foot. The *trenching* will not be more than three cents for 2 feet, or about $75 per

* It now occupies a space 10 inches long, 8 inches high, and 5 wide.

mile. This estimate is for a trench 3 feet deep and 1½ wide. There is no *grading;* the trench may follow the track of any road, over the highest hills or lowest valleys. Across rivers, with bridges, the circuit may easily be carried, enclosed beneath the bridge. Where the stream is wide, and no bridge, the circuit, enclosed in lead, may be sunk to the bottom.

If the circuit is laid through the air, the first cost would doubtless be much lessened. This plan of making the circuit has some advantages, but there are also some disadvantages; the chief of which latter is, that, being always in sight, the temptation to injure the circuit to mischievously disposed persons is greater than if it were buried out of sight beneath their feet. As an offset, however, to this, an injury to the circuit is more easily detected. With regard to danger from wantonness, it may be sufficient to say, that the same objection was originally made in the several cases, successively, of water-pipes, gas-pipes, and railroads; and yet we do not hear of wantonness injuring any of these. Stout spars of some thirty feet in height, well planted in the ground, and placed about 350 feet apart, would, in this case, be required, along the tops of which the circuit might be stretched. Fifteen such spars would be wanted to a mile. This mode would be as cheap, probably, as any other, unless the laying of the circuit in water should be found to be most eligible. A series of experiments to ascertain the practicability of this mode, I am about to commence with Professor Gale, of our university, a gentleman of great science, and to whose assistance, in many of my late experiments, I am greatly indebted. We are preparing a circuit of twenty miles. The result of our experiments I will have the honor of reporting to you.

The other machinery, consisting of the apparatus for transmitting and receiving the intelligence, can be made at a very trifling cost. The only parts of the apparatus that waste or consume materials, are the batteries, which consume *acid* and *zinc*, and the register, which consumes *paper* for recording, and *pencils* or *ink* for marking.

The cost of *printing*, in the first instance, *of a telegraphic dictionary,** should perhaps also be taken into the account, as each officer of the Government, as well as many others, would require a copy, should this mode of telegraphic communication go into effect. This dictionary would contain a vocabulary of all the words in common use in the English

* Mr. Francis O. J. Smith has recently published a Secret Corresponding Vocabulary adapted to this purpose.

language, with the numbers regularly affixed to each word.

The stations in the case of this telegraph may be as numerous as are desired; the only additional expense for that purpose being the adding of the transmitting and receiving apparatus to each station.

The cost of supporting a system of telegraphs on this plan, (when a circuit is once established,) would, in my opinion, be much less than on the common plans; yet, for want of experience in this mode, I would not affirm it positively.

As to "the propriety of connecting the system of telegraphs with any existing department of Government," it would seem most natural to connect a telegraphic system with the Post Office Department; for, although it does not carry a mail, yet it is another mode of accomplishing the principal object for which the mail is established, to wit: the rapid and regular transmission of intelligence. If my system of telegraphs should be established, it is evident that the telegraph would have but little rest day or night. The advantage of communicating intelligence instantaneously in hundreds of instances of daily occurrence, would warrant such a rate of *postage*, (if it may be so called,) as would amply defray all expenses of the first cost of establishing the system, and of guarding it, and keeping it in repair.

As every word is numbered, an obvious mode of rating might be, a *charge of a certain amount on so many numbers.* I presume that five words can certainly be transmitted in a minute; for, with the imperfect machinery I now use, I have recorded at that rate, at the distance of half a mile.

In conclusion, I would say, that if the perfecting of this new system of telegraphs (which may justly be called the American Telegraph, since I can establish my claims to priority in the invention) shall be thought of public utility, and worthy the attention of Government, I shall be ready to make any sacrifice of personal service and of time to aid in its accomplishment.

In the mean time I remain, sir, with sincere respect and high personal esteem,

Your most obedient, humble servant,

SAML. F. B. MORSE.

HON. LEVI WOODBURY,
Secretary of the Treasury.

No. 3.

Letter from S. F. B. Morse to the Secretary of the Treasury.

UNIVERSITY OF THE CITY OF NEW-YORK,
November 28, 1837.

MY DEAR SIR: In my letter to you in answer to the circular respecting telegraphs, which you did me the honor to send me, I promised to advise you of the result of some experiments about to be tried with my electro-magnetic telegraph. I informed you that I had succeeded in marking permanently and intelligibly at the distance of *half a mile.*

Professor Gale, of our University, and Mr. Alfred Vail, of the Speedwell Iron-works, near Morristown, New-Jersey, are now associated with me in the scientific and mechanical parts of the invention. We have procured several miles of wire, and I am happy to announce to you that our success has, thus far, been complete. At a distance of *five miles*, with a common Cruikshank's battery of 87 plates, (4 by 3½ inches each plate,) the marking was as perfect on the register as in the first instance of half a mile. We have recently added *five miles more*, making in all *ten miles*, with the *same result;* and we have now no doubt of its effecting a *similar result* at *any distance.*

I also stated to you, sir, that machinery was in progress of making, with which, so soon as it should be completed, I intended to proceed to Washington, to exhibit the powers of the invention before you and other members of the Government. I had hoped to be in Washington before the session of Congress, but I find that the execution of new machinery is so uncertain in its time of completion, that I shall be delayed, probably, until the beginning of the year.

What I wish to learn from you, sir, is, "*How late in the session can I delay my visit, and yet be in season to meet the subject of telegraphs, when it shall be presented by your report to Congress?*"

I am anxious, of course, to show as perfect an instrument as possible, and would wish as much time for the purpose of perfecting it as can be allowed without detriment to my interests as an applicant for the attention of Government to the best plan of a telegraph.

I am, my dear sir, with the greatest respect and personal esteem,

Your most obedient servant,
SAML. F. B. MORSE.

HON. LEVI WOODBURY,
Secretary of the Treasury.

No. 4.

[From the New-York Journal of Commerce.]

We have received the following note and diagram, with the explanation of the latter, from Mr. Morse:

To the Editors of the Journal of Commerce:

GENTLEMEN: You had the kindness to assert, a few days ago, my claim to the invention of the *electro-magnetic telegraph*, for which I thank you. As to the priority of my invention, entirely planned, and for the most part executed as it was nearly five years ago, I can adduce the amplest proof.

You announced that I was preparing a short *circuit*, to show to my friends the operation of the telegraph. This circuit I have completed, of the length of 1,700 feet or about one-third of a mile; and on Saturday, the 2d instant, in presence of Professors Gale and Torrey of this city, and Professor Daubeny of the Oxford (English) University, and several other gentlemen, I tried a preliminary experiment with the register. It recorded the intelligence sufficiently perfect to establish the practicability of the plan, and the superior simplicity of my mode of communication, over any of those proposed by the professors in Europe.

It will be observed that no account has reached us that any of the foreign proposed electric telegraphs have as yet succeeded in transmitting intelligible communication; but it is merely asserted of the most advanced experiment, (the one in London,) that "by means of five wires," &c., intelligence "*may be* conveyed." I have the gratification of sending you a specimen of the writing of my telegraph, the actual transmission of a communication made this morning, in a more complete manner than on Saturday, and through the distance of one-third of a mile.

Thinking it may be gratifying to your readers to see the kind of writing which it performs, I have had it engraved for you, accompanied with an explanation.

Your obedient servant,

SAML. F. B. MORSE.

N. Y. City University, September 4, 1837.

No. 6.

Mr. SMITH, from the Committee on Commerce, made the following Report, April 6th, 1838.

The Committee on Commerce to whom the subject was referred, have had the same under consideration, and report:

On the 3d of February, 1837, the House of Representatives passed a resolution requesting the Secretary of the Treasury to report to the House, at its present session, upon the propriety of establishing a system of telegraphs for the United States.

In pursuance of this request, the Secretary of the Treasury, at an early day after the passage of said resolution, addressed a circular of inquiry to numerous scientific and practical individuals in different parts of the Union; and on the 6th of December last, reported the result of this proceeding to the House.

This report of the Secretary embodies many useful suggestions on the necessity and practicability of a system of telegraphic despatches, both for public and individual purposes; and the committee cannot doubt that the American public is fully prepared, and even desirous, that every requisite effort be made on the part of Congress to consummate an object of so deep an interest to the purposes of Government in peace and in war, and to the enterprise of the age.

Amid the suggestions thus elicited from various sources, and embodied in the before mentioned report of the Secretary of the Treasury, a plan for an electro-magnetic telegraph is communicated by Professor Morse, of the University of the city of New-York, pre-eminently interesting, and even wonderful. See Report, No. 2.

This invention consists in the application, by mechanism, of galvanic electricity to telegraphic purposes, and is claimed by Professor Morse and his associates as original with them; and being so, in fact, as the committee believe, letters-patent have been secured, under the authority of the United States, for the invention. It has, moreover, been subjected to the test of experiment, upon a scale of ten miles distance, by a select committee of the Franklin Institute of the city of Philadelphia, and reported upon by that eminently high tribunal in the most favorable and confident terms.

In additional confirmation of the merits of his proposed system of telegraphs, Professor Morse has exhibited it in operation (by a coil of metallic wire measuring about ten miles

in length, rendering the action equal to a telegraph of half that distance) to the Committee on Commerce of the House of Representatives, to the President of the United States, and the several heads of Departments, to members of Congress generally, who have taken an interest in the examination, and to a vast number of scientific and practical individuals from various parts of the Union; and all concur, it is believed, and without a dissenting doubt, in admiration of the ingenious and scientific character of the invention, and in the opinion that it is successfully adapted to the purposes of telegraphic despatches, and in a conviction of its great and incalculable practical importance and usefulness to the country, and ultimately to the whole world.

But it would be presumptuous in any one, (and the inventor himself is most sensible of this,) to attempt, at this stage of the invention, to calculate in anticipation, or to hold out promises of what its whole extent of capacity for usefulness may be, in either a political, commercial, or social point of view, if the electrical power upon which it depends for successful action shall prove to be efficient, as is now supposed it will, to carry intelligence through any of the distances of 50, 100, 500, or more miles now contemplated. No such attempt, therefore, will be indulged in this report. It is obvious, however, that the influence of this invention over the political, commercial, and social relations of the people of this widely-extended country, looking to nothing beyond, will, in the event of success, of itself amount to a revolution unsurpassed in moral grandeur by any discovery that has been made in the arts and sciences, from the most distant period to which authentic history extends, to the present day. With the means of almost instantaneous communication of intelligence between the most distant points of the country, and simultaneously between any given number of intermediate points which this invention contemplates, space will be, to all practical purposes of information, completely annihilated between the States of the Union, as also between the individual citizens thereof. The citizens will be invested with, and reduce to daily and familiar use, an approach to the HIGH ATTRIBUTE OF UBIQUITY, in a degree that the human mind until recently, has hardly dared to contemplate seriously as belonging to human agency, from an instinctive feeling of religious reverence and reserve on a power of such awful grandeur.

Referring to the annexed report of the Franklin Institute, already adverted to, and also to the letters of Professor Morse, marked 2, 8 and 9, for other details of the superiority of this system of telegraphs over all other methods heretofore reduced

to practice by any individual or Government, the committee agree, unanimously, that it is worthy to engross the attention and means of the Federal Government, to the full extent that may be necessary to put the invention to the most decisive test that can be desirable. The power of the invention, if successful, is so extensive for good and for evil, that the Government alone should possess the right to control and regulate it. The mode of proceeding to test it, as suggested, as also the relations which the inventor and his associates are willing to recognize with the Government on the subject of the future ownership, use, and control of the invention, are succinctly set forth in the letters of Professor Morse.

The probable outlay of an experiment upon a scale equal to fifty miles of telegraph, and equal to a circuit of double that distance, is estimated at $30,000. Two-thirds of this expenditure will be for material, which, whether the experiment shall succeed or fail, will remain uninjured, and of very little diminished value below the price that will be paid for it.

The estimates of Professor Morse, as will be seen by his letter, amount to $26,000; but, to meet any contingency not now anticipated, and to guard against any want of requisite funds in an enterprise of such moment to the Government, to the people, and to the scientific world, the committee recommended an appropriation of $30,000, to be expended under the direction of the Secretary of the Treasury; and to this end submit herewith a bill.

It is believed by the committee that the subject is one of such universal interest and importance, that an early action upon it will be deemed desirable by Congress, to enable the inventor to complete his trial of the invention upon the extended scale contemplated, in season to furnish Congress with a full report of the result during its present session, if that shall be practicable.

All which is respectfully submitted.

FRANCIS O. J. SMITH,	JAS. M. MASON,
S. C. PHILLIPS,	JOHN T. H. WORTHINGTON,
SAMUEL CUSHMAN,	WM. H. HUNTER,
JOHN I. DE GRAFF,	GEORGE W. TOLAND,
EDWARD CURTIS,	

Committee on Commerce, U. S. H. R.

TO THE MAGNETIC TELEGRAPH.

"Harp of a thousand strings!"
Swept by a mightier minstrel than the wind,
A viewless spirit, whose unfettered wings
Leave all, save thought, behind.

Outvying in its flight
The fleeting footsteps of the panting steed,
The arrow keel that cleaves the billows bright,
Or the fierce engine's speed.

Thine is the magic spell
With deepest tones the human heart to thrill;
The power, outvying feeble speech, to tell
Tidings of good or ill.

Peace, promise, joy, or woe,
These, mystic harp, we trust to thee,
All that our weak Humanity may know,
Thy Melodies shall be.

Thou, who dost herald on
To the vast inland, stretching far and wide,
Tales from the ships, whose moorings yet unwon
Must still the wild waves ride.

We pause and gaze on thee,
Marking with wondering eye thy tiny chords,
Weaving perchance, our fortunes yet to be,
Still unrevealed by words:

Telling of kings and thrones,
A nation's downfall, or an empire's birth,
Revealing in thy weird and mystic tones,
Strange histories of Earth.

Of famine, fire, and flood,
The fearful earthquake, or the whirlwind's breath,
The ocean, tempest, or the field of blood,
The pestilence, and death.

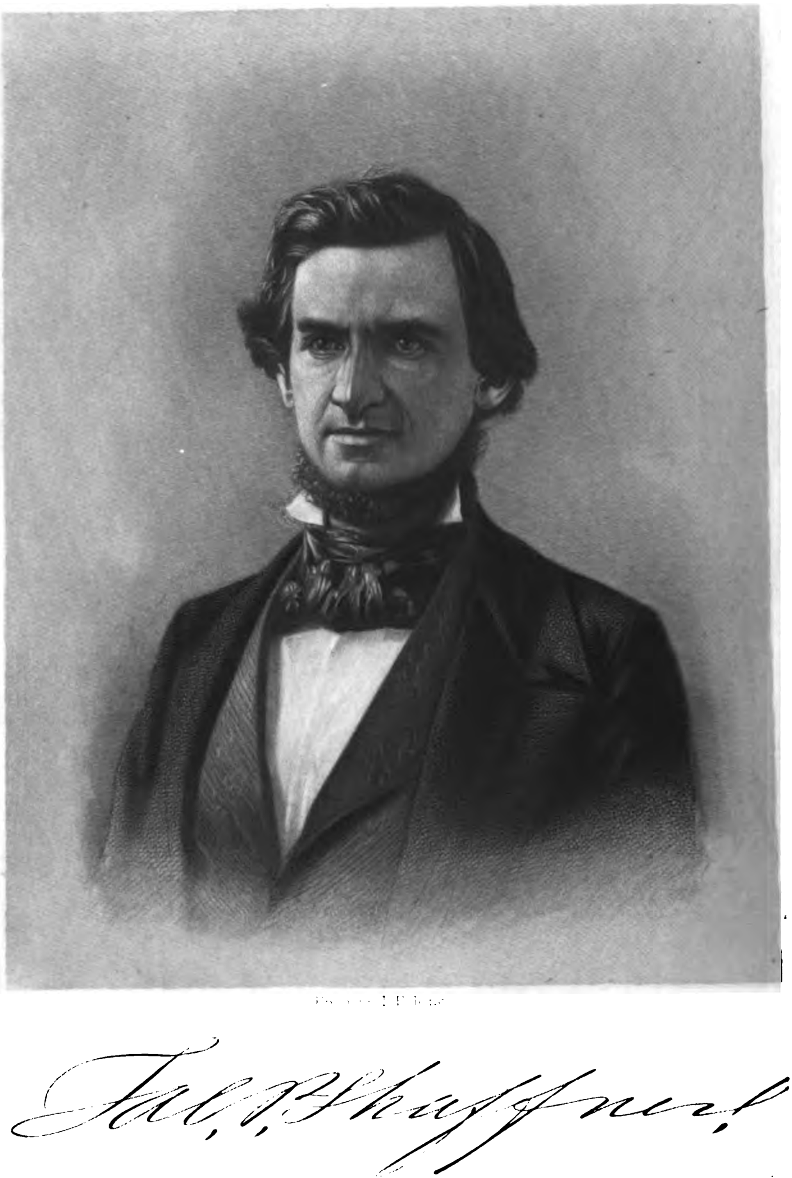
Or tidings sweet and dear,
The blissful messages of love and peace,
To waiting hearts that yearn—from thee to hear
Hope, joy, return, release.

Thou who shalt link all lands,
Thou who at last shalt span the stormy sea,
Binding the nations into brother bands—
What shall we sing of thee?

The earth whereon we tread,
The mighty billows rolling over thee,
The lightning's flash, the sky, the clouds o'erspread,
Shall yet thy minstrels be.

Thou messenger of mind,
Thy triple chords shall make the electric zone,
Which heart to heart, as shore to shore shall bind,
When space shall be unknown.

"Harp of a thousand strings!"
Swept by a mightier minstrel than the wind,
A viewless spirit, whose unfettered wings
Leave all, save thought, behind.



SHAFFNER'S

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Eng'd by J. E. Jones

SHAFFNER'S

Telegraph Companion,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

BY TAL. P. SHAFFNER,

Secretary of the American Telegraph Confederation,

NEW-YORK CITY.

Et non "eripuit cœlo fulmen,"
Fulguri mentem fodit, et orbem lumine cinxit.
Chancellor Pirtle to Prof. Morse.

"Canst thou send lightning, that they may go and say unto thee, Here we are?"—*Job.*

"The names of Franklin and Morse are destined to glide down the declivity of time together—the equals in the renown of inventive achievements."—*F. O. J. Smith.*

"As the inventor of the Electric Telegraph, you, Prof. Morse, stand pre-eminent."—*Arago.*

"The Electro-Magnetic Telegraph—that last and most wondrous birth of this wonder-teeming age."—*Cong. Rep. on Morse's Telegraph.*

VOLUME II.

NEW-YORK:

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1855.

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SHAFFNER'S

TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. II. JANUARY, 1855. No. 1.

Art. I.—THE MORSE AMERICAN TELEGRAPH.

PROF. HENRY'S ATTACK, AND PROF. MORSE'S DEFENCE—CLAIMS OF THE FORMER TO DISCOVERIES AND INVENTIONS BEARING ON THE TELEGRAPH CRITICALLY EXAMINED AND REFUTED BY PROF. MORSE—HISTORY OF EARLY TELEGRAPHS—PROF. MORSE'S CLAIMS AS FIRST INVENTOR ESTABLISHED.

On our return from Europe, in December last, we addressed a letter to Professor Morse, at Poughkeepsie, on the subject of any claims of Professor Henry to the invention of the American Electro-magnetic Telegraph; and this, in consequence of our having found, in our recent intercourse with Professor Wheatstone, in England, and others, that such supposed claims, whether real or pretended, exercised an unfavorable influence on Professor Morse's character for probity and honor. He was spoken of by Mr. Wheatstone particularly, rather as a *lucky* robber of that which was due to Professor Henry; and even in the minds of those who had seen the decisions of our courts in favor of Morse, and the deposition of Professor Henry in the case, there was still a feeling of doubt whether, after all, Mr. Morse had not had the art shrewdly to steer clear of *legal* fraud, and so been lucky enough to escape an adverse decision, on mere legal or technical grounds, while in truth he had actually defrauded Henry both out of the credit and the profit of the invention. Convinced that such an impression was a gross injustice to Professor Morse, and knowing, before we left home, that he had been engaged in preparing a review of that subject, we promised our scientific friends abroad to procure from Pro-

fessor Morse, on our return home, if possible, such a statement from him as would clear up the matter. Consequently, deeming it but right that Professor Morse should know these facts, and act his pleasure in furnishing us with his exposé, we addressed to him the following letter:—

NEW-YORK, *Dec. 27th*, 1854.

TO PROFESSOR S. F. B. MORSE.

MY DEAR SIR:—It affords me great pleasure to inform you that your system of the Electric Telegraph is fast spreading over the earth. Not only is it in general use in America, but, during the past summer, I had the pleasure of witnessing it in successful operation in various parts of Europe. In fact, it is the *only* system in *general* use on the continent. The needle system and yours are at present used between France and England, but throughout all Germany, Belgium, Prussia, Austria, Denmark, Sweden, and Russia, the Morse system is the only one in successful use.

While I was thus pleased to see your Telegraph so popular throughout the Eastern Continent, I was pained to hear a few, in high scientific position, asserting that Professor Joseph Henry, of America, was the true inventor of your system; for, say they, "you obtained all you knew of the invention from his writings and in conversations with him." This erroneous statement has, doubtless, been circulated through Professor Henry's deposition in Europe by those who are jealous of the superiority of your system over others with whom it interferes, and in which they are interested. But it is true, nevertheless, that many persons have really been led to believe that it is to Professor Joseph Henry that the world is indebted for your Telegraph, and that you had in some way wronged him out of it.

Of course, so far as I knew, I endeavored to correct this unjust statement, but the following, among others, was quoted to me from the *London Mechanics' Magazine* as evidence of the fact.

"We cannot but feel that, in relation to the practical development and discovery of the principles embraced in the Electro-Magnetic Telegraph of Professor Morse, our country is *more indebted to Professor Joseph Henry than any other living man*, and he has *neither received the public credit nor honor*, *which are justly his due*, much less any remuneration for his invaluable discoveries. He was the first man in the world who moved machinery by an Electro-magnet; and he is the inventor of the '*Electro-magnet*' to do this—and without this Morse's Telegraph would yet be in oblivion."

It will be seen that the above extract, based on Henry's de-

position, is taken from the Scientific American, and thus has had weight in Europe.

There is also an extract from Donald Mann's Telegraph Magazine, (now discontinued,) and based on the same ground, which, so far, implicates you in some ungenerous, if not dishonorable, conduct towards Professor Henry, as to require some explanation, but you having left it unexplained, the impression is strengthened abroad that there is something of the kind which you fear to meet. The following is the extract:

"One writer points to one great defect in Vail's book—a defect which, considering, especially, that Mr. Vail is a partner of Professor Morse, appears in a peculiarly unfortunate light, namely, *the total omission* to narrate in proper manner the *extraordinary electric discoveries of our countryman Professor Henry*, on which the Morse system is essentially founded, though we will not readily believe that this *inexcusable omission* could have been sanctioned by Professor Morse."

Although the writer of the above is reluctant to believe this "*inexcusable omission*" was sanctioned by you, yet without some explanation on your part, you must see that the impression must be left on the minds of those who are strangers to your character, that there is something wrapt up in this mysterious innuendo.

If Professor Henry has been knowing to these statements, I do not see how, as a just man, he could have ever allowed them to pass current without immediately correcting them, but he has never done so, I believe. You will know.

It is due to your country, to your friends, your family, and yourself, to correct an error which has been and is still used to the injury both of your fame and personal character. Silence on your part has hitherto given authority for its continued circulation.

I hope, therefore, you will no longer withhold from the world any facts you may possess in the case, and that you will forward to me, at your earliest convenience, a full and detailed statement relative to any participation Professor Henry may have had in the early invention and introduction of your Telegraph.

I desire the facts for publication in my Magazine, and hope you will find it convenient to give this your earliest consideration.

Very truly yours,

TAL. P. SHAFFNER.

Professor Morse replied as follows:

POUGHKEEPSIE, *Dec.* 29*th*, 1854.

DEAR SIR:—Yours of the 27th instant I have received. It has given me mingled pleasure and pain. It cannot but be gratifying to me to have corroborated, by your own personal observation during your recent extensive intercourse in Europe, with the most illustrious persons in rank and in science, the fact which I had previously learned, to some extent, from other sources, to wit:—the fact of the popularity, and almost universal extension, of the American Telegraph system throughout the Eastern Continent. I was not, however, aware that it had been introduced to so great an extent as you tell me, in the Northern parts of Europe.

The painful part of your letter acquaints me with a fact, of which I was, indeed, not aware, to wit: that the *absolutely groundless pretensions* to any participation in my invention, set up by, or for Professor Joseph Henry, on the ground of his deposition in the Telegraph suits, had produced, and is still producing, impressions unfavorable to my personal character in Europe.

I knew, indeed, that in various publications, got up under the patronage and to serve the private purposes of those who were pirating my invention, I and my claims were subjected to every sort of misrepresentation and disparagement for effect at home.

While saddened at this ungenerous conduct, on the part of my own countrymen, from whom I was not prepared to expect it, I preferred to pass by these injurious imputations in the main, in silence, leaving their refutation to the less prompt, but not less sure, influence, as I supposed, of the judicial decisions in my favor, not dreaming at the time, that these *home* perversions of the truth, got up by pirate speculators to justify their subterfuge, might have an adverse effect upon scientific minds *abroad*. I knew that opposing counsel, too, had gone to the full length of their proverbial license "to make the worse appear the better side," and had made bold assertions, and sophistical arguments, and assumptions of facts unwarranted by the evidence; but all these I regarded as the usual concomitants of legal warfare, and so bore them as patiently as possible and in silence, awaiting the decision of the cool, dispassionate, discriminating minds of the final arbiters of the strife, conscious that the truth would eventually make its way to the surface, however deeply buried beneath the rubbish of error.

Nevertheless, finding, even at that time, to my surprise and mortification, so great stress laid, by opposing counsel, upon Professor Henry's deposition in the case, I prepared a *defence*

(more than two years ago) against the injurious imputations attempted to be drawn from that deposition, mainly to arm myself with the proper explanations, in case their absence should be made the occasion of any real misgivings among my friends as to the soundness of my own claims, so as to affect my standing with those of my own countrymen, whose good opinion I valued. I considered, also, that it behooved me (as being conversant *alone with many of the facts*, and *possessing the evidence in my own hands*) to vindicate the truth of history, distorted and falsified by the sophistry of counsel. I felt a repugnance, however, to appear, even in self-defence, lest my motives might be mistaken and misrepresented while the decision of the Supreme Court of the United States was in abeyance, and after that decision was given, in my favor, I was disposed to let this judgment of the court, and time, work a gradual cure in neutralizing all the fallacies of my opponents, those professedly drawn from Professor Henry's testimony among the rest, without imposing upon myself the disagreeable necessity of a public exposure of its individual fallaciousness.

But if I have been deceived (and it seems I have been) in regard to the power and extent of the misrepresentation, and it has travelled *abroad* to my injury beyond the influence of the judicial decisions in the United States, or if these decisions have failed to meet the more subtle *moral exigencies* of the case, I have no other course than to comply with your request. I, therefore, send you what I had prepared, which you are at liberty to publish entire, or if its voluminousness startles you, as much as you may think proper. If, for the most part, the subject-matter is, of necessity, personal, you will yet find with it some important facts illustrative of the history of the Telegraph.

I remain, dear Sir,

Respectfully, your obedient servant,

SAMUEL F. B. MORSE.

TAL. P. SHAFFNER, Esq.

THE ELECTRO-MAGNETIC TELEGRAPH.

A DEFENCE

AGAINST THE INJURIOUS DEDUCTIONS DRAWN FROM THE

DEPOSITION OF PROF. JOSEPH HENRY,

(IN THE SEVERAL TELEGRAPH SUITS,)

WITH A CRITICAL REVIEW OF SAID DEPOSITION, AND AN EXAMINATION OF PROF. HENRY'S ALLEGED DISCOVERIES, BEARING UPON THE ELECTRO-MAGNETIC TELEGRAPH.

BY SAMUEL F. B. MORSE, LL.D.,
PROFESSOR IN THE NEW-YORK CITY UNIVERSITY, &c., &c., &c.

INTRODUCTION.

THE deposition of Prof. Joseph Henry (substantially the same in each of four Telegraph suits) has been erected by the ingenuity, and I must add, by the sophistry of the counsel of my opponents, into an apparently formidable barrier to my claims to originality in the invention of the Electro-Magnetic Telegraph.

While the facts he professes truthfully to state have been extravagantly dilated, and his position in relation to discoveries, alleged to have a bearing upon the Electro-Magnetic Telegraph, immoderately exaggerated; yet the fault of this extravagance lies not altogether at their door. Prof. Henry has himself furnished, by the ambiguity, as well as incorrectness of his narration, much of the specious material for their argument.

His deposition has been made to bear, not only on the legal points involved in my invention; but it contains imputations

against my personal character. For *insinuations* that I had derived scientific information from him, not only without *voluntarily* giving him credit; but that I had even persisted in *withholding* it after remonstrance on his part, and a promise on my part to do so; *insinuations* of the untruth of my declaration of the fact that "I had not a knowledge of his 'researches' at the time my invention had been demonstrated;" *insinuations* that my invention of the Receiving Magnet and combined circuits were surreptitiously taken from him. These surely have such a bearing on personal character, as not only to justify, but to demand from me an exposure of their utter want of foundation.

It behooves me, from motives of self-respect, no less than from regard to the opinion of a large body of scientific friends, to free my skirts from any such imputation of unfairness, as the tone and spirit of Prof. Henry's deposition inevitably leaves on the mind of the reader; a tone and spirit, which I am constrained to believe, has biased the after testimony of other witnesses, scientific men, enlisting for him their sympathies, and exciting prejudice in an equal degree against me; so coloring their evidence as to raise the suspicion, (at least in my own mind,) that under the influence of a mistaken impression, that I had been guilty of wrong towards Prof. Henry, they considered that I ought to suffer in kind by a summary application of the *lex talionis*.

Granting all credit for the *generous sentiment* which lies at the foundation of such action, however strongly I may protest against its *rash* application to me, I yet do not refuse to submit to any infliction which their dispassionate judgment may award, after an impartial examination of the merits of the case, being confident, from the ennobling nature of their pursuits, that a *wrong done to me*, will excite these same generous sympathies *for me*, as promptly as they have been excited *against me*, when they believed the *wrong was committed by me*.

It becomes, moreover, not less a duty to the cause of Historic truth, (a duty from which the position of my assailant no less than my own, will not permit me to shrink,) to expose as I shall be able to do, the utter *non-reliability* of Prof. Henry's testimony.

1st. I certainly shall show that I have not only manifested every disposition to give due credit to Prof. Henry, but under the hasty impression, (generated by personal respect, and friendliness towards him,) that he deserved credit for discoveries in science bearing upon the Telegraph, I did actually give him a degree of credit, not only beyond what he had received at that time from the scientific world, but a degree of credit to which *subsequent research* has proved him *not to be entitled.*

2d. I shall show that I am not indebted to him for any discovery in science, bearing on the Telegraph, and that all discoveries of principles having this bearing, were made not by Prof. Henry, but by others, and prior to any experiments of Prof. Henry in the science of Electro-Magnetism.

3d. I shall further show that the claim set up for Prof. Henry, (and with some plausibility, as if sanctioned by him in his deposition,) to the invention of an important part of my Telegraph system, has no validity in fact; and, construing his language to make him consistent with himself, is at variance with his positive disclaimers, and without support in his testimony.

4th. I shall further show that his complaint against me for an alleged injustice to him, in the work of another, (Mr. Alfred Vail,) has not only no foundation as against me; but that it has none as against Mr. Vail, and none whatever, in fact, against any one.

For more convenient reference, and also that the reader may have before him both sides of the matter in controversy, to examine at his leisure, I have given, in an Appendix, Prof. Henry's deposition in full as it appears in the case before the Supreme Court of the United States; and also Prof. Henry's paper, published in the XIX. Vol. of Silliman's Journal of Science; and in the body of my defence, I have also given some extracts from his cross-examinations upon the same deposition in other cases.

No one who reads Prof. Henry's testimony can fail to perceive that he has given it under the influence of some unhappy feeling, occasioned by real or supposed *wrong* to himself, a wrong not ambiguously charged upon me. This feeling manifests itself in the bringing into his deposition matters irrele-

vant, which have no legitimate bearing on the legal points of the several cases, except as they tend to disparage me in the opinion of the Courts, and of the public, as truthful, honorable and frank; and this he has done, I am sorry to say, but as I shall certainly prove, *not in ignorance of facts which make his statements incorrect.* I am aware that this is a serious charge, and no one can feel a deeper repugnance than myself at the necessity imposed upon me, for making and sustaining such a charge against a gentleman of Prof. Henry's high scientific and social position; a gentleman for whom I had cherished so profound a respect, as a deservedly eminent philosopher, and confidence, and even affection, as a friend.

That I have been slow to complain of the injurious character of his testimony; that I have so long allowed, almost entirely uncontradicted, its distortions to have all their legal weight against me in four separate trials, without public exposure, and for a space of four years of time; will at least show, I humbly contend, my reluctance to appear opposed to him, even when self-defence is combined with the defence of the interests of a large body of assignees.

But there is another reason which has had its weight with me. Nassau Hall, though not my Alma Mater, has had associated with it in my mind, from my earliest recollections, one of the deepest, and most sacred ancestral memories—memories which have given Princeton College, and all that is connected with it, a hold on my affections, scarcely less strong than that which attaches them to my own Alma Mater, the time-honored Yale. It was from a venerated ancestor who once presided over the College at Princeton, that I derive my own patronymic; from him whose Christian character was in such strong contrast to that of the infidel Hume, as to be chosen to illustrate most favorably the opposite effects of Infidelity and Christian faith upon the dying hour. And when, therefore, I reflected that Prof. Henry was, at the time of my acquaintance with him, and for so long a period connected as a valuable and efficient officer with this same institution, there are some who can understand the feelings which have hitherto restrained me. I have borne and forborne; but to forbearance there is a limit, for there is a paramount duty to see that the truth of History be

not violated, especially since the Telegraph has now become so largely a part of the history of science, and is directly associated with the progress of the world.

Painful, therefore, as is the task imposed upon me, I cannot shrink from it, but shall endeavor so to perform it, as rather to parry the blows that have been aimed at me, than to inflict any in return. If what I say shall wound, it shall be from the severity of the simple truth itself, rather than from the manner of setting it forth.

I am aware that Prof. Henry commences his deposition with a profession of reluctance to give his testimony; stating, indeed, clearly, that it was "not voluntarily" given, but "on legal summons and in submission to law;" manifesting thereby, as it appears to me, an unnecessary fastidiousness, if he was conscious of being about to give only the facts of history; for surely there is no one who could justly reflect upon him for giving facts; least of all was there required from him any special delicacy towards me in this particular; for I have no motive for desiring that he should conceal anything he knew. On the contrary, one of the most objectionable features of his deposition, in the part in which he makes *complaint*, is the concealment of important facts which essentially change its whole character. His citation to give evidence under oath, in a court of justice, ought undoubtedly to have made him specially cautious, both in the matter to which he deposes, and in the manner of propounding it, lest, by any means, his mode of stating truths or suppressing them, should give just ground for an untrue impression.

The subject-matter of the deposition of Prof. Henry contains:—

1st. Complaints against me of injustice towards him, in not acknowledging my indebtedness to him in elaborating my system of Telegraphs.

2d. Portions of scientific history misstated, so as to give an untrue impression.

3d. Claims to scientific *discoveries*, bearing essentially on my invention of the Telegraph.

4th. Claims, ambiguously expressed, to *invention* of parts of my Telegraph apparatus.

Under the *first* head, I shall have occasion to expose his incorrectness in giving controlling dates, his errors of memory, and his insinuations of untruthfulness in my statements.

Under the *second* head, his looseness and inaccuracy of historical narration.

Under the *third* head, the illusiveness of his claims to *discoveries* bearing on my invention of the Telegraph; and

Under the *fourth* head, the invalidity of any seeming claims to *invention*, on his part, of any portion of my Telegraph apparatus.

These fallacies and errors, interspersed throughout his whole deposition, will require me necessarily to occupy considerable space in exposing them; and in separating the true from the false, I am compelled to be thorough in the exposition of all that is essential, even at the risk of being thought prolix.

From the way in which Prof. Henry alludes to the intercourse between us, and especially from the erroneous conclusions of my having derived indispensable aid in my labors from him, which have been suggested in consequence, I am compelled to narrate, with some minuteness of detail, *the circumstances* which led to our acquaintance; to give the *time* of that acquaintance; and also the *nature* and *extent* of our intercourse.

To begin with our *first acquaintance.*—My acquaintance with Prof. Henry commenced in the month of May, 1839, under the following circumstances:—In the spring of 1838 I visited Europe with my invention, and resided abroad, principally in Paris, till March, 1839, returning home in April of the same year. While absent, my friend and colleague at the New-York City University, Dr. Gale, who had charge of my apparatus in my absence, loaned to Prof. Henry a reel or spool containing five miles of my telegraph wire, with which Prof. Henry made some interesting scientific experiments at Princeton. The results of these were reported by him in a paper read before the American Philosophical Society, November 2d, 1838, and published early in 1839, under the title of "Contributions to Electricity and Magnetism." On my return from Europe, I found awaiting me a copy of Prof. Henry's "Contributions," directed to "Prof. Morse, with the respects of the author." I had returned from Europe in the expectation of proceeding

within five or six weeks to Russia, under a contract with a Russian government agent in Paris—the Baron Meyendorff—to establish the Telegraph in that country. Dr. Gale, my confidential scientific friend, had sailed for New-Orleans on the very day of my return. I could not therefore have my usual consultations with him, for I was naturally anxious to review and revise all the scientific facts that lay at the foundation of my invention, to make assurance doubly sure, before risking in a foreign country either my own or my country's reputation by possible failure. In this conjuncture I wrote the following letter to Prof. Henry, to whom I had never been introduced, availing myself of his politeness in sending me his "Contributions" as a sufficient introduction:—

NEW-YORK, *April 24th*, 1839.

MY DEAR SIR:—On my return, a few days since, from Europe, I found directed to me, through your politeness, a copy of your valuable "Contributions," for which I beg you to accept my warmest thanks. The various cares consequent upon so long an absence from home, and which have demanded my more immediate attention, have prevented me from more than a cursory perusal of its interesting contents; yet I perceive many things of great interest to me in my Telegraphic enterprise. I was glad to learn, by a letter received in Paris, from Dr. Gale, that a spool of 5 miles of my wire was loaned to you, and I perceive that you have already made some interesting experiments with it. In the absence of Dr. Gale, who has gone south, I feel a great desire to consult some scientific gentleman on points of importance bearing upon my Telegraph which I am about to establish in Russia, being under an engagement with the Russian Government Agent in Paris to return to Europe for that purpose in a few weeks. I should be exceedingly happy to see you, and am tempted to break away from my absorbing engagements here to find you at Princeton. In case I should be able to visit Princeton for a few days, a week or two hence, how should I find you engaged? I should come as a learner, and could bring no "contributions" to your stock of experiments of any value, nor any means of furthering your experiments, except, perhaps, the loan of an additional 5 miles of wire which it may be desirable for you to have.

I have many questions to ask, but should be happy in your reply to this letter of an answer to this general one. Have you met with any facts in your experiments, thus far, that would lead you to think that my mode of Telegraphic communication

will prove impracticable? So far as I have consulted the savans of Paris, they have suggested no insurmountable difficulties. I have, however, quite as much confidence in your judgment, from your valuable experience, as in that of any one I have met abroad. I think that you have pursued an original course of experiment, and discovered facts of more value to me than any that have been published abroad.

I will not trouble you at this time with my questions until I know your engagements. Accompanying this is a copy of a report, made by the Academy of Industry, of Paris, on my Telegraph, which I beg you to accept.

Believe me, dear Sir,
With the highest respect,
Your most obedient servant,
SAMUEL F. B. MORSE.

To PROFESSOR JOSEPH HENRY, *Princeton.*

To this letter I received the following reply:—

PRINCETON, *May 6th*, 1839.

DEAR SIR:—Your favor of the 24th ult. came to Princeton during my absence, which will account for the long delay of my answer. I am pleased to learn that you fully sanction the loan which I obtained from Dr. Gale, of your wire, and I shall be happy if any of the results are found to have a practical bearing on the Electrical Telegraph.

It will give me much pleasure to see you in Princeton after this week; my engagements will not then interfere with our communications on the subject of electricity. During this week I shall be almost constantly engaged with a friend in some scientific labors which we are prosecuting together.

I am acquainted with no fact which would lead me to suppose that the project of the Electro-Magnetic Telegraph is impracticable; on the contrary, I believe that science is now ripe for the application, and that there are no difficulties in the way, but such as ingenuity and enterprise may obviate. But what form of the apparatus, or what application of the power will prove best, can, I believe, be only determined by careful experiment. I can say, however, that so far as I am acquainted with the minutiæ of your plan, I see no practical difficulty in the way of its application for comparatively short distances; but if the length of the wire between the stations be great, I think that some other modification will be found necessary, in order to develop a sufficient power at the farther end of the line. I shall, however, be happy to converse freely with you on these points when we meet. In the meatime I remain,

With much respect, yours, &c.,

To PROFESSOR MORSE. JOSEPH HENRY.

Thus was prepared my first personal acquaintance with Prof. Henry. A few days after the receipt of this letter, I visited him, having prepared beforehand a few questions, the better to economize his time. The following is a copy of the original paper, (which I preserved,) with the answers of Prof. Henry, so far as they were given, put down by me in pencil at the time:—

Questions prepared to ask Prof. Henry, and shown him in my visit May, 1839, *and his answers, on reading them to him.*

1st. Have you any reason to think that magnetism cannot be induced in soft iron, at the distance of 100 miles or more, by a single impulse, or from a single battery apparatus? * "No."

2d. Suppose that a horse-shoe magnet of soft iron, of a given size, receive its maximum of magnetism by a given number of coils around it, of wire, or of ribbon, and by a given sized battery, or number of batteries, at a given distance from the battery, does a succession of magnets introduced into the circuit diminish the magnetism in each? "No."

3d. Have you ascertained the law which regulates the proportion of quantity and intensity from the voltaic battery, necessary to overcome the resistance of the wire in long distances, in inducing magnetism in soft iron? "Ohm has determined it."

4th. Is it quantity or intensity which has most effect in inducing magnetism in soft iron? "Quantity with short, intensity with long wires."

According to the best of my recollection, I left New-York a few days after the receipt of his letter, in the morning of the day, and arrived at Princeton about noon, passed the afternoon and night with Prof. Henry, and returned to New-York the next morning. This was the first intercourse, either personal, or by correspondence, I ever had with him; and pausing a moment at this point, it may be well to inquire, how much of information I could have received from him *personally* or by *correspondence*, in the elaborating of my Telegraph as it then existed?

* That is, from any generator of the galvanic current, whether a voltaic, inductive, or thermo-electric apparatus.

From the autumn of the year 1829 till the autumn of the year 1832, I was in Europe, principally in Italy. Prof. Henry's paper in Silliman's Journal was published in 1831,* (in the interval of my absence from America.) I conceived the Telegraph on board the ship in 1832, while on my return home, *essentially* as it now exists. It was operated in my rooms before numerous persons, my pupils, and others, in 1835; it was exhibited to a large audience of a thousand or more persons, through ten miles of wire, in the New-York City University, in the autumn of 1837; to a committee of the Franklin Institute in Philadelphia, in January, 1838; to Congress and the Cabinet at Washington, for three months, in the early part of that year; to the Academy of Sciences, and thousands of visitors in Paris, in the autumn of 1838; to Members of the Royal Society, of both Houses of Parliament, and the Lords of the Admiralty at Lord Lincoln's,† in London, in the month of March, 1839; *and after all this*, I first became acquainted, either personally, or by correspondence, with Prof. Henry.

Here then is a controlling date, (1839,) proved to be most incorrectly deposed to by Prof. Henry (as 1837). It is a date which controls the question of fact, whether I could have derived from him any information directly by *personal interview*, or *correspondence* with him, leaving but two other sources from which aid from him could be derived by me in the elaboration of my Telegraph.

There are but three sources whence I could derive scientific information from Professor Henry.

1st. *Directly* by personal interview, or by correspondence.

2d. *Indirectly* through others.

3d. From his published works.

The first, I think, is effectually disposed of. The other sources will be examined in the sequel.

While on the subject of erroneous dates given in the deposi-

* Before examining this paper, let me for a moment grant, for argument's sake, that it is (what some would claim for it) suggestive of my Electro-Magnetic Telegraph, what are the *probabilities* that it could reach me in Italy or France, where I was then residing, so as to influence my mind in the conception and construction of the Telegraph on my return voyage in 1832? The probabilities, it will be seen, are certainly very small. The *fact* is, it did not come to my knowledge until *five years after* my return, (in 1837.)

† The present Duke of Newcastle.

tion, I proceed to notice others, illustrative of the incapacity of Prof. Henry, from defective memory, to depose correctly where dates are essential to elicit the truth.

In connection with his declaration that, in 1837, he became acquainted with me in New-York, (instead of 1839 in Princeton,) he says that he "*gave me a certificate in the form of a letter.*" I give the *certificate letter* thus referred to, *and its date*, referring the reader to his deposition, answer to 4th interrogatory, for his narration on this point.

"PRINCETON COLLEGE, *Feb. 24th*, 1842.

"MY DEAR SIR:—I am pleased to learn that you have again petitioned Congress, in reference to your Telegraph, and I most sincerely hope you will succeed in convincing our Representatives of the importance of the invention. In this you may, perhaps, find some difficulty, since, in the minds of many, the Electro-Magnetic Telegraph is associated with the various chimerical projects constantly presented to the public, and particularly with the schemes, so popular a year or two ago, for the application of electricity as a moving power in the arts. I have asserted from the first, that all attempts of this kind are premature, and made without a proper knowledge of scientific principles. The case is, however, entirely different in regard to the Electro-Magnetic Telegraph. *Science is now fully ripe for this application*, and I have not the least doubt, if proper means be afforded, of the perfect success of the invention.

"The idea of transmitting intelligence to a distance, by means of electrical action, has been suggested by various persons, from the time of Franklin to the present; but until within the last few years, or since the principal discoveries in electro-magnetism, all attempts to reduce it to practice were necessarily unsuccessful. The mere suggestion, however, of a scheme of this kind, is a matter for which little credit can be claimed, since it is one which would naturally arise in the mind of almost any person familiar with the phenomena of electricity; but the bringing it forward at the proper moment, when the developments of science are able to furnish the means of certain success, and the devising a plan for carrying it into practical operation, are the grounds of a just claim to scientific reputation as well as to public patronage.

"About the same time with yourself, Prof. Wheatstone, of London, and Dr. Steinheil, of Germany, proposed plans of the Electro-Magnetic Telegraph; but these differ as much from yours as the nature of the common principle would well permit; and unless some essential improvements have lately been made

in these European plans, I should prefer the one invented by yourself.

"With my best wishes for your success, I remain, with much esteem, Yours truly,

(Signed) "JOSEPH HENRY.

"PROFESSOR MORSE."

It will be perceived that Prof. Henry has misrecollected the time and circumstances of our first acquaintance, making the date 1837, in New-York, instead of 1839, in Princeton, and he leaves the impression that the time of giving me his "certificate" letter was in 1837, instead of 1842, the true date, as the letter itself shows.

But while on this topic I may as well fix certain other dates which have a bearing on Prof. Henry's qualifications for a deponent. Prof. Gale, my colleague, left the University for the South in the spring of 1839. Prof. Draper had been appointed his successor in the Chair of Chemistry in September, 1838; but, being unable at once to enter upon the duties of his office, Prof. James C. Fisher received a temporary appointment in January or February of 1839. On my return from Europe, in April, 1839, I found Mr. Fisher in the University, and then made my first acquaintance with him. I had never seen or known him previously. The bill before Congress making an appropriation to test the practicability and utility of my Telegraph, passed on the 3d of March, 1843. My scientific assistants, in preparing the Telegraph, could not well have been appointed *previous* to the passage of this bill. Prof. Gale, Prof. Fisher, and Mr. Vail received their appointment from me, as my assistants, March 27, 1843; and they were confirmed by the Secretary of the Treasury March 28, 1843. The records of the Treasury Department will verify these dates. Let Prof. Henry's narrative now be compared with these facts. He says:—"I learned in 1837, or thereabouts, that Prof. Gale and Dr. Fisher were the scientific assistants of Mr. Morse in preparing the Telegraph. Mr. Vail was also employed, but I know not in what capacity, and I am not personally acquainted with him." Is not here further proof of Professor Henry's *incorrectness in giving dates*, and *looseness and inaccuracy of historical narration?*

As intimately connected with this misrecollection of dates, I must expose another of a more serious character, since it involves a charge against me of deriving from him advice against subterranean conductors, and the adoption of the plan of putting my conductors on posts at his suggestion and recommendation.

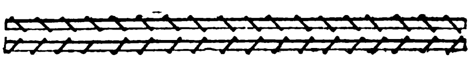
To show which of the two plans of disposing of the conductors was occupying Prof. Henry's mind in April, 1843 (the one in tubes beneath the ground, or the one on posts through the air), I give the following letter from Prof. Henry to Prof. Fisher, who was then my assistant, and who had written to Prof. Henry in relation to the conductors:—

"PRINCETON, *April* 17*th*, 1843.

"DEAR SIR:—A friend of mine in Trenton has a machine for winding wire, of which he promised to give a description. I will write to you on the subject, and send you a copy of his answer.

"The greatest practical difficulty you will have to contend with, I should think, will be the insulation of the wires. Twine is a partial conductor, and by making the surface sufficiently extended, lateral transmission will take place to some extent. The loss, however, on this account can only be determined by direct experiment with extended wire. It will probably increase with an increasing ratio: first, on account of the greater surface of contact; and secondly, because electricity of greater tension will be required to send the current through the longer wire.

"In order to diminish the number of points of contact, it might perhaps be well to wrap around each wire, besides its continuous covering, an extra strand of coarse twine, with the several turns at a distance from each other. Thus—

a
b


a and b representing the two wires, the contact, instead of being continuous, will only exist at the points where the outer strands of twine touch each other.

"Galvanic electricity has never been made to project itself through a stratum of air of the ordinary density, so as to exhibit a spark, although the experiment has been tried with a battery of several hundred plates, and with the poles approached within the $\frac{1}{1000}$th part of an inch. I should therefore conclude that it would be of little importance to fill the space between the wires with cement, provided the metal can be as well secured from contact by less expensive means.

"I shall probably visit New-York some time during the present college vacation, and shall not fail to accept the kind invitation of Prof. Morse to visit your establishment, and perhaps make some experiments with your long wires.

"Respectfully yours, &c.,
(Signed,) "JOSEPH HENRY.

"D. FISHER, *Professor, &c., &c.*"

The plan of preparing my conductors for the Telegraph, at the date of the preceding letter, it will be perceived, was that of inclosing them in *tubes of lead, to be interred in the earth;* and it will be observed that Prof. Henry does not in this letter (where it would be in place, if he had had any doubts of the success of conductors thus laid) suggest anything in regard to putting the conductors on posts.

It will not be out of place here to explain the reason of my adopting at that time the mode of *interring* the conductors, in preference to the present mode on posts, both of which modes (see Vail's book, p. 71) are proposed in my letter to the Secretary of the Treasury of September 27th, 1837, long previous to my acquaintance with Prof. Henry. Both plans had occupied much of my thought previous to the passage of the bill in 1843, for the government experimental essay. In the early attempts to establish the Telegraph in England, as well as here, it was a matter of doubt, and to be determined only by experience, which of the two modes would prove the best; and it may be remarked in passing, that at this day, in Russia and in other European countries, the mode of interring the wires is extensively adopted.

At the time the Telegraph bill passed, in March, 1843, there had been about thirteen miles of Telegraph conductors, for Prof. Wheatstone's Telegraph system in England, put into tubes and interred in the earth; and there was no hint publicly given that that mode was not perfectly successful. I did not feel, therefore, at liberty to expend the public moneys in useless experiments, on a part which seemed to be already settled by Prof. Wheatstone from his adopting that part, and, so far as I could learn, with success. Hence, I fixed upon this mode as one settled; and it was prosecuted until the winter of 1843–44. It was abandoned, among other reasons, in consequence of as-

certaining that in the process of inserting the wire into the pipe, (which was at the moment of forming the pipe from the lead at melting heat,) the insulating covering of the wires had become charred at various and numerous points of the line, to such an extent that greater delay and expense would be necessary to repair the damages than to put the wire upon posts. In this state of affairs, I recurred to my other mode proposed, to wit, *putting my conductors on posts*, (the mode now in use;) and in a letter dated Washington, February 2d, 1844, I asked the permission of the Secretary of the Treasury to try the mode upon posts, as far as Beltsville, twelve miles from Washington, towards Baltimore, which was accorded; and sealed proposals for seven hundred posts were advertised for by me, in the *Madisonian* and in the *National Intelligencer* of February 6th, 1844.

On February 7th, 1844, I went to Baltimore, on my way to New-York. At Baltimore I found awaiting me at the Depôt the following:—

Letter from Prof. Henry, dated Princeton, Jan. 24th, 1844, *post marked Jan. 26th, directed "Professor Morse, Electrical Telegraph Depot, Baltimore."*

"PRINCETON, *Jan. 24th*, 1844.

"MY DEAR SIR:—I am anxious to hear from you, in reference to the Telegraph, and I have intended to write to you on the subject for a month past, but extra college duties have occupied all my thoughts and all my time, since the beginning of the present term. During the last vacation I occupied myself as usual with my investigations in electricity, and among other results, I arrived at one which I think may have an important bearing on the success of the Telegraph. It is this: while a current of electricity is passing through a wire, one part of the conductor is constantly plus to any other part which succeeds it, the difference in the degree of the electrical state constantly increasing as the distance of the two points is greater. The maximum difference is, therefore, at the two ends; and when the two extremities of a long wire are brought into near approximation, there is a great tendency in the electricity to cut across from the one to the other. This tendency is not due, as has been supposed, merely to the great resistance of the long wire, and the cross-cut offering a less resisting channel; but to the fact of the one part being positive, and the other negative,

and the consequent great attraction of the electricity in the one part for the unsaturated matter in the other.

"According to this view, the insulation which would be sufficient to stop a current when applied to separate two consecutive portions of the same wire which had been divided, would be entirely insufficient to prevent the cutting across. I consider the fact I have stated as one of considerable importance in a theoretical point of view, and I do not wish it to be made public before the publication of my next paper in the Transactions of the American Philosophical Society.

"On reading your letter, on the subject of the Telegraph, in the newspapers, I was struck with the idea that you had probably met with the very difficulty my researches have led me to anticipate. If this is the case, and your insulation is not found sufficient, you have no cause to blame yourself, since the previous state of knowledge on the subject of electricity could not lead you to suspect such a condition of things.

"With much respect,

"Yours truly,

(Signed) JOSEPH HENRY.

"PROFESSOR MORSE."

From this letter it will be perceived that Prof. Henry had his mind occupied at that date with the *conductors in tubes*, predicting "cross-cut," &c., and no suggestion is given of *conductors upon posts*. From the commencement of the letter it will also be seen that for at least *a month before* its date, he could not have suggested to me to put my *conductors on posts*, as he had not written me before on the subject.

Immediately on receipt of this letter, and whilst waiting at Baltimore over night, I hastily wrote the following reply:—

"BALTIMORE, *Feb. 7th*, 1844.

"MY DEAR SIR:—You must think it strange that I have not answered your letter of the 24th ult. before this; but I have this moment received it, in passing through this place on my way to New-York, which I trust will be a sufficient apology for my apparent neglect. I have read your letter with much interest, and it has determined me to make you a visit on my return from New-York, which will be the beginning of the week, perhaps on Tuesday morning, 13th inst. If anything in New-York should prevent me from being with you then, I will drop you a line on Monday morning. Several questions occur to me in this *hurried* moment, (as I leave in the morning and carry this

with me to Princeton, on my way to New-York,) suggested by your results.

"1st. How does the result you have arrived at affect the experiments made on my 80 reels of wire of 160 miles?*

"2d. What distance apart must the wires of a circuit be to prevent the cross-cut? Will *any* insulation in a tube prevent it?

"3d. If my conductors are placed on poles, suspended in the air, will there then be any danger of cross-cut?

"4th. How is it that Wheatstone (who has extended in tubes his conductors for 20 miles or more) has not discovered this difficulty of cross-cut?

"I found the difficulty † which you apprehend, in the insulation of my wires; but this I will explain when I have the pleasure of seeing you.

"In the meantime believe me,

"With sincere respect,

"Your most obedient servant,

"SAMUEL F. B. MORSE.

"*To* PROF. JOSEPH HENRY, *Princeton*."

With these facts substantiated by letters and dates, I will ask attention to the following passage in Prof. Henry's deposition. In speaking of his experiments, in *repeating Steinheil's earth-circuit*, he says, "The exact date of these experiments I am unable to give without reference to my notes. They were previous, however, to the unsuccessful attempt of Mr. Morse to transmit currents of electricity through wires, buried in the earth, between Washington and Baltimore, and before he attempted to use the earth as a part of the circuit. Previous to this time, and after the above-mentioned experiments, Mr Morse visited me at Princeton, *to consult me on the arrangement of his conductors*. During this visit we conversed freely on the subject of insulation and conduction of wire. *I urged him to put his wires on poles*, and stated to him my experiments and their results."

How stands the matter, then, in regard to his suggestion, or "*urging me to put my wires on poles*"? It is in evidence, and in public documents, that this mode "on poles," was one of the modes

* No cross-cut was noticed in this distance of 160 miles, a circumstance which militated against the theory deduced by Professor Henry, from his experiments.

† That is, "cross-cut;" but this was owing, as I afterwards explained to him, from the injury to the insulation by charring, which produced conduction.

I proposed to the Secretary of the Treasury as early as Sept., 1837, at least a year and a half before my acquaintance with Prof. Henry. Nor could I have been influenced by any correspondence, or conversation with Prof. Henry, in the visit to which he alludes, (and which was, as is shown, about the 13th February, 1844,) to try the mode on poles, after having abandoned the mode of *burial in the earth.* I had not only determined on trying this mode on poles, before the visit referred to by Prof. Henry; but it is seen that I had requested leave, February 2d, 1844, of the Secretary of the Treasury, to adopt that mode, as one long since proposed by me; and I had actually advertised, with the sanction of the Secretary, for the delivery of the posts, *a week before* I made the visit, and had the conversation, in which he says, "I *urged him to put his wires on poles.*"

How is it in regard to *Steinheil's earth-circuit*, which Prof. Henry intimates, I adopted in consequence of its being made known and recommended by him to me? On this it will be only necessary to state that the memoir of that distinguished and able savan, Prof. Steinheil, in which he first announces publicly his "*earth-circuit*," was read in my presence and hearing, to the Academy of Sciences, in Paris, at their Session, September 10th, 1838, (the same Session in which I explained to that body my Telegraph, and showed it in action;) and this memoir was in my possession the week after in the Comptes Rendus of that Session, published side by side with the description of my own Telegraph, and, therefore, was necessarily known to me long before it could have been known to Prof. Henry. My adoption of Steinheil's earth-circuit (which I need not say I never pretended to claim as my discovery) was not in consequence of any conversation or recommendation from Prof. Henry.

This visit to Prof. Henry was the *second*, and *last* I ever made him at Princeton.

I think I have conclusively shown that I could have derived from Prof. Henry no aid, in *personal interview*, or *by correspondence*, in the invention of my Telegraph. How is it in regard to the second source of information, to wit: *Indirectly through others?*

It is strongly hinted by Prof. Henry, [answer to 4th interroga-

tory,] that, since Dr. Gale, who was my early associate, obtained his knowledge of electro-magnetism from him, I therefore, *indirectly*, through Dr. Gale, obtained his scientific discoveries bearing on the Telegraph. Plausible as this may seem, facts disprove it utterly.

The condition of my Telegraph, previous to the time of my acquaintance with Prof. Henry, in brief, was this. In 1832, I had conceived and planned it in its leading features as a Recording Telegraph. In 1835, it was completely embodied as such, in a practicable form, essentially as it now exists. It operated to mark characters upon a strip or ribbon of paper; moved by clock-work, by means of electro-magnetism excited in an electro-magnet by a galvanic battery. Thus, much had been accomplished even before my acquaintance with my friend and colleague, Dr. Gale. Dr. Gale became acquainted for the first time with the Telegraph when it was in this condition, "*in January*, 1836."* To this fact he testifies in his deposition. He also testifies†—"It was in perfect order when I first saw it." And again‡—"Said Morse could have successfully operated his Telegraph, and did so operate it, prior to my communicating to him any scientific intelligence." Whatever of scientific intelligence, therefore, bearing upon the Telegraph, had ever been communicated to Dr. Gale, by Prof. Henry, either personally, by correspondence, or through his "published researches," could not possibly have been available to me through Dr. Gale, as Prof. Henry intimates, at the time my Telegraph was in actual operation in its first practical embodiment.§

It may be here remarked, that, whatever improvement Prof. Henry claims to have made at this time in the *magnet*, I found the electro-magnet which I use, substantially in its present form in public use, as I had found the galvanic battery and various mechanical elements; knew its principles and action in 1827, as I shall prove; and applied it in combination and with additions, to accomplish my purpose, in the same way as I applied other agencies, without going into the records of its paternity. It was known only as *the electro-magnet*,‖ and I never called it mine.

* S. Court Record, p. 713. † Philadel. Case, Comp. Ev., p. 442. ‡ Ibid, p. 441.
§ See note on last line of answer to 4th interrogatory of Henry's Deposition.
‖ The instruments called *Morse's Register Magnet* and *Morse's Receiving Mag*

When, at a later period, it was stated by certain scientific genealogists who professed to have searched the record, that Prof. Henry had improved the magnet, I neither manifested any disbelief of the fact, nor reluctance to concede to him any credit he might deserve on that account. Nay, more (as I shall show before I close), I awarded to him, under a mistaken apprehension of the real nature of his improvement, more than subsequent research proves him to be entitled to. Besides, what motive could I have in depriving him of any such credit, if the electro-magnet I used was his invention, since I never claimed its invention for myself? It was no sacrifice on my part to give the electro-magnet, if he invented it, to Henry, in preference to Arago or to Sturgeon. I have, indeed, applied the electro-magnet (but not his electro-magnet,) in combination with other discoveries and inventions of others, which have at various periods been given to the public as materials for combination to create inventions. Whatever Prof. Henry's discoveries may have been, he gave them to the public for that purpose; and granting, therefore, that he has made important discoveries, surely it is a singular cause of complaint on his part that the public make use of them.

But granting for the moment, that any discoveries claimed for Professor Henry, in the articles in Silliman's Journal, have in reality an important bearing on the invention of the Electro-Magnetic Telegraph, which I do not concede, these are based on the discoveries and inventions of others, some of which have a much more comprehensive application than any he assumes to have discovered; some, indeed, holding and including all that is claimed for him, and all that he claims as his own, within them, and without which those he would claim could not have existed. For example, where would have been Henry's assumed discoveries, if Volta had not made practical for him the discovery of Galvani, by the invention of the pile, the first

net, are names given to instruments with magnets in combination with other mechanical devices, fitted up by me to accomplish respectively a particular purpose, to wit, *registering* and *receiving*. The compound word designates a combination, in which the magnet is, indeed, an important part; but registering and receiving are the *purposes* severally of the combination, and give the qualifying name to the combination, as pen-lever designates a combination; the lever being an important part, but the pen in this case designating the peculiar purpose of the combination.

intensity battery; and Cruikshank had not furnished his improvement upon Volta, in the battery known by his name, the battery with which Henry made his experiments; or Oersted had not proclaimed for him the birth of Electro-Magnetism, the science in which Henry was experimenting; or Schweigger had not furnished him with the principle of his multiplier; or Arago had not given him the original Electro-Magnet, or Sturgeon his improvement upon it; or Ohm previously determined for him the law of propulsion of the galvanic current? And when, by the aid of the previous discoveries and inventions of so many distinguished philosophers before him, he had added what he claims to be a discovery on his own part, did the Electro-Magnetic Telegraph then stand revealed to the world, the practical, useful instrument we see it to be? Was nothing more to be done? Can Prof. Henry say, "Go read my papers of 1831, and there you will find the Electro-Magnetic Telegraphs of Morse, or of Wheatstone, a telegraph ready to do all that these respectively accomplished, the former in 1835, and the latter in 1837? No. There was no such thing. The Telegraph lay long after 1831, as it had lain before, an inoperative, lifeless, disjointed thing: it had a language to learn; it needed a tongue to talk, and fingers to write; it needed some one yet to conceive a whole; to collect the scattered materials dispersed through the records of years of the laborious research of eminent men, in different sciences and arts. These were to be brought together, to be digested and arranged for a specific purpose, before the Telegraph could be born. Without this gathering, without this application, this combination of parts known, to the production of a new art, and of course to a new process in the arts, there would have been no Electro-Magnetic Recording Telegraph. These various principles were not brought together by Prof. Henry, and applied for this or any other purpose in the arts. His discovery (supposing still that there is such a discovery) was but one in the combination with many other discoveries and inventions quite as necessary as his own to make up the present practical commercial Telegraph. Nor was his alleged discovery the only one remaining to be made, to effect the end; for its *present economical condition* is due to my inventions, and to the subsequent improvements of Professors

Daniel and Grove in the Voltaic battery. But who did bring all these parts together, and by one combination create one con sistent operative whole? If Prof. Henry did it not himself, he may yet be permitted to say who did.

It was "he" (whoever he may be) "who brought the idea forward at the proper moment when the developments of science were able to furnish the means of certain success, and devised a plan for carrying it into practical operation." These acts, he says, are "the grounds of a just claim to scientific reputation as well as to public patronage." [Professor Henry's letter to Professor Morse of February 24th, 1842.]

In the argument under this head, I have assumed, thus far, that Professor Henry had actually made discoveries having an important bearing on the Telegraph; and that, even under this aspect of the case, I have shown that I could neither have been acquainted with them *directly* through personal intercourse or correspondence with him, or *indirectly* through Dr. Gale, as he distinctly intimates in his deposition.

The third, and only remaining source whence I could have derived any such information of his alleged discoveries, must be from his *published works*. To these, his "published researches," he constantly refers in the deposition, and these I now proceed to examine.

PROFESSOR HENRY'S "PUBLISHED RESEARCHES."

To ascertain what Professor Henry had discovered, bearing on the Telegraph, previous to my invention, I will now examine his "published researches." The paper in the Albany Transactions (1830), and the two papers in Silliman's Journal of 1831, Vols. XIX. and XX., are the only legitimate documents of his having any bearing on the subject; they are all that was known publicly of his experiments previous to my invention; all that he had then published. The year 1835, not 1849, is the proper stand-point for examining Professor Henry's claims to discoveries bearing on the Telegraph. His paper in Volume XIX. is the one principally relied on as containing the alleged discoveries. It gives a detail of certain experiments to solve a certain problem, to wit: How to obtain "*great magnetic power with a small galvanic element.*" This purpose is declared in the

title of the paper, and is the declared object and result of *twenty-eight* out of the thirty experiments there recorded. He succeeded in his object. By winding his magnet with numerous short coils of conductors, instead of one long wire, as had been usual previously, and uniting the similar poles of each coil into one conductor, uniting the two coil poles at the battery poles, he made what he now styles his *Quantity Magnet*, and produced a greater magnetic power than had anywhere been attained previously in the Electro-magnet. For this success, he gained deserved credit at home and abroad. The term "Quantity Magnet," however, it should be observed, is of very recent origin, as well as the term "Intensity Magnet." The latter is a new name given to the common Electro-Magnet. They are terms first used by Professor Henry, and first by him in the evidence given in his deposition of 1849. He employs them in 1849 in describing his experiments of 1831, to distinguish two different modes of using the helix or coil of the Electro-magnet, the one with a long continuous wire in connection with the common intensity battery, and the other with numerous short wires in connection with a quantity battery. The magnet thus called Intensity Magnet by Professor Henry, is the invention originally of M. Arago, who first used the helix of one continuous long wire round a soft iron bar. Mr. Sturgeon, in 1825, improved upon the Electro-magnet by a longer coil, an improvement deduced as the result of the previous discoveries of Oersted, Schweigger, and Arago. Oersted in 1820 had discovered the magnetic effect of a current of voltaic electricity in a straight conducting wire. This was the embryo of the science of Electro-Magnetism, as Galvani's discovery was the embryo of the science of Galvanism.*

Schweigger improved upon the *primary element* of Oersted, just as Volta had done upon his own *primary element* of a single pair, and demonstrated that the magnetic effect of the current was increased by repeating the primary element, and hence resulted his celebrated *multiplier*, increasing the intensity of mag

* The condition of the simple instrumentality of Oersted's discovery, as he left it, is very analogous (in its relations to its after applications) to the single voltaic element, in its relations to the galvanic or voltaic battery. That is, it was the primary element for producing electro-magnetic effects, as the latter was in producing electrical effects.

netism as the repetiton of the galvanic or voltaic pairs increases the intensity of galvanism. Arago, reflecting on the multiplier of Schweigger, constructed the helix of the electro-magnet, and first demonstrated the practicability of magnetizing soft iron, and also steel bars within it; and then Mr. Sturgeon, applying the helix of Arago, on the principle of Schweigger, to the soft iron bar, adding *more convolutions* to the helix, bending the iron bar into the horse-shoe form, to give it the advantage of the proximity of the two poles as in the permanent horse-shoe steel magnet, produced the first form of the now *common electro-magnet.*

This was the condition of the Electro-Magnet when Prof. James Freeman Dana, in public lectures in New-York, before the New-York Athenæum, in 1827, exhibited to his audience all the principles of the present common electro-magnet, that which Prof. Henry now calls the "intensity magnet." He showed experimentally the magnetic effect of the galvanic current.

1st. In a *single straight* conjunctive wire.

2d. In a conjunctive wire bent into the *form of a ring.*

3d. In a *single spiral,* or helix around a piece of soft iron, bent into a horse-shoe form, (Sturgeon's improvement.)

4th. He showed the increased magnetic effect of the helix when formed with a *volute spiral,* the present mode of forming the helices of the electro-magnet, that is, with the wire superposed or wound upon itself.

In another part of this defence, I have made a large extract from Prof. Dana's manuscript lectures, (in evidence before the Court,) in which the above experiments are given in detail, with their rationale.

From that date to the present, there has been no improvement in the *electro-magnet proper,* having a bearing on the Electric Telegraph. The helices of the magnet employed in my Telegraph, from its inception to the present time, are made precisely on the principle demonstrated, and in the mode indicated, by Prof. Dana, in 1827.

Prof. Henry, subsequently, in 1829, made an improvement in the lifting power of the electro-magnet, which he gave to the

world in 1831. To this improvement he gave, in 1849, the name of *quantity magnet.*

The mode of forming this magnet, and the details of his experiments with it, are the main topic of his paper of 1831, and are in accordance with the proposed object of it, as standing out upon its title; in accordance with the object, as stated in the closing remarks of his paper, in which he says, "the principle object in these experiments was to produce the *greatest* magnetic effect with the *smallest* quantity of galvanism;" and in accordance with the fact that the quantity magnet is illustrated by the *only diagram* of the paper. It is the success of his experiments with this *quantity* magnet, as I shall show, that created any interest among the scientific world, so far as I have been able to discover. But this *quantity* magnet has no bearing whatever on the Telegraph, and has never been used, so far as I can learn, by any one as an instrumentality in the Telegraph; certainly not by me, and is wholly *unnecessary* for the purpose.

The only fact proclaimed in that paper, bearing on the Telegraph, is not that a *powerful magnet*, nor indeed any magnet at all, could be made at a distance. It "relates solely to the *propulsion of a current through a long wire*, if not with an *increased* effect," at least with "*but slightly diminished effect.*"

In one of his experiments "to determine to what extent *the coil* could be applied, in developing magnetism in soft iron, and also to ascertain the most proper length of the wires to be used," his attention was drawn to the fact, not new, that the Cruikshank's battery, of 25 pairs, propelled the current more effectively through a long wire, than did a single galvanic element, or pair. Hence he drew this inference: "the fact that the magnetic action of a current from a trough is *at least* not sensibly diminished by passing through a long wire, is directly applicable to Mr. Barlow's project of forming an Electro-magnetic Telegraph." This is the inference bearing upon a Telegraph, and the *only remark* of his bearing upon a Telegraph, published by him *in this paper, or anywhere else*, previous, at least, to the year 1838.

But what was "Barlow's project of an Electro-magnetic Telegraph?" He had none. Prof. Henry states, in his deposition, that he was in error on that point. Barlow, in reference to a

suggestion that an instantaneous Telegraph might be established, was induced to make some experiments, to ascertain if the only difficulty which he apprehended to its realization, existed or not. His language is, "It had been suggested that an instantaneous Telegraph might be established, by means of conducting wires and compasses," (that is, magnetic needles.) * * "*There was only one question which could render the result doubtful*, and this was, *Is there any diminution of effect by lengthening the conducting wires?* It had been said that the electric fluid from a common electrical battery had been transmitted through a wire, four miles in length, *without any sensible diminution of effect, and to every appearance instantaneously;* and *if this should be found to be the case with the galvanic circuit*, then no question could be entertained of the practicability and the utility of the suggestion adverted to." Barlow adds, "I was, therefore, induced to make the trial; but I found such a sensible diminution, with only 200 feet of wire, as at once to convince me of the impracticability of the scheme."

The *only question* (so believed to be by Barlow) respecting the practicability of establishing an Electric Telegraph, was thus solved by him, adversely to its practicability. This only question is clearly and succinctly — *Can galvanic electricity, like common electricity, be propelled through a long wire, so as to produce no sensible diminution of its effects at a distance?* If it can, the Electric Telegraph is practicable; if it cannot, it is not practicable. This is the problem as presented to the minds both of Prof. Barlow and Prof. Henry.

Prof. Barlow supposed that his experiments had clearly solved the problem *negatively*, because of the observed "diminution of effect," even in a distance of a few hundred feet. Prof. Henry as truly supposed that his incidental experiments as clearly solved the problem *affirmatively*, because he observed that the "magnetic action of a current from a trough is, *at least, not* sensibly diminished by passing through a long wire."

Two important questions here meet us for solution:

First. Did the practicability of the Telegraph depend on the *affirmative* solution of this problem?

Second. Did Prof. Henry solve it *affirmatively?*

In proof that the practicability of the Telegraph did not de-

pend on the affirmative solution of the problem, I have only to refer to the notorious fact in the experience of all Electric Telegraphs, that there is a "*sensible diminution of effect*" proportionate to the length of the conductors, whatever form of battery is employed in generating the current. The inference of Mr. Barlow, therefore, is not correct, as to the *controlling nature* of the fact to be ascertained. It was not the "only question" to be solved, and he was equally incorrect in the general inference which he drew of the "impracticability of the scheme."

Second. Did Prof. Henry solve Barlow's problem affirmatively? It is on this assumption, indeed, that is based the validity of his claims to having removed the difficulties, propounded by Barlow, to the practicability of the Electric Telegraph. In one part of his remarks, he directly maintains the affirmative. He says, "The fact that the magnetic action of a current from a trough is, *at least*, not sensibly diminished, by passing through a long wire, is directly applicable to Mr. Barlow's project of forming an Electro-magnetic Telegraph." But in another part of his remarks, while hypothetically hinting that the effect of a current from a trough may be even "*increased*," in consequence of passing through a long wire, he at the same time suggests a "*slightly diminished effect*;" he says, "but that the effect of a current from a trough, *if not increased*, is but *slightly diminished* in passing through a long wire, is certain."

Which, then, is the real inference that he would draw? If he infers an *increase* of effect *in passing through a long wire*, it is not correct in its applicability to Telegraphs. If he infers that a trough current is, at least, "*not sensibly diminished by passing through a long wire*," it is equally incorrect, as experience shows, since it is notoriously and sensibly diminished in a long circuit. But if he infers that it is but "*slightly diminished in passing through a long wire*," then his inference is measurably correct; but he is then in the predicament that his inference does not meet, nor solve, the main, and, indeed, only point raised by Barlow, which is distinctly, whether there be "*any* diminution of effect by lengthening the conducting wires."

The utmost that can be granted to Prof. Henry, then, under the most favorable aspect of his claims, on the score of his "published researches," is, that he suggested the use of a trough

or intensity battery as a *probable* means of *partially* solving the difficulties in the way of an Electric Telegraph; but, as the question then stood, he did not solve Barlow's difficulty, nor by any means remove other obstacles, quite as indispensable to be removed, before the Telegraph could be a practical invention. But even these *probable* means of *partially* solving the difficulty are not original with Prof. Henry.

There was published in the Transactions of the Bavarian Academy of Sciences, at Munich, in the year 1812, more than twelve years before Barlow's paper was published, and eighteen years before Prof. Henry's experiments, a paper by Samuel Thomas Soëmmerring, from which I make the following extract:—

"In order to exhibit, at least, by a convincing experiment to my own eye, that the difference between communicating through a wire, the length of *two feet* and *two thousand feet*, was not observable, (though reason tells us there must be a difference,) I caused a glass cylinder to be wound round with 2,248 Bavarian feet of wire, *through which was conveyed the current of the voltaic pile*, so as to reach from the pile to the alphabet in the water reservoir, and serve as an example. The evolution of the gas, through this considerable length of wire, appeared to begin as quickly as if the effect had only to traverse *two feet*."

This experiment of Soëmmerring's was not made, indeed, directly for the purpose of showing whether the current of the voltaic pile, as that of common electricity had been, *could be conveyed through a long wire*, nor whether the *magnetic effects* could be thus transmitted; but both were demonstrated by the experiment, as any reader can see, and the great generic fact stands out clearly that *a current from an intensity battery can be propelled*, and produce effects at a distance, and with no more *sensible diminution* of effect than in Henry's subsequent experiment; *none* were noticed, or, at least, *none* are recorded. The well-known indications of a galvanic current, are *evolution of heat; magnetism; chemical decomposition; physiological effects;* and the *spark*. In this case *chemical decomposition* was chosen by Soëmmerring, by which to demonstrate the presence of the current, and the current was shown to be present, with "no

observable difference of effect" between communicating through a wire of the length of *two feet*, and *two thousand feet.*

Suppose, now, that previous to 1831, having my apparatus arranged, as it was arranged in 1835, I was in doubt whether, after all, I could propel galvanic electricity effectively to a distance; and that in searching for some fact, in the Records of Science, to dispel this doubt, I had met with this notice of Soëmmerring's experiments, published in 1812. Is it not perfectly clear that, so far as the propulsion of the galvanic current to a distance is concerned, it would have been more satisfactory than Henry's subsequent experiments, inasmuch as it was propelled through *double the distance*, and could I have failed to notice, too, that the common *voltaic pile*,* an *intensity battery* was used for that purpose? And, further, knowing the usual effects of the galvanic current, and learning that one of these effects was sensibly present at a distance, was the step, a very wide one to the inference, that the galvanic current being present at a distance by one of its effects, the other concomitant effects of the same current were present also?

In the Telegraph case, Smith *vs.* Downing, the testimony of that distinguished savan, Professor Hare, was taken on the opposite side (that of the defendants), and he testifies to having made an experiment which is almost identical with that of Soëmmerring's. He says, "By recurrence to the American Journal of Science, volume VIII., (1825,) it will be seen that an experiment was made agreeable to which *a galvanic discharge appeared to take place as instantaneously through* 700 *feet of wire as through seven inches.*" But his remarks upon this experiment are worthy of special notice: he adds, "*It follows as a consequence inevitably* in the eye of any one practically acquainted with electro-magnetism, that *an iron bar included in a coiled portion of the wire*, and thus *forming an electro-magnet, might have been magnetized and demagnetized* as readily as in the illustrations, before my class, alluded to."

So in the experiment of Soëmmerring in 1812, can any one doubt if he had introduced an iron bar into the coiled portion

* In the elaborate work of Dr. Schellen, der Electro-magnetische Telegraph, p. 54, the *voltaic pile* used in Soëmmerring's apparatus, is represented, and is the Cruikshank's battery, of 14 plates.

within the glass cylinder, around which was 2,248 feet of wire, that Soëmmerring instead of Oersted would have been the discoverer of Electro-magnetism, and also of the electro-magnet instead of Arago. All the other conditions were there precisely, *except*, *alone*, *the iron bar within the helix*, and after the discoveries of Oersted, of Schweigger, of Ampère, and Arago, in 1820, nothing remained to be discovered after this latter date to complete what Henry calls the *intensity magnet*. Everything was ready for the invention of the intensity electro-magnet in 1812, except, only, the simple placing of the iron bar within Soëmmerring's helix. But in 1820 *Arago finished the invention by actually placing such a bar within the helix*, and thus gave birth to the *Electro-magnet*. What then remained for Henry or any one else to do, so far as the *intensity electro-magnet* is concerned? Arago was unquestionably its inventor.

But will it be said that Soëmmerring merely proved, by his experiments, that a current could be transmitted by an intensity battery some two or three thousand feet, and it could only be inferred, plausibly indeed, that it might be propelled further, for he does not give the data by which it could be determined how far the current could be propelled. And then there might be a limit so near as in effect to be an insuperable obstacle to a Telegraph? This is true, and it is a point regarding the practicality of the Telegraph that was yet to be solved before perfect confidence in the results of it as a commercial enterprise could be inspired. But Professor Henry has not solved this difficulty any farther than Soëmmering; indeed, not quite so far. His experiments furnished him with a length of wire of 1,060 feet, (about half the extent of that which Soëmmerring had used;) he applied to this no "new arrangement of battery of his own," as Mr. Chase, counsel for opponents,* has erroneously declared, but the well-known ordinary Cruikshank's battery, the battery almost coeval with the birth of galvanism itself, the same in kind precisely that was used by Soëmmerring 18 years before him; and Professor Henry noticed this result, to wit: that the magnetic effects of the galvanic current were produced in a greater degree at a distance when the Cruikshank's battery was used, than when a single element or single pair was used.

* In his argument before the Supreme Court, Dec. 1852.

Barlow used a single element battery, and drew a false conclusion (except so far as it bore upon the single element battery), opposed to the previous prevailing scientific opinion, which was grounded on the use of the intensity battery. Or will it be still urged that Soëmmerring did not produce "*mechanical effects* at a distance" (a phrase much insisted on in the deposition), and that it was Henry who first demonstrated these effects by his experiments in passing a current through a long wire with an intensity battery? Although the inference, that there was power adequate to the production of "mechanical effects" at a distance, is unavoidable, from this experiment of Soëmmerring, after the discovery of Oersted, and especially after the invention of the multiplier, by Schweigger, yet it was not left to inference alone, after the year 1820.

M. Ampère, in his memoir, presented to the Academy of Sciences the 2d Oct., 1820,* says:—

"On doit conclure de ces observations que les tensions électrique des extrémités de la pile ne sont pour rien dans les phénomènes dont nous nous occupons, car il n'y a certainement pas de tension dans le reste du circuit; ce qui est encore confirmé par *la possibilité de faire mouvoir l'aiguille aimantée a une grande distance de la pile*, au moyen d'un conducteur très long, dont le milieu se recourbe dans la direction du méridien magnetique, au-dessus, et au-dessous de l'aiguille. Cette expérience m'a été indiquée par le savant illustrė (Laplace†) auquel les sciences physico-mathematiques doivent surtout les grands progrès qu'elles ont faits de nos jours: *elle a parfaitement réussi*. . . . D'après le succès de cette expérience, on pourrait, au moyen d'autant de fils conducteurs et d'aiguilles aimantées qu'il y a de lettres, et en plaçant chaque lettre sur une aiguille différente établir, à l'aide d'une pile placée loin de ces aiguilles," &c., &c.

Here were "mechanical effects" produced at a distance by Ampère in 1820, who unquestionably used the intensity battery. The needle was deflected, which is a *mechanical effect*; and the Abbé Moigno, in remarking on this passage from Ampère, says that one might conclude that the Electric Telegraph was practicable in 1820—"si l'on avait pu parer dés lors à deux

* Annales de Physique et de Chimie, t. XV., p. 72.
† This gives the first suggestion of a *needle* telegraph to Laplace.

inconvénients très graves, l'action irrégulière des piles, et surtout la décroissance rapide de leur *intensité.*"

The rapid decrease of the *intensity*, in the intensity battery then in universal use, was an obstacle to the practicability of the Telegraph; it was a defect common to the pile, the "couronne des tasses," and the Cruikshank's battery; nor was this defect of "rapid decrease of intensity" remedied, until Daniel's & Grove's improvements, in the invention of the *sustaining* battery. There is not a particle of advance on this experiment of Ampère, of 1820, so far as producing "*mechanical effects*" *at a distance* is concerned, in Henry's experiments of 1831.

In the light of these facts and experiments, in which an *intensity battery* had been successfully used to propel a current of galvanic electricity effectively to produce mechanical effects at a distance, Barlow seems rather to have proved that a single pair, or *quantity* battery, *would not answer* for telegraphic purposes, while Soëmmerring, as well as Ampère, had shown, by actual experiment, that an intensity battery would answer to propel a current through a long wire; and Ampère, that it would produce *mechanical effects* at a distance. Prof. Henry used only means which Soëmmerring and Ampère had used before him; and the utmost that can be awarded to him, therefore, on this point, is the restoring the *status quo* of the previous opinion disturbed by the opinion of Prof. Barlow.

One word in regard to *the application of the Cruikshank's battery*, to propel the current through a long wire. Such application was an event inevitable, especially after Soëmmerring's or Ampère's experiment; it would, indeed, have been more surprising, if this intensity battery had not been applied, than that it was so applied. For there were, at that time, only two kinds of galvanic batteries in use, to wit: the "*single element,*" "*single pair,*" or *quantity battery;* and the battery of many pairs, called the *Voltaic pile*, the *couronne des tasses* and the *Cruikshank's battery*, the *intensity* battery, and this last, among the first and most common intensity batteries in use. I say, then, the application of the *intensity* battery to the Telegraph was an act inevitable. No one, for example, could repeat Soëmmerring's, or Ampère's, experiments, with a view to ascertain how far they

had gone in solving the problem of an Electric Telegraph, or to ascertain how he might improve upon their plans, without *using the Cruikshank's*, or an *intensity battery*. It could not be avoided; for the repeating of their experiments could not be influenced by any conclusions to which Barlow had subsequently arrived, from the use of a *single pair* battery.

The obstacle remaining in the way of the establishment of the Telegraph, was not removed either by Soëmmerring, by Ampère, or by Henry. Even the result which Prof. Henry announces *as* "*certain*," proves to be not correct, as experience shows. There *is* "*a sensible diminution*" in the magnetic action of a current in passing through a long wire, if not sensible in the trifling distance of 1,060 feet, from which he drew his inference; yet experience abundantly proves that, through telegraphic conductors of great length, there is a sensible diminution of effect as the length of wire increases; and although both Soëmmerring, Ampère and Henry, (the two former quite as much as the latter,) in their use of the Cruikshank's intensity battery, suggest the kind of battery best to be used for telegraphic purposes, yet neither of them suggests the remotest hint of any method to overcome the most formidable obstacle that remained foreshadowed, by observing even the *least diminution* of effect as the length of wire increases. A slight diminution observable in a mile, points inevitably to a limit beyond, where, at length, no effect can be produced; and this is fatal to a Telegraph, unless further discovery be made of some mode of overcoming the difficulty. It is not pretended that Prof. Henry has given the slightest hint of any means of overcoming this obstacle in any of his "published researches," nor is there made any claim for him to that effect, until the publication of his deposition of 1849.

In view of these facts, how is it that such exorbitant claims to discoveries in science, bearing upon the Telegraph, have been set up by legal counsel in behalf of Prof. Henry, mainly, as it would seem, for the purpose of disparaging my claims? The process has been one of mystification.

Two things, totally distinct, have been confounded in the judgment formed of Henry's paper in Silliman's Journal. That paper does announce a great improvement in the construction of an electro-magnet for a specific purpose, to wit: for the

attainment "of *great magnetic power* from a *small galvanic element;*" and hence, without inquiring whether such improvement has any bearing upon the Electro-magnetic Telegraph, the conclusion has been hastily adopted, that because Prof. Henry has made an improvement in the *lifting power of the magnet*, therefore he is entitled to the credit of improvement in the Telegraph, and this apparently on the sole ground, that he incidentally refers to a proposed (or what he presumed was a proposed) Electro-magnetic Telegraph, by Barlow. Henry's improvement in the magnet was not made with reference to the Telegraph, is of no use in it, as I have said, and, indeed, has no applicability to it. The reference which he makes to the Telegraph in his "published researches" relates to *the propulsion of a galvanic current by an intensity battery to a distance*, not for the purpose of making an electro-magnet of any kind at a distance, but only for the purpose of deflecting a needle.

It may be incidentally remarked, that the professed object of Henry, in his experiments, is precisely the *reverse* of my object in my experiments. Prof. Henry's object was to produce "*great magnetic power*, with a *small galvanic element.*" My object was to produce a magnetic power, however *small*, at a distance, by a galvanic element arrangement, however *large.*

One of the difficulties that seemed most formidable from the outset, that, indeed, which weighed most heavily upon me, arose from observing that, *notwithstanding I had used a Cruikshank's battery*, (*the intensity battery*,) *to propel a galvanic current with an apparently trifling diminution of effect*, through a distance of a few hundred feet, yet the fact that there was *any diminution* as distance increased was suggestive of a limit somewhere, and not far off, where the effect must cease altogether. This difficulty I had indeed remedied by a repeating apparatus, (the receiving magnet, and combined circuits,) so far that the uncertain, or rather unascertained limit of effective motion at a distance being reached, I had the remedy prepared, of a second link, to repeat the effect to a similar distance further on; but here a new obstacle arose, bearing not so much on the *practicability* as the *practicality* of the Telegraph, from the still unascertained limit of this single link, suggesting numerous repeating stations, and, consequently, increased expense to such a degree,

it might be, as still to render the Telegraph, not from any scientific objection, so much as from an economical one, impractical.

In my conception and invention, certainly, as early as March, in 1837, (see extracts from Gale's deposition,) of my receiving magnet and combined circuits, no reader of anything that Prof. Henry had then published will say that there was any hint, by him, of any such contrivance. How does anything proposed in the paper of Henry, of 1831, apply to the removal of the obstacles I have just mentioned to an Electro-magnetic Telegraph? The *deflecting needle* Telegraph was the only Electro-magnetic Telegraph then known or dreamt of, and this is conclusive that Prof. Henry, addressing the conscious knowledge of the scientific mind, at that date, could have had no other kind of Telegraph, in his own mind; certainly no subsequently invented one, unless distinctly suggested by him at the time, and this it is not pretended that he has done. He did not suggest any other; his allusion is only to the one then projected, or rather supposed by him to have been projected by Barlow, a *needle* Telegraph, not to a kind not then in existence. How, then, I say, does anything that Henry proposed, in 1831, apply to the removal of the obstacles I have mentioned as standing in the way of a practical Electro-magnetic Telegraph? There is in his paper an interesting experiment (experiment 7), in which we learn that a Cruikshank's battery, of 25 pairs, was found to be more effective in "producing greater magnetic effects on soft iron after traversing more than one-fifth of a mile of intervening wire, than when it passes only through the wire surrounding the magnet." Then follows Prof. Henry's observation on this discovery, "that the effect of a current from a trough, (that is, an intensity battery,) if not increased, is but slightly diminished in passing through a long wire, is certain." And then, again, "the fact that the magnetic action of a current from a trough is, *at least*, not sensibly diminished, by passing through a long wire, is directly applicable to Mr. Barlow's project of forming an Electro-magnetic Telegraph." All this is very well, so far as it goes; but it goes no farther, as I have shown, than others had gone before him. Neither their discoveries, nor Prof. Henry's, go the whole length of solving the difficulties.

As the experiment left Henry's hands, was there nothing further to be discovered and applied to insure the success of the Telegraph? There is a general direction that a battery of many pairs, an intensity battery, is best for long wires. This, however, is the inevitable inference also from Soëmmerring's experiment, 18 years, and Ampère's, 11 years before. But there is no law discovered, no ratio observed between the number of plates in the battery, the length of conductors, and the effect produced, so as to direct to the distance apart at which repeating stations must be placed. The experiment of Soëmmerring, in 1812, and Ampère, in 1820, as I have observed, are as satisfactory to me in solving any difficulty of that kind, as the experiment of Henry.

But setting this aside for the moment, and allowing to Henry's alleged discovery all the force of originality on this point, to what does it amount? Twenty-five pairs produced a decidedly powerful and encouraging effect through 1,060 feet, or one-fifth of a mile. The inference is a fair one, that to a certain extent the same effect, or one but "*slightly diminished*," can be produced at a greater distance; but with how many pairs; and to how much greater distance? and, especially, with *what diminished effect?* What is the amount of the loss by "*retardation of the velocity of the current*," by increased distance? and then, specially, what is the *remedy* for this loss?

How does Prof. Henry resolve these difficulties? He asks an important question, in the attempt to account for the fact he had noticed; but he leaves it unanswered, and it remains rather to embarrass than to clear up the mind of the inquirer. "May it not be a fact," says Prof. Henry, "that the galvanic fluid, in order to produce the greatest magnetic effects, should move with a *small velocity*, and that in passing through one-fifth of a mile, *its velocity is so retarded* as to produce a greater magnetic action?" Now the *retardation of velocity* in one-fifth of a mile, suggests a *greater* retardation in a mile, and a final *cessation* at some unknown distance beyond. Thus the very cause of magnetic effect which he hypothetically proposes, to wit, "*retardation of velocity*," substitutes a new difficulty, quite as formidable as the one he professes to have removed. I repeat, therefore, there is

nothing in Henry's paper that provides against this exigency, nor hints at any mode of overcoming the difficulty.

I come now to show that this difficulty, consequent on the fact of a "*slightly diminished current*," was overcome by me.

In view directly and distinctly of such a foreshadowed limit to the effective action, even of the most powerful voltaic battery, at some unknown distance, my mind was engaged, as early certainly as 1836, in devising the means of removing this apprehended obstacle to the Telegraph. Hence resulted, first, the *devising* of the plan of *combined circuits* in *successive links*, connected by receiving magnets, which plan was then freely conversed upon with Dr. Gale before its actual invention (or the actual embodiment of the idea); and second, to demonstrate the action experimentally, it was then invented, or put into apparatus, as early as the first week in March, 1837, by embodying the device in an actual combined circuit and receiving magnet. Dr. Gale's testimony (at page 176 Supreme Court Record) is conclusive on this point. This was the mode I invented to overcome the difficulty suggested by a diminution of effect as the length of the conductors increased; and no research, though diligently and perseveringly made by my opponents, has yet discovered a prior date to this invention.

I thus had at command the means of repeating an effect at a distance. But there still remained another problem to solve, bearing rather upon the economy or practicality of the enterprise, than upon its actual *practicability*. This may be stated thus. Given the length of a conductor forming a single link through which the desired effect can be produced, the receiving magnet and combined circuits furnish the means of repeating that effect in successive combined links of the same length, to any distance, even around the globe.

But *the length of that single link* was yet to be ascertained. How long may that link be? Can the current be made effective for a single link of one, two, ten, twenty, one hundred miles? For the number of repeating stations in a distance of thousands of miles must be governed by a solution of this question. What facts in science had been discovered bearing on this question? Two laws opposed to each other, bearing upon the conductibility of the current, were announced, the one by Barlow, in 1824,

the other by Ohm, in 1827. I will use Professor Page's clear statements of these two laws of conduction. Barlow's law was, "*That the conductibility was inversely proportionate to the square of the lengths, and directly as the diameters of the wires, (or as the square roots of their sections.*")

The other, and the true law, as expressed by Dr. Page, is, "*the resistance by bodies to the conduction of electricity, is directly as their lengths, and inversely as the areas of their cross-sections.*"

"This law," says Dr. Page, "was proved many years since by Davy, Pouillet, Becquerel, Christie, Ohm, Fechner, and others." Thus, Barlow's law was proved unsound by what is now known as Ohm's law. Priority in the discovery of this law has been contested among some of these distinguished savans, a question not pertinent to settle in the present disquisition, as it is sufficient for my purpose to know that the law, by whomsoever discovered, was established and published at least two years before Professor Henry made his experiments, and four years before he had published them. All the facts of science, therefore, necessary to be established to make the telegraph practicable, up to the single point of determining the practical length of the first link of the great chain of the combined circuits which I had invented, had been developed and established and published previous to Henry's experiments, and consequently, his results, whatever they may be, were not indispensable to my success in my invention.

Who, then, determined this remaining point? It was not Prof. Henry. Recurring to the previous mode of telegraphing, and the necessity that the *repeating stations* should be in telescopic sight of each other, it is perceived that in a line of telegraphs of 1,000 miles in extent, (assuming that ten miles is a practicable distance with the telescope,) there must be one hundred stations.* Hence I felt an anxiety, while inventing the new Telegraph, certainly not to exceed the number of stations of the old mode. No one, as I have said, had determined by actual experiment the distance to which a current could be effectively propelled through a single circuit, by one electro-

* The average distance in France was less than three miles between the stations; so that in a distance of 1,474 miles, there were no less than 519 stations.

motor; no one had thus determined the length of the first link of a chain of circuits. Should this be no more than ten miles, my Telegraph was then practicable; but should it be proved that twenty, fifty, one hundred miles, or more, were a practicable length for a single link, its still greater triumph over the old modes would be manifest, and would insure its practical success.

I think no one can read my narrations at various times previous to 1844, published in the Congressional Documents, without perceiving that this point was one which seriously occupied my mind. It was one not necessary, as I have said, to prove the *practicability* of the Electric Telegraph; for if only a mile was the limit of that link, it was *practicable;* but that the Telegraph be *practical*, it was a preliminary point necessary to be resolved, since it bears directly on the Telegraph as a practical or commercial enterprise.

In my letter to the Hon. C. G. Ferris, one of the House Committee of Commerce, dated December 6th, 1842, and printed in Vail's book, at page 89, I have thus written:—"I have, nevertheless, been able to resolve all the doubts that lingered in my own mind, in regard to the perfect practicability of establishing my telegraphic system to any extent on the globe. I say 'doubts that lingered in my own mind.' The principal, and, indeed, the only one of a scientific character which at all troubled me, I will state, and the manner in which it has been resolved.

"At an early stage of my experiments, I found that the magnetic power produced in an electro-magnet by a single galvanic pair, diminished rapidly as the length of the conductors increased. Ordinary reasoning on this fact would lead to a conclusion fatal to the whole invention, since at a great distance I could not operate at all, or, in order to operate, I should be compelled to make use of a battery of such size as would render the whole plan in effect impracticable. I was, indeed, aware that by multiplying the pairs in the battery—that is, increasing the intensity, or its propulsive power—certain effects could be produced at great distances, such as the decomposition of water, a visible spark, and the deflection of the magnetic needle. But as magnetic effects, except in the latter case, had not, to my knowledge been made the subject of careful experiment, and as these va

rious effects of electrical action seemed in some respects to be obedient to different laws, I did not feel entirely assured that magnetism could be produced by a multiplication of pairs sufficiently powerful at a great distance to effect my purpose. From a series of experiments which I made, in conjunction with Prof. Fisher, during the last summer, [1842,] upon 33 miles of wire, the interesting fact so favorable to my telegraphic system was fully verified, that, *while the distance increased in an arithmetical ratio, an addition to the series of galvanic pairs of plates increased the magnetic power in a geometric ratio.* Fifty pairs of plates were used, as a constant power. Two miles of conductors at a time, from two to thirty-three, were successively added to the distance. The weight upheld by the magnet from the magnetism produced by fifty pairs, gradually diminished up to the distance of ten miles; after which, *the addition of miles of wire up to thirty-three miles,* (the extent to which we were able to try it,) *caused no further diminution of power.* The weight then sustained was a constant quantity. The practical deduction from these experiments is the fact that, with a very small battery, all the effects I desire, and at any distance, can be produced. In the experiments alluded to, the fifty pairs did not occupy a space of more than eight cubic inches, and they comprised but 50 square inches of active surface.

"The practicability of establishing my telegraphic system is thus relieved from all scientific objections."

At a later period, on the 8th of August, 1843, having one hundred and sixty miles of wire prepared, I repeated the experiments of 1842 in a modified form, and a publication of the results were made in Silliman's Journal of Science, Sept., 1843, with a diagram of the curves projected from both these series of experiments, accompanied by a paper on the law of the conducting power of wires, by my distinguished and learned friend, Prof. John W. Draper, of the New-York City University. This paper, with the diagrams, are given by Mr. Vail, in his book, at pages 53 to 56.

Thus, it will be perceived, that in 1842, seven years before Prof. Henry gave his deposition, and also in 1843, six years before, these experiments of mine, and these results, were published in Congressional documents, and in a Scientific Journal.

They were experiments to determine whether the first link of a chain of circuits was within a *practical* distance; and they did satisfactorily determine that that link was of such a length (more than 33 miles in the one case, and 160 miles in the other,) as to make my Recording Telegraph not only *practicable*, but *practical*.

Were not those experiments within the sphere of electrical science? and was not the deduction from them a scientific deduction? Was not this deduction an original discovery in electrical science, applicable to the invention of the Telegraph? Was it not definitely, that the length of the circuit composing the first link of a telegraph line was so great, that the Telegraph was proved *practical*, as it before had been proved *practicable?* If so, how is it that Prof. Henry (who could scarcely have been ignorant of my experiments, since I sent him, at the time, the printed Congressional document in which they were published,) could say, in his deposition, "I am not aware that Mr. Morse ever made a single original discovery in electricity, magnetism, or electro-magnetism, applicable to the invention of the Telegraph?"

I have already commented at large on the paper in Silliman's Journal of Science, Vol. XIX., 1831, which is principally referred to by Prof. Henry, as containing his discoveries bearing on a Telegraph; and that it may be critically examined, I have embodied it in full in the Appendix. Yet, lest a vague impression may exist that there are other publications of his which contain discoveries pertinent to the case, I will briefly review them all.

The *first* of these "published researches" on the subject of Electro-magnetism, is to be found in the "Transactions of the Albany Institute," Vol. I., Art. IV., page 22, occupying three pages, and read Oct. 10th, 1827, but collected, with other papers of the Society, and published in 1830. It is entitled, "*On some Modifications of the* ELECTRO-MAGNETIC APPARATUS, *by* JOSEPH HENRY." The sole object of this paper is to announce, as its title indicates, some modifications of the Electro-magnetic apparatus already in use, as improvements, or additions, to some constructed by Sturgeon and others, for class illustration of experiments for "deflecting the magnetic needle," "for showing

De la Rives ring," the action of "two conjunctive wires upon each other," and "the dipping needle." Prof. Henry was desirous of forming, as he says, "a set of instruments, on a large scale, that would illustrate all the facts belonging to the science, *with the least expense of galvanism*,"* and he accomplishes his object by applying Schweigger's multiplier to the deflecting of the needle, and also of a wire charged with a galvanic current, to supply the defects of Mr. Sturgeon's apparatus. This is all that is pretended in this paper, and I presume it will not be asserted that there is anything contained in it bearing upon the Electro-magnetic Telegraph.

It may be here noticed, that in his deposition, Prof. Henry, after speaking of the above publication, states that in 1828 he commenced "the investigation of the laws of development of magnetism in soft iron;" that "the first idea that occurred with reference to increasing the power of the electro-magnet, was that of using a longer wire than had before been employed;" he states, also, that he "exhibited to the Albany Institute in March, 1829, electro-magnets of this kind, which possessed magnetic power superior to that of any before known." But these experiments and results, it will be noted, were not deemed by him of sufficient importance to be published in the Transactions: not by any means of so much importance as his "modifications of electro-magnetic apparatus," published in the Transactions in 1830; and the announcement of their ever having been made, was not even published until 1831. If the credit of first making experiments with "*longer wires* than had been previously employed in constructing the coils or helices of the *electro-magnet*," is that which Prof. Henry would here claim, it appears to belong to him; but this was simply an *enlargement*, by addition of wire, of the *volute spiral helix*, which Professor Dana had two years before publicly and experimentally explained in his lectures. The only novelty of Prof. Henry's was the *adding* to the *length of the wire*. The wire of the helix was wound in a *volute spiral*, as Prof. Dana had wound it two years before. There was no new principle discovered; it was

* It cannot but be noticed that a *leading object* of Prof. Henry, not only in his experiments detailed in this paper, but also in the longer paper of January, 1831, in Silliman's Journal, is *economy of galvanism*.

but the mechanical and obvious application of an already known principle, and in accordance with the previous suggestion of at least one other philosopher.

But if there were a question whether Prof. Dana or Prof. Henry had priority in thus improving the electro-magnet, it is a point quite immaterial in its bearing on my telegraph invention. The magnet thus formed was in common public use, as I have before said, when I applied it, and combined it with other apparatus, to the production of my peculiar purpose. I never claimed as my invention the electro-magnet of Arago, nor any of its improvements. It is a matter altogether outside of my claim to the invention of the Electro-Magnetic Telegraph.

The *second* of Prof. Henry's "published researches," is the one just alluded to in the introduction, and published in the Appendix. It occupies eight pages in Silliman's Journal. I have already examined it at length, and I therefore dismiss it here with the single remark, that all the allusion to a Telegraph contained even in this paper, is comprised in *three and a half lines!* to wit:—

"The fact, that the magnetic action of a current from a trough is, *at least*, not sensibly diminished by passing through a long wire, is directly applicable to Mr. Barlow's project of forming an electro-magnetic telegraph."

The *third* and last of his "published researches" previous to 1838, is to be found in the American Journal of Science, Vol. XX., July, 1831. It is entitled, "Art. XVII." "On a reciprocating motion produced by magnetic attraction and repulsion, by Joseph Henry." This paper need not detain us long. No reader of it will be able to find any allusion to a Telegraph in an instrument, which Prof. Henry himself considered "not of much importance," and which he designates as "only a philosophical toy." He suggests, indeed, this general thought, to wit:—"Although in the progress of discovery and invention, it is not impossible that the same principle, or some modification of it, on a more extended scale, may hereafter be applied to some useful purpose."

No sentence could be worded in more general terms, none more full of diluting and qualifying phrases; "not impossible" that some future application of this principle, or something like

it—"some modification of it"—may be made and applied to some not now even conceived purpose, but this not till further discovery and invention!

In regard to this "philosophical toy," it can hardly be a very extraordinary step, after the previous discovery by others of a new mechanical force, the (*Electro-magnetic*,) to make the application of it to the most obvious of the mechanical powers, to wit: the *lever*. Is it claimed for Professor Henry that here he first applied electro-magnetic power to move a lever? If so, I have no wish to deprive him of the credit of it. I never claimed it for myself. Granting it to be his, his invention begins and ends in that single act, so far as this paper shows any use of it, or any suggestion of a use, he himself being the judge. The peculiarity of my use of the electro-magnet is, not that I move a lever* with it, but that the new power (which is not Professor Henry's discovery) is of a nature to be *commanded and nicely regulated at a distance* to carry out my original idea—*a Recording Telegraph*—and in a way in which no other power whatever had been previously commanded for the same purpose.

These three papers comprise the entire "Published Researches" of Professor Henry, up to the time of the planning of my invention of the Combined Circuits and Receiving-magnet, in 1836, and its embodiment in March, 1837. There is no evidence of any published or existing invention (of Professor Henry's, or of any person whatever) of a similar character, or for a similar purpose, previous to this date (March, 1837.) The "*Published Researches*," then, of Professor Henry, amount altogether to twelve pages, octavo, of a magazine, containing *three and a half lines of allusion to a Telegraph!* and on this slight basis is built the claim for Professor Henry, which is to deprive me of my claim to originality in my invention.

Here this point might be permitted to rest, but that Professor Henry's supposed claims to the invention of the Combined Circuits and Receiving-magnet (claims, if advanced at all, *first* advanced in 1849 in his deposition) have been the basis of assertions by opposite counsel, adverse to my right; and, there-

* The *lever* is not essential; it may be dispensed with.

fore, it is proper to give the deposition on this point a thorough examination.

From some parts of this deposition, notwithstanding his absolute silence on the subject in any of his "published researches," it has been not only inferred, but positively asserted, that Professor Henry had actually provided a remedy for this evil, of a slightly diminished current—and that, too, by a mode which, it is said, is, in principle, if not identically, like mine—and that he had even explained such a process to his pupils.

Previous to my invention, also, he says that he was shown, in London, by Professor Wheatstone, a different device for a similar purpose, in April, 1837, thus interposing two claimants, to wit: Professor Henry and Professor Wheatstone, as disputing my priority in this essential part of my telegraphic invention. I will thoroughly expose the baseless grounds of these pretensions.

First, then, what are the grounds upon which this part of the invention is claimed for Professor Henry?

The records of all Professor Henry's published researches, up to the time of my first intercourse with him, either personal or by correspondence, in May, 1839, will be consulted in vain to find a single hint to this effect. Had he any method of overcoming the difficulty when he wrote me his letter of May 6, 1839, (the first I ever received from him, and before I had any personal acquaintance with him,) when answering the general question which I had put to him in mine of April 24th, 1839?

I say in that letter, "Have you met with any facts in your experiments thus far, that would lead you to think that my mode of telegraphic communication will prove impracticable?" His answer to this question will surely indicate whether he had any plan to overcome any real or apprehended difficulty. What is his reply? "So far as I am acquainted with the minutiæ of your plan, I see no practical difficulty in the way of its application for *comparatively short distances;* but if the length of the wire between the stations be great, I think that some *other modification will be found necessary in order to develope a sufficient power at the other end of the line.*" Now, if Prof. Henry were conscious of having a plan at that time "*to develope a sufficient power at the other end of the line,*" would not here have been the place for some allusion to it? would he not have said something

to this effect:—this difficulty, however, I have long since overcome; I have a modification, which I have been in the habit of explaining for many years to my various classes, therefore, use my secondary circuit and receiving magnet, and the difficulty is obviated, you will then have the modification necessary for your purpose.—Whatever reasons may be assigned why he gave no hint of the kind, it is clear that in May, 1839, he had nothing like my receiving magnet and secondary circuit; yet at this very time, these parts of my Telegraph had been specified by me at the Patent Office, examined, and passed, and the patent ordered to be issued more than a year before, to wit: May 1st, 1838.

But there is another view of this matter. Giving to Prof. Henry the most favorable construction of his claims to discoveries bearing on the Telegraph; they may be stated thus, to wit: that an intensity battery propels the galvanic current to a distance, either with an "*increased effect*" as distance increases, or with an effect "*not sensibly diminished* by passing through a long wire." Now taking it for granted that he believed (and no one will doubt it) that these professed discoveries were correct in the results which he announces; that an intensity battery actually does, (what it is now well ascertained it does not do,) to wit: propel a current with an "*increased*" magnetic effect at a long distance, or that it propels a current at a distance with a magnetic effect "*not sensibly diminished*," (which is equally erroneous,) these results, however incorrect they have since proved to be, must at that time have operated on Prof. Henry's mind as *truths*, and have influenced his speculations on their applicability to the Telegraph project of Barlow *as truths*. In this aspect of the matter, it would appear perfectly conclusive, that Prof. Henry could have had no such device as a "receiving magnet or combined circuits," before he went to Europe, in 1837, and for the plain reason, that the alleged discoveries which he had made, or supposed he had made, rendered any such contrivance wholly unnecessary. A single long circuit, and an intensity battery, on the supposition that his results were correct, were to him all-sufficient. The means for attaining the end of a telegraph, if his discoveries were indeed real, were complete without any such devices, and under such circumstances a repetition of the apparatus, so as to form "combined

circuits," and "receiving magnets," would be but an uncalled for and superfluous complication. Invention, it is well known, grows out of a necessity; but here would be an invention without a necessity—an invention for no purpose. The inference is irresistible that Prof. Henry was mistaken in supposing that he had any such uncalled for device, before he went to Europe in 1837. There he saw Mr. Wheatstone's contrivance, which naturally suggested to him the modification of it of which he speaks.

But fortunately for the consistency as well as the integrity of Prof. Henry, he does not make this claim, however strongly it has been made for him by those who seek to deprive me of my claim in this respect. There are, indeed, *ambiguities* of language which have been misconstrued by opposing counsel, and a meaning elicited which seems to have so far satisfied Mr. Gillett, one of the counsel on the part of the plaintiffs in the case before the Supreme Court, as to lead him boldly to assert no less than *five times* in the course of his argument, merely on the uncertain conjecture of Prof. Henry as to a date, that he, Prof. Henry, had actually combined two circuits with a receiving magnet, and shown the invention, thus complete, to his classes of pupils in Princeton, before he went to Europe in 1837.

Whatever ambiguities of language, however, and seeming claim may there be found, his language interpreted in accordance with plain declarations which he has made in the same document, and elsewhere under oath, declarations without the least ambiguity, forbids that he can have intended to claim anything more than *showing to his pupils, as a class experiment, uncombined, a portion only of the single element of my combined circuits;* I repeat it, *showing to his pupils as a class experiment, uncombined, a portion only of the single element of my combined circuits,* a portion, too, not the discovery of Prof. Henry, but in existence as early as the invention of the electro-magnet, by Arago.

This I will clearly demonstrate before I have done.

The more clearly to make this point understood, I will state what is the great object or aim of my Telegraph; how the electro-magnetic power is applied to accomplish this object; and what part my combined circuits and receiving magnet perform in the process. And then examine what is stated in the depo-

sition to be Professor Henry's object, in any alleged device of his having any resemblance in principle or performance to my combined circuits and receiving magnet.

The main object in my telegraphic invention, as is abundantly set forth, is *Telegraphic Recording*, and by means of electro-magnetism. My new alphabet, adapted to the purpose, is to be marked or printed at a distance. This alphabet is formed by breaking into parts, conventionally, a *continuous line*, thus:

n *l* *t* *i* *u* *m* *s* *f* *a*
— · ——— — · · · · — — — · · · · — · · —

and by different combinations of the longer and shorter parts of such line, with the longer and shorter spaces between the broken parts, the various letters are formed. These letters are produced at a distance, by commanding the magnetic power of a galvanic current, induced in an electro-magnet, causing the current to flow, or to cease flowing at certain determinate intervals of time. *Duration*, both in the flow and the cessation of the current, is an indispensable element in the formation of a line, and also of a space, for forming my letters. The flow of the current of galvanism, and consequently the magnetic power, is caused by *closing* the circuit; the cessation of the current, and consequently the cessation of the magnetic power, is caused by *opening* the circuit. The *duration for a line* is marked by the *duration of the closing;* and the *duration for a space* is marked by the *duration of the opening* of the circuit. Two distinct and opposite acts are, therefore, equally necessary in forming every letter, to wit; *closing* and *opening* the circuit. The *closing* as well as the *opening*, and the *opening* as well as the *closing*, are equally and alike necessary to the result. They are indissolubly connected. *No letter* can be formed but by the conjoint acts of *closing* and *opening* the circuit. Hence, to produce the one or the other of these two acts, at pleasure, it is plain that the instruments at a station must be so constructed as to be controlled by the distant operator, enabling him to produce, at any moment, at his option, either of these two acts, to wit, the *closing* or *opening* of the circuit.

The *first part*, or element, of the combination in the combined circuits, consists of a single circuit of conductors, having in it a battery, an electro-magnet with its armature upon a lever, upon

which lever is a point or pen, brought in contact with a regularly moving strip of paper, when the magnet is charged with magnetism, and released from the contact with the paper by a reacting spring, while the magnet is discharged of its magnetism. The play of the armature of this magnet, or the sphere of its motion, is regulated by adjustable stops, so that during the attraction of the magnet, or flow of the current, it shall not come into actual contact with the poles, or face of the magnet; and during its retreat, while the magnet is without attraction, that is, during the cessation of the flow of the current, it shall not recede beyond the attraction of the magnet when again charged. The *opening* and *closing* of the circuit, is commanded by a key, or instrument, in which the broken parts of the conductors are readily united or severed at the will of the operator.

The *second* part of the combination, in the combined circuits, is similar to the first; is indeed a repetition or duplicate of the first, excepting that the registering instrument is dispensed with, and the magnet in the first circuit of the combination becomes a receiving magnet, that is, it receives the regulated impulses from the distant key, to be simultaneously communicated through the second circuit of the combination by *closing* and *opening* this second circuit. The receiving magnet performs, indeed, in this case, the office of a distant key, which is moved immediately by the electro-magnetic power of the receiving magnet, but is commanded by, and obeys, implicitly the action of the key under the hand of the operator, who thus *closes* or *opens* the second circuit of the combination simultaneously, and with the same exactness as he *closes* and *opens* the first.

Supposing, therefore, a limit of effective action in a long line, for directly marking the characters of the alphabet, by a single circuit, to be reached; my combination of circuits enables me (in the language of my patent) "*to extend more effectually the length* of any desired circuit of conductors, and to *perpetuate the power* of the electric or galvanic current equally throughout the same," and I thus successfully accomplish the ultimate end of my Telegraph, to wit: *the effective recording of letters at a distance.*

I now come to the examination of the *alleged* device of Prof. Henry to accomplish this purpose.

Here is all that he himself says, on this point, in his deposition proper:—

"In February, 1837, I went to Europe; and early in April of that year Prof. Wheatstone of London, in the course of a visit to him at King's College, London, with Professor Bache, now of the coast survey, explained to us his plans of an Electro-magnetic Telegraph; and among other things, exhibited to us his method of bringing into action a second galvanic circuit. This consisted in closing the second circuit by the deflection of a needle, so placed, that the two ends projecting upwards, of the open circuit, would be united by the contact of the end of the needle when deflected, and on opening or breaking of the circuit, so closed by opening the first circuit, and thus interrupting the current, when the needle would resume its ordinary position under the influence of the magnetism of the earth. I informed him that I had devised another method of producing effects somewhat similar. This consisted in opening the circuit of my large quantity magnet at Princeton, when loaded with many hundred pounds weight, by attracting upwards a small piece of moveable wire, with a small intensity magnet, connected with a long wire circuit. When the circuit of the large battery was thus broken by an action from a distance, the weights would fall, and great mechanical effects could thus be produced, such as the ringing of church bells at the distance of a hundred miles or more, an illustration which I had previously given to my class at Princeton. My impression is strong that I had explained the precise process to my class before I went to Europe, but [*testifying now without the opportunity of reference to my notes*,] I cannot speak positively.* I am, however, certain of having mentioned in my lectures every year previously at Princeton, the project of ringing bells at a distance by the use of the electro-magnet, and of having frequently illustrated the principle to my class, by causing in some cases a thousand pounds to fall on the floor, by merely lifting a piece of wire from two cups of mercury closing the circuit.

* In the Philadelphia case, 1851, as well as in the Boston case, 1850, the words in this last paragraph in Italics and brackets are left out, of his depositions, while the rest of the paragraph is retained. The fair inference from this is, that after having had "the opportunity of reference to his notes," he found nothing in them to confirm his impression. And a further inference taken in connection with the proofs of defective recollection already given, is, that he was mistaken in supposing he had explained any such contrivance as a combination of circuits, until after having seen Wheatstone's method in April, 1837, and on his return in the *autumn* of that year.

"The object of Prof. Wheatstone, as I understood it, in bringing into action a second circuit, was to provide a remedy for the diminution of force in a long circuit. My object, in the process described by me, was to bring into operation a large quantity magnet, connected with a quantity battery in a local circuit, by means of a small intensity magnet and an intensity battery at a distance."*

At this point, as serving to clear the ambiguity of his deposition in chief, if its perusal suggests to any one the idea that Prof. Henry had actually combined two circuits, I quote the 23d cross-interrogatory, with Prof. Henry's answer thereto, in the case (French vs. Rogers, Phila. Resp. Evid., pages 180 and 263, printed copy):—

Twenty-third. "If you have answered that you ever had any device of your own for breaking and closing a distant circuit, state and describe fully and particularly how it was made, each and every part of which it was composed, and the arrangement, connection and material of such parts, and who constructed the same, and where it was constructed, and whether it was used; and if yea, then by whom, how long, from what date to what date, how many times, to what extent, and for what purpose? And if you have stated, in this examination, that such device was one circuit of conductors to break and close another, then state how, and by what means they were connected and combined, designating or describing every piece and part of mechanism by which they were connected, and the use of every such part, and how long was each of such circuits?"

To which Prof. Henry answers:—

"To the *twenty-third* cross-interrogatory, on behalf of the plaintiffs, he answers: The *local circuit* devised by myself, and mentioned in my direct examination, was connected with a quantity battery and a large electro-magnet, loaded with several hundred pounds. When the ends of a forked-shaped wire were drawn up from the surface of mercury, contained in two cups,

* This last paragraph reads thus, as amended by Prof. Henry in 1851. "My object in the process *I have described*, was to *cause* a large quantity magnet connected with a quantity battery in a local circuit *to let fall its load* by means of a small intensity magnet, and an intensity battery at a distance."

(French vs. Rogers, Resp. Ev. p. 254.) Phila. case.

This being his emendation, after the lapse of two years for reflection upon the fact as set forth in his first deposition of 1849, may be considered the statement by which he is willing to abide.

(thimbles were used,) the circuit was broken, and the weights fell to the floor." (Let what follows be specially remarked.) "*This part*" (the *local circuit,*) "of the combination and action was actually and repeatedly exhibited in my lectures at Prince ton, from 1833 to 1848. I also accompanied the exhibition with the *statement,*" (not with a device showing it,) "that the same effect *could be* produced by the action of a battery at a distance, for ringing bells or producing other mechanical effects. The results of my first experiments in causing an electro-magnet to act through a long wire, furnished me with the means of accomplishing this. For this purpose, it was only necessary to attach the forked wire to the armature of a small intensity magnet connected with the long circuit, in which was also an intensity battery. When the current was passed through the long wire, the armature *would be* attracted upwards, the short circuit *would be* broken, and the weight *would* fall.*

"*I do not recollect to have exhibited the last part of this arrangement in my lectures, or remember when I invented it;* but the invention was made and explained to others, before the publication of Mr. Morse relative to his Telegraph."

It will be perceived that this cross-interrogatory is not answered, but for the most evaded. Yet it does dissipate the fog that hung over the essential point. The *combined circuits*, the matter on which light was sought to be elicited by this question, consists of two circuits *combined*, as the very name indicates, and for the accomplishment of a special, yet complex purpose. A portion only of the first part of a combination is described, that is, *one circuit* uncombined, an arrangement which was in existence, and exhibited to me as early as the beginning of the year 1827, in lectures before the New-York Athenæum, by Professor James Freeman Dana, and this before Prof. Henry

* It cannot escape observation that the *verbs* used by Professor Henry, in describing the part of the combination which existed, and which he exhibited to his classes, and the part which did not exist, and which, of course, he did not exhibit, are significant of the existence of the one, and the non-existence of the other. When he speaks of the former he says, "the local circuit, &c., *was* connected:" "when the ends of the wire *were* drawn up, the circuit *was* broken:" and "the weights *fell* to the floor." Here everything is described as a result that had been demonstrated by apparatus in existence. But when he speaks of the latter he says, "the same effects *could be* produced:" "when the current was passed through the long wire, the armature *would be* attracted:" "the short circuit *would be* broken:" and the weight *would* fall." Here everything is *conditional;* it is a *predicted* result of apparatus not in existence.

had any knowledge whatever of the science of electro-magnetism. This portion alone he describes, and states that he repeatedly exhibited it, in his lectures at Princeton, from 1833 to 1848. There is nothing extraordinary in this. It was but the ordinary class experiment, common then and now in the courses of Natural Philosophy, illustrative of the lifting power of the electro-magnet; the only novelty shown by Prof. Henry to his classes being, as was natural, a substitution of his more powerful quantity magnet for the feebler common electro-magnet, shown for the same purpose by Prof. Dana.

The "*other part* of the *combined circuits*," a part essential to be added, before there could be "*combined* circuits," was not exhibited in his lectures; he does not even "remember when he invented it." Questioned, "where it was constructed; whether it was used; then if yea, by whom; how long; how many times; to what extent; and for what purpose?" the general vague, indefinite answer is, "The invention was made and explained to others" (not in his lectures to his classes) "before the publication of Mr. Morse relative to his Telegraph."*

But he is asked, "for what purpose" he made the device. Although we get no definite answer here, we can gather it distinctly from his answers to interrogatories propounded on the same deposition in the Boston case.†

The sixth question is, "Had it not been proposed prior to 1832, to apply electro-magnetism, developed as above stated, to telegraphing?"

Prof. Henry replies, "I cannot say it had been definitely proposed; but I consider my publication, in the nineteenth volume of Silliman's Journal, as stating the applicability of the electro-magnet to telegraphic purposes; and after my call to Princeton, and in my first lecture to the students of that institution, in 1833, I exhibited the experiment of *causing a large weight to fall to the floor*, and stated that this effect *could be* produced at a

* No date is here fixed. The publication referred to cannot be earlier than that of October, 1837, in Silliman's Journal, because he elsewhere says, that this was the first knowledge he had of my Telegraph. So that this fact determines nothing in his favor, or against me as to priority, even if the inventions were in all respects identical. He had, at that date, been in Europe, seen Wheatstone, and returned, before he knew of my invention.

† Smith vs. Downing, pp. 93, 94.

distance, and that bells *might be* rung with it, and other mechanical actions *produced.*"

The purpose, then, of his "device" distinctly is, "to cause a large weight *to fall to the floor;*" "*the short circuit would be broken, and the weight would fall.*" "I frequently illustrated the principle to my class, by *causing in some cases a thousand pounds to fall on the floor.*" "My object in the process I have described was to *to cause a large quantity magnet,* connected with a quantity battery in a local circuit, *to let fall its load.*" This was the definite *purpose* of Professor Henry, and his end was attained, and by what means? "By *opening* the circuit." There is not a word respecting the *closing* of a circuit anywhere in his evidence, and for a very obvious reason—*opening* the circuit was the only act necessary for his purpose. "The short circuit would be *broken,*" (that is, *opened,*) "and *the weight would fall.*" All that he accomplished—all that he desired to accomplish before his class—the entire process was done by *opening the circuit;* if he had then *closed* the circuit again—even if the *actual* circuit, and *ideal* circuit, the two parts of which he speaks, had been actually put together, so as to form combined circuits—the *closing* would not, and could not, restore the *status quo,* and enable him to repeat the operation, without the invention of additional apparatus. Granting, then, for argument sake, that Professor Henry had actually combined his real and his ideal circuit, and made a system of combined circuits, his purpose was not my purpose, nor could my purpose be accomplished by his means; for it is shown clearly, that the *closing* as well as the *opening,* and the *opening* as well as the *closing,* are essential and conjoint operations in the formation of every character that I cause to be made for telegraphic purposes.

Sufficient has probably been said to satisfy any candid mind, that Professor Henry cannot legally or justly lay claim to any such invention or process as I have claimed in the receiving-magnet and combined circuits.

I will only add one word further on this point. The counsel of my opponents, in their zeal for their clients, seem to have been utterly regardless of the awkward position in which they have placed their witness in respect of consistency, by their overstrained efforts to make him the inventor of the receiving-

magnet and combined circuits. Professor Henry, in his evidence, draws this definite and just distinction between the terms *discovery* and *invention.* "The first," he says, "relates to the development of new facts; the second, to the application of these, or other facts, to practical purposes." He puts himself into the first category, priding himself only on being a discoverer of scientific facts, disclaiming explicitly having applied any of these facts to a process. He also says, that in his first lectures, at Princeton, in 1833, "he mentioned the *project* (Barlow's project) of the Electro-magnetic Telegraph, and explained how the electro-magnet might be used to produce mechanical effects at a distance *adequate* to making signals of various kinds; but lest it should be inferred that by thus simply mentioning the project, and explaining the ability of the electro-magnet to produce mechanical effects, the principles he had alluded to had been actually applied by him to a practical purpose, and so had passed from the abstract region of mere *discovery* into the practical and useful one of *invention*—he immediately adds, "I never myself attempted to reduce these principles to practice, or *to apply any of my discoveries to processes in the arts.*" What can be plainer than that Professor Henry intended to be understood that he made no such invention as the combined circuits and receiving-magnet, and intended to guard his language from any such misconstruction. By saying, then, (as Mr. Gillett in his argument boldly asserts) that the receiving-magnet "was invented by Professor Henry, and *used by him*, as he swears, years before Morse claims to have made the invention," he recklessly asserts that which Professor Henry himself repudiates, and leaps the barrier which Professor Henry had placed to shield himself from any such misconstruction; for if he had made such an invention, and "used it," he did "reduce these principles to practice," and did "apply his alleged discoveries to a process in the arts:" the very thing he emphatically disclaims.

But my opponents have two strings to their bow. If Professor Henry did not invent the combined circuits and receiving-magnet, Professor Wheatstone did; and, as if apprehensive that the claim of the former could not be sustained, they bring forward Professor Henry as a witness to show that Pro-

fessor Wheatstone invented such a contrivance before I invented mine. My argument here need not be long. I might take the ground that the contrivance of Professor Wheatstone is not the same as my contrivance, in its parts, its purpose, or results; that it could not accomplish my purpose, while mine would readily accomplish his purpose—and, therefore, granting that he had invented his contrivance before I invented mine, yet that mine being different in parts, and for a different purpose, and producing a different result, there could be no legal interference in our claims to our respective inventions.

It will be sufficient, however, to show that whatever Professor Wheatstone's invention is, mine was invented previously.

I quote from Professor Gale's deposition.

He says—"It was *early* a question between Prof. Morse and myself, where was the limit of the magnetic power to move a lever. I expressed a doubt whether a lever could be moved by this power, at a distance of twenty miles, and my settled conviction was, that it could not be done with sufficient force to mark characters on paper at 100 miles distance. To this Prof. Morse was accustomed to reply—'If I can succeed in working a magnet ten miles, I can go round the globe.' The chief anxiety at this stage of the invention was, to ascertain the utmost limit of distance at which he (Morse) could work or move a lever by magnetic power. He often said to me—'It matters not how delicate the movement may be; if I can obtain it at all, it is all I want.' Prof. Morse often referred to the number of stations which might be required, and which he observed would add to the complication and expense. The said Morse always expressed his confidence of success in propagating magnetic power through any distance of electric conductors which circumstances might render desirable. His plan was thus often explained to me. '*Suppose*,' said Prof. Morse, '*that in experimenting on twenty miles of wire, we should find that the pouer of magnetism is so feeble that it will but move a lever with certainty but a hair's breadth; that would be insufficient, it may be, to write or print, yet it would be sufficient to close and break another, or a second, circuit twenty miles further; and this second circuit could in the same manner be made to break and close a third circuit twenty miles further; and so on, round the globe.*'"

Here was the invention of the combined circuits, and the means of combination; to wit, the "*lever*," moved by electro-magnetism, to *close* and *break* a *second* circuit used with a receiving magnet, explained to Dr. Gale "early" after his seeing the Telegraph in operation; that is, then, in the early part of the year 1836. But although thus actually described, so that from the description and a knowledge of the purpose a mechanician could easily have made the invention, yet I will not here press this as the time of the invention, but will show the time when the circuits and magnet were *actually made* and experimentally *used.*

Dr. Gale proceeds—"This general statement of the means to be resorted to, now embraced in what is called the '*receiving magnet*,' to render practical writing or printing by Telegraph through long distances, was shown to me more in detail *early in the spring* of *the year* 1837 (eighteen hundred and thirty-seven,) and I am able to approximate the date very nearly from an accident that occurred to me in falling on the ice formed of late snow in the spring of that year. The accident happened on the occasion of removing to Prof. Morse's rooms in the University some pieces of apparatus to prepare a '*receiving magnet*' temporarily." Dr. Gale proceeds to illustrate the invention with a diagram, and adds, "This I depose and say was the plan then and there revealed and shown to me by Prof. Morse, and which, so far as I know, has constituted an essential part of his Electro-magnetic Telegraph from that day till the present time."

If the time testified to had been unaccompanied with any further evidence than that it was—"*early in the spring of the year* 1837"—a doubt might still exist as to the priority of the two inventions, since April 1st, 1837—the time when Wheatstone's plan was shown to Prof. Henry—might come within the meaning of "early in the spring;" but fortunately a circumstance is casually mentioned by Dr. Gale, in his narration, which has enabled me to fix the date conclusively. He says—"I am able to approximate the date very nearly, from an accident that occurred to me *in falling on the ice formed of late snow* in the spring of that year."

Here, then, is an incident which suggests a clue to the exact time; at least, to a time sufficiently remote to show that such an event must have happened before the 1st of April. Supposing

it to be the *latest* ice formed that year, upon which the slipping took place, (which is by no means certain, for it is possible it might have been on earlier ice,) such ice could not be formed unless the temperature of the atmosphere was below 32° of Fahrenheit. Nor could there be ice formed from snow at a freezing temperature, unless there were snow on the ground. There must be a coincidence of the two conditions—*snow* on the ground, and *a temperature to freeze it.* To ascertain this point, I was at much pains to find a record of the temperature and state of the weather in the city of New-York, from February to May of the year 1837; and, after much research, I at length found such a record, which had been regularly kept by a gentleman of the highest intelligence and character, who has for years, without the intermission of a day, made and recorded his observations at 8, A. M., and 3, P. M., and at 10, P. M., daily, at the corner of Prince and Crosby streets, with a northern exposure, and within musket-shot distance of the New-York City University. This record, so far as it bears on the points in question, I here append:—

Daily Record of the Temperature, and State of the Weather, kept at the corner of Prince and Crosby Streets, Northern Exposure, New-York City.

1837. February.	Temperature. 8 A. M.	3 P. M.	10 P. M.	State of the Weather.
Mon., 20	28°	40°	34°	Somewhat cloudy till 10, A. M.; then northerly, clear and very pleasant for several hours. Evening, cloudy, and after 10, rainy.
Tues., 21	32½	37	34	After a rainy night, a cloudy, disagreeable day; wind moderate. Baltimore harbor clear of ice, and vessels reach Philadelphia without the assistance of steamboats.
Wed., 22	30	38	34½	Somewhat overcast after 10 A. M., but very pleasant; wind light. On Thursday, P. M., a great snow storm at Cleveland, Ohio, Buffalo and Quebec; snow about 2 feet deep, much drifted by a high and very cold wind. At Quebec, mercury 8° below 0, during the day; wind from N. E.
Thurs., 23	32½	34	34	Snow commenced falling at 6, A. M, which, at ½ past 9, A. M., turned to rain, which fell heavily for several hours. After 3, P. M., foggy and misty. A. M., wind fresh.
Fri., 24	36	36	31	Mostly cloudy till noon, then clear, wind fresh.
Sat., 25	30	39	31	Clear and very pleasant; wind light.
Sund., 26	30	37	31	Clear and pleasant; wind moderate; Hudson open to Nyack, about 25 miles.
Mon., 27	37½	41	34	Cloudy, and P. M., rainy; wind light; about ½ past 11, P. M., it commenced snowing.
Tues., 28	19	22	17½	*Snowed* last night about 2 inches, much drifted by a high wind from N. To-day, clear and windy; somewhat overcast and windy, P. M.; a cold day.
March.				
Wed., 1	17	27	23	Somewhat cloudy; wind light; (snow, this day, at Philadelphia, 3 or 4 inches deep,) none here.
Thurs., 2	15	23	20	Mostly clear, A. M.; mostly cloudy, P. M., and in the evening, *light snow*; wind light.
Fri., 3	18	26	14	*Light snow* during the night, about ½ inch deep; after 9, A. M., clear cold morning. (At Quebec, on Monday, a severe snow storm; snow 5 or 6 feet deep, on a level, in the woods.)
Sat., 4	10	22	17½	Clear, calm, and very cold. Good sleighing at Philadelphia, 8 inches deep; and floating ice in the river.
Sund., 5	22	32	26	From ½ past 7 to ½ past 8, A. M., a light fall of *snow*; after 9, mostly clear and pleasant.
Mon., 6	23	34	33	Clear and pleasant. (On Saturday, snow fell 12 inches deep at Savannah, Ga.; deepest snow known for 37 years.)
Tues., 7	32	42	34	Hazy and partly cloudy; very pleasant day.
Wed, 8	34	40	40½	After 9, A. M., rainy, and in the evening, fresh wind.
Thurs., 9	40	41	37	A. M., foggy, and occasional sprinkling of rain; after 4, P. M., rainy.

	1837. March.	Temperature. 8 A. M.	3 P. M.	10 P. M.	State of the Weather.
Frid.,	10	34°	41°	36°	Clear and pleasant.
Sat.,	11	33	41	34	Clear and very pleasant.
Sun.,	12	31	41	36	Somewhat overcast, and P. M., windy.
Mon.,	13	37	50	50	Rainy, and P. M., windy; at 11, P. M., a hard rain.
Tues.,	14	44	39½	32	Mostly clear and rather windy.
Wed.,	15	26	36	30	Cloudy till 9, A. M., then most clear. Freshets to the North and East, by the heavy rains of Sunday and Monday.
Thurs.,	16	26	37	30	Clear and pleasant; the ice in the Hudson moved, opposite New-York, on Monday, but remains fast below.
Fri.,	17	31	44	36	Clear, and P. M., windy. Hudson open to West Point.
Sat.,	18	41	48	40	Cloudy, and P. M., rainy till evening; then windy.
Sun.,	19	32	36	26	Clear, cold and windy.
Mon.,	20	28	38	32	Mostly cloudy, A. M., and, at 9, a flurry of snow. P. M., clear, windy.
Tues.,	21	34	37	34	Mostly cloudy and windy, and after 5, P. M., very rainy.
Wed.,	22	36	34½	34	Heavy rain and high wind all night; to-day, very rainy and misty; wind fresh.
Thurs.,	23	34	37	36	Rainy; wind moderate; a steamboat, this day, made her way through the ice to Newburg, from New-York.
Fri.,	24	36	46	39	Somewhat cloudy, but very pleasant; wind light.
Sat.,	25	38	49	39	Clear and very pleasant; freshets in New-Jersey from heavy rain on Tuesday and Wednesday last.
Sund.,	26	41	48	39	Clear and very pleasant; Hudson open to Poughkeepsie.
Mon.,	27	39	48	38	Cloudy till 10, A. M., and early in the morning some rain; afterwards somewhat hazy, but very pleasant.
Tues.,	28	37	49	46	Foggy till 10, A, M.; afterwards hazy and somewhat cloudy, but very pleasant. About 9, P. M., a shower, with some thunder and lightning.
Wed.,	29	36	43	30	Clear and cold, rather windy, P. M.; steamboat reached Hudson.
Thurs.,	30	28	40	36	Mostly clear till 4, P. M., then overcast.
Fri,	31	37	40	36	Cloudy, and P. M., rainy and misty; this day first steamboat reached Albany.
	April.				
Sat.,	1	37	42	35	Rain till 9, A. M.; afterwards clear and pleasant.
Sun.,	2	34	45	40½	Clear and pleasant, windy, somewhat cloudy.
Mon.,	3	39	51	35	Slight rain early, A. M.; afterwards misty, clear and windy.
Tues.,	4	35	33	32	Cloudy, and P. M., flurry of snow; wind light. (Yesterday, at St. Louis, snow 17 inches deep.) No snow whitened the ground in New-York.
Wed.,	5	32	42	36	Clear and pleasant.
Thurs.,	6	39	49	41	Clear and very pleasant.
Fri,	7	40	48	44	Cloudy, and, after 5, P. M., rainy, with a fresh wind.

1837. April.		Temperature. 8 A.M.	3 P.M.	10 P.M.	State of the Weather.
Sat.,	8	47°	47°	41°	The lowest temperature, after the 5th of April, is on the 23d, to wit: 32½ degrees; not low enough to form ice, and without *snow on the ground*, even if the temperature had been lower. On the 4th and 5th, the thermometer was at 320, but no snow was on the ground.
Sun.,	9	40½	47	41	
Mon.,	10	40	54	41	
Tues.,	11	41½	59	43	
Wed.,	12	43	62	46	
Thurs.,	13	46	54	43	
Fri.,	14	47	53	46	
Sat.,	15	45	56	49	
Sun.,	16	44	51	49	
Mon.,	17	46	55	49	
Tues.,	18	43	49	41	
Wed.,	19	42	55	43	
Thurs.,	20	43	55	43	
Fri.,	21	43	50	42	
Sat.,	22	40	49	42	
Sun.,	23	44	39	32½	
Mon.,	24	34	48	41	

On examination of this record of temperature and the weather, it is found that on Sunday, the 5th of March, there was a light fall of snow, with a temperature until Monday noon the 6th, which would keep it from thawing; but that, then, it must have thawed at 34°, and frozen again at night, so that on Tuesday the 7th the two conditions of snow on the ground, and a temperature to form it into ice after a thaw, coincided, and these conditions do not meet again after that date. The temperature is often low enough afterwards to form ice, but the weather has not produced the snow upon the ground coincident with the temperature for that purpose.

On the 20th March for example, there was a flurry of snow, but the temperature could not have formed it into ice even if it were more than a flurry.

No snow lay on the ground after the 6th of March. The conclusion, therefore, appears to me irresistible, that the time of Dr. Gale's accident, in "slipping on ice, formed of late snow," must have been on Tuesday the 7th of March, or if not at that time, it must have been even *earlier* in the season. It could not possibly have been *later*.

Suppose, then, that Prof. Henry was shown by Prof. Wheatstone a device identically like mine on the 1st of April, 1837, my combined circuits and receiving magnet were made and used experimentally *previous* to that date.

But grant that Prof. Wheatstone's device of combined circuits was identical in its construction, purpose, and results with mine

(which is not true); granting, further, that it was invented previous to mine (which, also, is not true); it is perfectly clear that my invention could not be the result of a knowledge of his. This will appear from the fact that December, 1837, is the date of the enrolment of Prof. Wheatstone's patent; and any one conversant with English patent law will readily perceive, that his invention could not have been published previous to that date without nullifying his patent. His imparting his plan to Prof. Henry in April, 1837, was at this risk; and I am not sure that an opponent of his patent might not have used Prof. Henry's testimony on this point in his deposition successfully to annul it.

THE DESTRUCTION OF AN IMPORTANT PART OF THE RECORD BY FIRE.

I come now to notice an important item of testimony bearing on the question, "Did I, or did I not derive from Prof. Henry the scientific knowledge necessary to my purposes in the Telegraph?" This testimony was excluded from any influence in the decision of the Supreme Court, by its mysterious destruction by fire.

It is not generally known, probably, that a portion of the Record, in this case, sent up from the Court below, was thus mysteriously destroyed by fire in the office of the Clerk of the Supreme Court, in the Capitol at Washington, on the — day of April, 1852.

Among the documents thus destroyed was the original sketch-book I had on board the ship *Sully*, in 1832, in which were some of the drawings then and there made of parts of the Telegraph, especially the elaboration of the characters or marks for recording, with the form and proportions of the type, &c., for that purpose. Also a bag containing some of the type, made after the pattern there delineated, and cast in the latter part of the year 1832. Also the original autographic manuscript lectures, 1, 2, 3, and 4, of Prof. James Freeman Dana, as delivered by him before the New-York Athenæum, in 1827. Also the original electro-magnet with which he illustrated the nature of the electro-magnet in these lectures.

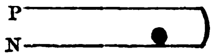
After the announcement of this untoward accident, I presumed these documents, and whatever light they were capable of throwing upon the truth in this case, were irrecoverably lost. But to my surprise and gratification, I have lately discovered [1853] that certified copies of both the sketch-book and Prof. Dana's lectures were taken previous to the transmission of the originals to Washington: The copy of the sketch-book, certified to by John H. Hanna, Clerk Circuit Court, Kentucky District, and the copy of the lectures certified to by George S. Hilliard, Esq., of Boston, Commissioner before whom Mrs. Dana's deposition was taken. I have, therefore, for the purposes of correct evidence, virtually the original documents restored, and shall therefore appeal to these certified copies as to the originals.

I need scarcely remark, that any advantage my cause might have derived from the documents, &c., destroyed, was in consequence of that destruction lost to me. No use was made, or could be made of them, before the Supreme Court. The certified copies were discovered too late to be of service to me there. They may be of some service now.

To show that I do no injustice to Prof. Henry in denying that I derived from him the facts and scientific principles in electro-magnetism on which my Telegraph is based, I quote at some length from these manuscript lectures of Prof. Dana, which, as I have said, *were delivered in public, and in my hearing, in the year* 1827.

In his second lecture, Prof. Dana says, "The effect of the conjunctive wire in impressing the magnetic state is uniform and constant, and we can infer with absolute certainty the kind of magnetism which will be exhibited by either end of a needle, by reference to its position with regard to the wire. We are led to this by our previous knowledge of the positions assumed by a magnetic needle under the influence of the wire. Thus, if the electric current flow from the right hand to the left, and the needle to be magnetized be placed over the wire, the end pointing from us will acquire the austral magnetism, or a north polarity, &c. We have seen that the pole of the magnetic needle, *over* which the positive electricity enters, turns to the east, but the pole *under* which it enters, turns to the west. If,

therefore, a needle be placed between two conjunctive wires situated in the same vertical plane, and transmitting the electric current in opposite directions, it is evident that both will conspire to produce the same effect, which will, consequently, be much more considerable than that produced by either of them alone; but a wire bent in this form,



having its two ends connected with the opposite poles of the Voltaic instrument, will evidently have the electric current passing in opposite directions in its upper and lower portions, and, consequently, it will produce on a needle, between them, an effect similar to that produced by the two wires. Wires thus situated produce a more prompt development of magnetism in steel, than a single wire does, because both tend to turn the same kind of magnetism in the same direction, and the opposite magnetisms in opposite directions, and hence we have one method of measuring the action of a battery on steel bars. Again, two parallel wires, having the electric current moving through them, in the same direction, will, evidently, produce a greater effect on a steel bar than either of them alone, for the effect of the whole must be greater than that of a part.

"Where several conjunctive wires are placed together, side by side, the power is apparently diminished in the central wires, and concentrated in the extreme portions; the magnetic state of the latter seems to be augmented by induction or by position.

"When such an assemblage of wires acts on the magnetism of a piece of steel, they decompose it, and each individual wire acts with most force on the magnetism nearest to it. Each conspires in its action to produce the same effect as the others; and hence, in addition to the effects of currents in opposite directions, we have another method of increasing the power of a battery in magnetizing needles. We shall probably render steel strongly magnetic, if we combine these two methods of increasing the effect. *This is effected by forming the conjunctive wire into a spiral around the steel bar to be magnetized;* for, at the opposite extremities of any diameter of this spiral, it is evident that the electric current moves in opposite directions. Suppose the spiral to be placed horizontally, E. and W., the current on its upper part to move from N. to S., it will at its lower part move from

S. to N.; and the spiral thus gives us the combined influence of currents in opposite directions. Moreover, the different coils of the spiral are nearly at right angles with the axis of *the included bar;* and they are parallel to each other. Hence, at any given portion of the bar the effect of many currents passing in the same direction is produced, *and the included bar becomes strongly magnetic; and a spiral placed round a piece of soft iron bent into the form of a horse-shoe magnet, renders it strongly and powerfully magnetic when the electric current is passing through it.*" * * * * The opposite sides of a conjunctive wire exhibit the opposite magnetisms; and we have seen that, by placing the wires parallel to each other, and connecting them with a battery so that they may transmit the current in the same direction, that the magnetisms seem to be concentrated in the extreme wires, and that we can thus separate them in a degree from each other. Now, when we consider that the direction of the magnetic power is at right angles to the conjunctive wire, it is evident that in a helix this direction must nearly coincide with that of the axis of the helix, and the one kind of magnetism be found concentrated at one extremity, and the other kind at the opposite end. * * * * Iron filings adhering to dissimilarly electro-magnetic wires, repel each other; and to similarly electro-magnetic wires, attract each other.

"In the course of our reasoning, by which we were led from step to step to the adoption of a spiral or helix in powerfully developing magnetism in bars, we inferred that two or more parallel and similarly electro-magnetic wires acted with greater energy than one, and that the magnetisms were accumulated in the extreme wires by a species of induction between them all. A ribbon of metal substituted for these wires exerts a stronger influence on the needle at its edges than at its sides, for a similar reason. So, also, if *a series of concentric wires* be used, and the electric current sent through them in the same direction, we infer that they will have the power of the corresponding sides of the different rings concentrated and accumulated in their common centre, and will, on the same side of their centre, act as parallel similarly electro-magnetic wires. A *flat spiral or volute,* having two ends connected with the opposite poles of a battery, will correctly represent concentric rings under the condi-

tion we have proposed; and the great quantity of iron filings which such a spiral or volute takes up, and the accumulation of them in the centre, fully evinces the concentration of power there, and the correctness of the reasoning by which we have been led to this modification of the conjunctive wire."

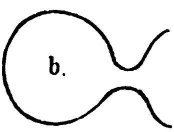
These extracts from Prof. Dana's lectures, demonstrate several important facts.

First.—Prof. Henry gives in his deposition the time of his first acquaintance with the science of electro-magnetism; and it will be seen that it was subsequent to the delivery of these lectures of Professor Dana. He says—"I commenced the study of electro-magnetism in 1827." What time in this year does not appear; but, as Prof. Dana's lectures were given in January and February, (and he died in April of that year,) Prof. Henry could scarcely have made much progress in his studies at the time these lectures were delivered; consequently, whatever of information respecting the science of electro-magnetism is contained in these lectures, could not possibly have reached me first through Prof. Henry. They first came to my knowledge through Prof. Dana, whose lectures I attended in 1827.

Second.—I learned from Prof. Dana, in 1827, the elementary facts that lie at the basis of the electro-magnet, to wit:—

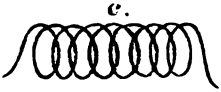
a

The effect of a *single straight conjunctive wire* in producing magnetism. (Oersted's discovery.)

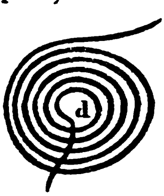


The effect of a conjunctive wire, *bent into the form of a ring*, for the purpose of increasing the magnetism. (Schweigger's experiment.)

c.



The effect of *a series of these conjunctive wire rings*, forming a *spiral*, for the same purpose of increasing still further the magnetism. (Arago's experiment, at the suggestion of Ampère.)



The effect of a *flat spiral* or *volute*, the conjunctive wire *superposed* upon itself, for still further increasing the magnetism. Schweigger discovered the principle of this modification, and embodied it in his *multiplier*, while Dana applied it to the magnetizing of iron filings in demon-

strating its magnetic power, and suggested it for the electro-magnet.

Third.—I learned from Prof. Dana, in 1827, the rationale of the *electro-magnet*, which latter was exhibited in action. I witnessed the effects of the conjunctive wire in the different forms described by him in his lectures, as a, b, c, d, and exhibited to his audience. The electro-magnet was put in action by an *intensity battery;* it was made to sustain the weight of its armature, when the conjunctive wire was connected with the poles of the battery or the circuit was *closed;* and it was made "to drop its load" upon *opening* the circuit.

These, with many other principles of electro-magnetism, were all illustrated experimentally, to his audience. These being facts, to whom do I owe the first knowledge which I obtained of the science of electro-magnetism, bearing upon the practical development of the Telegraph? Prof. Dana had publicly demonstrated, in my hearing, and to my sight, *all the facts* necessary to be known *respecting the electro-magnet*, so far as it has any relation to the Telegraph, before Prof. Henry had made any experiments whatever in the science of electro-magnetism. Prof. Henry made no subsequent improvement in the electro-magnet, no additions to the *volute modification of the conjunctive wires*, invented by Schweigger, and exhibited by Prof. Dana, that have any bearing whatever on the Telegraph.

The *volute modification* of the helix, to show the concentration of magnetism at its centre, adapted to the electro-magnet, the modification since universally adopted in the construction of the *electro-magnet*, is justly due, I think, to the inventive mind of Prof. James Freeman Dana. Death, in striking him down at the threshold of his fame, not only extinguished a brilliant light in science, one which gave the highest promise of future distinction, but by the suddenness of the stroke, put to peril the just credit due to him for discoveries he had already made. Dana had not only mastered all of the science of *electro-magnetism* then given to the world—a science in which he was an enthusiast; but, standing on the confines that separate the known from the unknown, was, at the time of his decease, preparing for new explorations and new discoveries. I could not mention his name, in this connection, without at least ren-

dering this slight but inadequate homage, to one of the most liberal of men, and amiable of friends, as well as promising philosophers of his age.

It must be obvious, I think, that the question, Who first applied the *volute modification* of the *conjunctive wire* directly to the bar of soft iron? is one altogether immaterial in determining any claim of mine. It lies entirely outside of my invention. The *electro-magnet* and its *armature*, as it exists at this day, was an instrument complete and in common use when I required its aid, and applied it, with adjusting adaptations of my own, to effect my novel purpose; but as an instrument *per se*, it is one to which I have never laid any claim whatever.

The credit, therefore, of the paternity of the electro-magnet is not mine, nor any improvement of it, *per se*, as now employed in the Telegraph. Dana, in 1827, publicly exhibited the electro-magnet, with its spiral conjunctive wire. He also exhibited, at the same time, and directly in the same connection with the electro-magnet, the "flat spiral," or "*volute modification* of the conjunctive wire;" showing its increased power over the single spiral, demonstrating this effect with iron filings, and directly suggesting its application to the soft-iron horse-shoe bar. It surely did not require the actual putting of the iron bar in the place of the iron filings, demonstrably to verify his suggestion.

I have now, I think, satisfactorily shown that I could not have received any aid from Prof. Henry: 1st, *directly* from *personal* interview or *correspondence;* nor, 2d, *indirectly* through others; nor, 3d, from his "*published researches;*" and consequently, the impression that I derived *any* aid from him in the elaboration of my Telegraph, is utterly fallacious.

PROF. HENRY'S COMPLAINT AGAINST ME ON ACCOUNT OF MR. VAIL'S BOOK.

Having disposed of the essential scientific and historical questions at issue in the deposition, there is a *special complaint* of a more personal bearing, preferred by Prof. Henry against me, in connection with Mr. Alfred Vail's work, entitled "The American Electro-magnetic Telegraph," which is made a prominent ground of censure upon me, not only in the deposition

but it seems elsewhere, a complaint which, therefore, demands my attention, and a full exposure.

No correspondence occurred between Prof. Henry and myself from the year 1844 to the year 1846. The Telegraph at this latter period was a successfully established fact, and had become incorporated among the necessary institutions of the country.

It will be perceived, by the correspondence up to this time, that our relations were of the most friendly character. But in the year 1845 an event occurred which suddenly changed their entire aspect. Whether the event alluded to was of a kind justly to disturb these friendly relations, the sequel will show.

Mr. Alfred Vail, the son of Judge Vail, of Morristown, New-Jersey, and brother of the present (1853) Member of Congress, from New-Jersey, the Hon. George Vail, was a student in the New-York City University in 1837. Being a young man of great ingenuity, and having heard of my invention, he was naturally desirous of seeing it as it then existed in my rooms in the University. In the summer of that year he came to my rooms, and I explained it to him, and from that moment to the present, he has taken the deepest interest in the Telegraph. Finding that I was unable to command the means to bring my invention properly before the public, and believing that he could command those means through his father and brother, he expressed this belief to me, and I at once made such an arrangement with him as to secure the pecuniary means and the skill of these gentlemen. It is to their joint liberality, but especially to the attention and skill, and faith in the final success of the enterprise maintained by Mr. Alfred Vail, that is due the success of my endeavors to bring the Telegraph at that time creditably before the public. He was with me, assisting me in its construction, in its first exhibitions to the New-York public, in 1837; to the Franklin Institute, in Philadelphia, and to Congress, in 1838; and from his peculiar experience in all that relates to the invention, was appointed one of my Assistant Superintendents, on the passage of the Telegraph Bill in 1843. On my visit to Europe, in 1838, I learned that electric telegraphs, of various kinds, had been projected and abandoned as impracticable, at various times, from the time of Reiser, 1794. The thought occurred to me to

search the records of science for these various projects as materials to be arranged at some future time, for a History of the Rise and Progress of Electric Telegraphs. With the aid of a scientific friend in Paris, M. Amyot, I made this search at the library of the Academy of Sciences, and made notes of several, to wit: Reizer's, 1794; Dr. Salva's, 1798; Soëmmerring's, 1809; Schilling's, 1833; Steinheil's, 1837; Masson's, 1837; and Amyot's suggestion, 1838. Rough notices of these I brought home. I found no time, however, from the pressure of cares which devolved upon me, to arrange these materials. Mr. Vail manifested a strong desire to publish a work on the Telegraph, and under these circumstances I gave these few materials into his hands, to arrange, to add to, or reject, as he thought proper. It was not my work. Nor did I ever assume any responsibility for its matter, or manner of arrangement. Thus much for the work of Mr. Alfred Vail, on the American Electro-magnetic Telegraph, which was published also at his own expense and risk, and while I was absent in Europe, in 1845.

Soon after my return to the United States, in 1845, I learned casually, in New-York, from some friends, that Prof. Henry had expressed some dissatisfaction towards me, in consequence of the publication of Mr. Vail's book. Of the precise nature of his complaints I had no idea, coming to me as they did, at second hand, and with the vagueness consequent on passing through an indirect channel. My first impression, as well as expression, was, "There is some mistake in this. Prof. Henry and myself are on such terms, that he would not fail to let me know the whole matter directly from himself, if there existed really any serious dissatisfaction." But being about to visit Washington, I took the earliest opportunity on my arrival there, in July, 1846, to question Mr. Vail on the subject, asking him what foundation in his work (which I had not then even examined) there could be for any complaint from Prof. Henry. He seemed wholly at a loss to account for the complaint, which he also had heard. I suggested to him that he ought, as the author of the work, and as an act of courtesy, at least, to write at once to Prof. Henry and have an explanation. With Dr. Gale in company, we sat down in the telegraph office to examine Mr. Vail's work, to discover the cause of the grievance; and as we could only conjecture, we presumed the difficulty was in some omission by Mr.

Vail of some of Prof. Henry's electro-magnetic experiments, when giving the history of electro-magnetism at page 135 of his book. At the moment, Mr. Vail had charge of the telegraphic instrument, and was engaged in receiving from and sending despatches to Baltimore; he complained also of not feeling very well. He turned to me and said to this effect—"I wish you would have the goodness to draft a letter to Professor Henry for me. You know what I would say." To oblige Mr. Vail, as well as to expedite, what I had much at heart, such an explanation as would satisfy Prof. Henry that there had been no intentional slight, either on my own or Mr. Vail's part, I put Mr. Vail's sentiments, which he had just expressed, into letter form, hastily on the spot, and gave it to him to revise. He did so; he approved, and, as he afterwards told me, he copied, signed, and sent it. These are the simple facts in relation to what Prof. Henry says in his deposition of the letter "copied and signed by Mr. Vail, but written by Mr. Morse, as the latter afterwards informed me." I subjoin a copy of the letter deemed so offensive by Prof. Henry as to be treated with contempt. It is as follows:—

WASHINGTON CITY, D. C., *July* (22,) 1846.

DEAR SIR:—I have learned within a few days, from two different sources, that you had made the observation that, in my late work on the Electro-magnetic Telegraph, I had not done you justice. I beg you to believe that if such is the case, it has been wholly undesigned, and I am not now conscious wherein I have offended, whether by act of omission or commission. It has been suggested by Dr. Gale, on looking over the work with the view of discovering the cause, that it might be in that part of it in which I speak of magneto-electricity, page 135, and onward. While engaged on this part of the subject, I not only thought of you, but made many inquiries for your labors, and requested, through a friend, that I might be furnished from yourself with an account of them; but I was so unfortunate as never to hear from you, nor to have found them in print. I am not only willing, but most desirous to have anything on the subject you may be willing to communicate, for I consider you as standing at the head here of this branch of science, and I wish that ample justice may be done to your labors, not only on your own account, but on that of the country which also derives honor from them. I am making preparations for another edition, and be assured I shall feel it to be a great favor to have errors of omission or commission pointed out and corrected. I ought also to

say, in justice to Prof. Morse, to whom I learn you attribute the blame, (on the supposition that he revised my labors,) that my book was published while he was absent in Europe, and that this part was not seen by him until it was in print.

Respectfully, Sir,
Your obedient servant,
ALFRED VAIL.

To PROF. HENRY, *Princeton.*"

The fate of this letter is told by Prof. Henry himself, in his deposition. "To the letter I did not think fit to make any reply." Of this determination, however, I then knew nothing; and as I heard nothing through Mr. Vail of the grievance of Professor Henry from July to October; and then hearing again, through a fresh channel, that this grievance still existed, I determined to know the length and breadth of it, by writing to Prof. Henry myself. Consequently, the following letter was written and sent, and received. It is referred to by Professor Henry in his deposition, when he says—"I afterwards received a letter from Mr. Morse, in his own name, on the same subject; to which I gave a verbal reply in January, 1847, in Washington."

WASHINGTON, *Oct.* 17*th*, 1846.

MY DEAR SIR:—Some months ago I learned, with much surprise and regret, that some dissatisfaction rested in your mind in regard to me. The person who first informed me was Dr. Gale, and more recently, our mutual friend, Prof. Ellet. He informed me, in substance, that you felt aggrieved, considering that I had not done you justice in my account of the Magnetic Telegraph. I expressed my astonishment, and searched my memory to know how, or where, or when, I could have done you the alleged injustice, conscious, as I was and am, that no man in the country held a higher place, in my respect and affection, than yourself. Dr. Gale suggested it might be in the work of Mr. Vail, my assistant. Prof. Ellet also stated, that you considered me responsible for the statements and conduct of that work. I immediately took up the work, and, eagerly, turned over its pages in search of the injustice, on my part, which, if anywhere, must be found in the Congressional reports, and also to ascertain if injustice had been done anywhere by Mr. Vail. I could only conjecture, and presumed that it might possibly be in the account which Mr. Vail has given of magneto-electricity, page 135, and onward. If here there has been any omission of your name and discoveries, I am confident that a plain statement of the position I hold to Mr. Vail's work will

at least exonerate me from blame; and I am also sure, from the high consideration in which I know that you and your labors are held by Mr. Vail, that no intentional omission was made on his part. In regard to the work in question, I had long desired to have the history of electric telegraphs collected and published, that justice might be done to foreign savans, who had conceived plans of telegraphs, as well as to myself. I had collected accounts of several of the projects devised in Europe, and hoped to have the leisure to put them in form for publication myself, but my other absorbing duties prevented, and Mr. Vail, being desirous of preparing such a work, I gave him my materials, which consisted solely of the plans of different European electric telegraphs, to which materials he made many additions from his own researches, and to him was consigned all the labor, and all the responsibility of their preparation, and the credit and profit which might arise from the work. Just before I left for Europe, in the autumn of 1845, I read over, at Mr. Vail's request, for correction and comparison with the plates, the manuscript of a small portion of this work, consisting only of the plans and descriptions of my own Telegraph. The work was completed and published by Mr. Vail while I was absent, and for his own benefit. You will see by this statement what share I could have had in any omissions of Mr. Vail.

So soon as I returned to Washington in July last, I apprised Mr. Vail of what I had heard in regard to your feelings, and he also expressed his surprise and regret that anything should have occurred, even by accident, which should have given you pain, and I immediately suggested the propriety of his writing to you, to disabuse you of any unfavorable impression his omission may have occasioned in your mind. At his request, I prepared the letter dated about 22nd of July, which he informs me, he copied and sent you. To this letter he says you have not replied; I suppose, nevertheless, that it would exonerate him, and myself certainly, from any blame which a misapprehension of my agency in the work may have produced. On Tuesday last, the day before I left New-York, however, I accidentally fell in with Mr. George Prosch, who had recently (he told me) received your kind hospitalities. Mr. Prosch gave me to understand that you had spoken of me (how lately I don't know) in terms which implied that you still felt much hurt at something I had done or had not done. But I could not learn what it was, nor have I any clue to the cause of your altered feelings towards me. Now, my dear sir, I cannot believe you capable of doing another the injustice to entertain suspicions of him, without giving him some opportunity to exculpate himself. If I have given you any cause to feel aggrieved, I beg you to tell me of it in all frankness, and then if I do not satisfy you that you have had groundless suspicions, you

will have a right to feel aggrieved. If I have done you any wrong, I will make you ample amends. I am certainly unconscious of ever doing you the slightest injustice, in thought, word or deed; on the contrary, I am conscious of entertaining only the most exalted opinion of your genius and labors, and of having on all occasions, where your name was mentioned, or when I had occasion to speak of you, thus expressed my feelings of respect and affection; and in view of all this, I confess that I feel unfeigned mortification to learn, not from one, but from several sources, that you should have any misapprehension on the subject. I can truly say, that if I had heard that my own brother was thus entertaining such unfounded suspicions of me, in regard to himself, I could not feel more surprise or more grief. I trust I need not say more, and that you will let me know from yourself, and not through others, the nature and extent of my supposed offending, so that if I have indeed unwittingly offended, I may make amends; and if I have not, that you may be satisfied that your suspicions are groundless.

With sincere respect,
Your obedient servant,
To Prof. JOSEPH HENRY, *Princeton.* S. F. B. MORSE.

Is it not true, as I stated in the beginning, that Prof. Henry has given his deposition "*not in ignorance of facts which make his statements incorrect?*" He states that he "*presumed the publication of Mr. Vail's work was authorized by me,*" yet he knew that it was not authorized by me. Was he not informed of this fact in this letter of Oct., 1846? It is not for me to explain the cause of his disbelief of my statement in this letter. He knew these facts in 1846; he deposes, in 1849, as if he were in utter ignorance of them.

Besides the "verbal reply" to this letter, which Prof. Henry says he gave in January, 1847, he also wrote the following, a few days after its receipt:—

PRINCETON, *Oct.* 23*d*, 1846.

MY DEAR SIR:—Your letter of the 17th was received two days ago, but as we are now in the midst of our quarterly examination, and I have nearly 70 examination papers to read and classify within the next five or six days, I shall be obliged to defer my answer in full until next week.

In the mean time, I remain,
Respectfully yours, &c.,
(Signed) JOSEPH HENRY.

S. F. B. MORSE, LL. D.,
Professor, &c.

The written "answer in full" was not given; but Prof. Henry's version of the verbal one in January, 1847, I will now examine.

THE TWO INTERVIEWS—THE INTERVIEW OF 1847.

Among the other matters deposed to on oath by Prof. Henry, he relates the incidents of two interviews, both of which I sought, and held with him, at two several times; one in Dec., 1846, (he says January, 1847,) and the other about the beginning of 1848, in Washington; the first, for an understanding of the nature, and an explanation of the difficulties that had arisen in regard to Mr. Vail's book; and the other, more especially for the purpose of learning, direct from Prof. Henry himself, what were his precise claims to any discovery bearing upon, or seeming to interfere with my claims to any part of my telegraphic invention.

Since Prof. Henry has thought it important to introduce the incidents of these interviews into his testimony, whether they are really important or not, it becomes quite as important that his statements, or rather, I must say, his *misstatements*, (without imputing motive or cause,) should be corrected, lest they unjustly prejudice my position.

After the middle of Dec., 1846, both Prof. Henry and myself being in Washington, I immediately sought him, and the first interview alluded to was held. I then learned, directly from him, that the cause of his dissatisfaction was the omission, by Mr. Vail, in his work entitled "The Electro-magnetic Telegraph," of all other mention of his (Prof. Henry's) labors and discoveries than the fact, that "Prof. Mohl and himself had made powerful electro-magnetic magnets."

From the deep feeling manifested by Prof. Henry on this point, I was under the belief that there must have been some great oversight on the part of Mr. Vail in making such a statement. I then explained my position in regard to Vail's book, stating distinctly what I had previously written him in October, repeating the substance of that letter, and especially stating that if Mr. Vail had omitted mention of his researches, I knew it must be unintentional, for that Mr. Vail had informed me,

that so desirous was he to have some account of Prof. Henry's labors, that he had applied to him through a friend, previous to the publication of his work, to write that part of his work relating to electro-magnetism, for the express purpose of being correct on that point; and that should another edition be published, I had no doubt that Mr. Vail would most gladly embrace the opportunity of doing him justice, and would insert any statement he might wish. The reply to this, on the part of Prof. Henry, I cannot forget, and, I own, it struck me with a sad surprise. He seemed quite excited, and broke out violently against Mr. Vail, with expressions to this effect: "Mr. Vail? I will have nothing to do with Mr. Vail. What right has Mr. Vail to write the history of electro-magnetism? He knows nothing about it." To this I replied, in a tone to mollify his excitement, to this effect: "Why, Prof. Henry, it will not do to say, in our free country, that any man may not write on any subject he pleases;" and finding that Mr. Vail's name only irritated him, I turned the subject by saying to this effect: "Well, Prof. Henry, I will take the earliest opportunity that is afforded me in anything I may publish, to have justice done to your labors; for I do not think that justice has been done you, either in Europe or this country." These were my sentiments at that time. The interview, on the whole, closed pleasantly, so far as I could judge, for I met him several times afterwards, and supposed that, as between him and myself, at least, there was no unpleasant feeling. On my part there never had been any.

Some time during the year 1847, however, I casually heard that Prof. Henry manifested afresh the same feelings of dissatisfaction; and, on inquiry, learned that he had said: "Mr. Vail has published another edition of his work, and has made no change, or addition, in regard to my researches." On learning this, I inquired of Mr. Vail if he had lately published another edition of his work? He replied: "No; a few copies more have been struck off from the stereotype plates, to enable me to pay expenses of publication for which I am in debt, and the year in the title page, 1845, has been changed to 1847, one figure only; that is the only change." "Ah," I observed, "that must be the new grievance of Prof. Henry." I may here

remark, that the contemptuous feeling manifested towards Mr. Vail by Prof. Henry, forbade the idea that he expected, or even wished, on his part, any notice of his researches by Mr. Vail in any new edition, as did also the total neglect of Prof. Henry to reply to Mr. Vail's courteous letter of July, 1846, in which he expressed his desire to have the most authentic means of doing him justice, by a detail of his researches from Prof. Henry himself. Such feeling, on the part of Prof. Henry to Mr. Vail, was certainly not calculated to render the latter over-anxious to trouble himself further on the subject, even if he had made an enlarged and revised edition of his work.

THE INTERVIEW OF 1848.

In January, 1848, there was another interview, sought also by me, with Professor Henry. The immediate occasion of my seeking it was the submitting to me, in manuscript, by the late Professor Sears C. Walker, of the Coast Survey, his report, previous to its publication, containing some remarks on the "*Theory of Morse's Electro-Magnetic Telegraph*," in which the expression "the helix of a soft-iron magnet, prepared after the manner first pointed out by Professor Henry," occurred. When, therefore, Professor Walker submitted to me this report —and I noticed this allusion to "the magnet," as quoted above —I at once observed to Mr. Walker to this effect: "I have now the long-wished for opportunity to do justice, publicly, to Henry's discovery, bearing upon the Telegraph; I should like to see him, however, previously, and learn definitely what he claims to have discovered; I will then prepare a paper, to be appended and published as a note, if you see fit, to your Report." Mr. Walker had also a mistaken notion that the *receiving-magnet* (the instrument which I invented) was Henry's invention. This I disputed, and, to determine this point, I invited him to accompany me to Professor Henry's rooms. The proposition was acceded to by Mr. Walker; we immediately repaired to the Patent Office, where Professor Henry had his office, and meeting with Professor Gale on the way, he also accompanied

us. The interview was held. From all that passed, it was perfectly clear to me that Professor Henry had no such idea as a *combination of circuits*, much less anything like what is known as my receiving-magnet, previous to his visit to Europe in the spring of 1837. Professor Henry's memory of dates, I have shown, is, unfortunately, very defective; and to this I would rather attribute his defective narration, than to any design to misrepresent. When he hinted that he thought that he had the *idea*, before he went abroad, I questioned him closely and particularly on the point, and he hesitated, and expressed doubts whether it was before or after, and said that he did not dare to say positively. His hesitation and whole manner were so convincing to me, at the time, of his not having conceived even the *idea*, much less invented the *thing*, that I well remember saying to Dr. Gale, in reference to it, as we left the room together, to this effect: "There is nothing there, Doctor, which at all interferes with my receiving-magnet invention." Mr. Walker, too, was satisfied that what was called the *receiving-magnet* was not Professor Henry's invention; but he considered that the electro-magnet, which was a part of the combination in its construction, owed its efficiency to what he deemed to be Henry's discovery, to wit: the means of propelling a galvanic current through a long wire, by the use of an intensity battery. On referring to Henry's article in *Silliman's Journal*, I readily conceded that point,* for I then supposed it to be due to him. If I have since changed my opinion, it is because, compelled to make a deeper research, I have found that this was an undisputed fact, from experiment, at least eighteen years before Professor Henry's published experiments in 1831.

As the immediate result of that interview, I drafted the proposed note to Mr. Walker's report on February 1st, 1848, and sent it to him the same day. As its contents have an important bearing upon the character of Professor Henry's deposition, in several vital particulars, I here give it in full.

* Such was the deference which I then bore towards him, and such the confidence I reposed in him, that the simple fact of his making a claim would, at that time, have found me in a state of *heart*, at least, to concede to him anything without question.

WASHINGTON, *January* 31*st*, 1848.

DEAR SIR,—I have perused, with much interest, that part of your manuscript, entitled "*Theory of Morse's Electro-magnetic Telegraph*," which you were so kind as to submit to my examination.

The allusion you make to "the helix of a soft-iron magnet, prepared after the manner first pointed out by Professor Henry," gives me an opportunity, of which I gladly avail myself, to say, that I think justice has not hitherto been done to Professor Henry, either in Europe or this country, for the discovery of a scientific fact, which, in its bearing on telegraphs—whether of the *magnetic needle*, or *electro-magnet* order—is of the greatest importance. To elucidate this, let me briefly state the condition of science, as its discoveries affected the practicability of Electric Telegraphs at the period of Henry's discovery, in 1830. The first plans of telegraphs by electricity were confined, till the year 1800, to *machine electricity*, but from the intractable nature of the agent employed, all of them proved unavailable. Telegraphs by electricity were at that period, fifty years from the first suggestion of the idea by Franklin, abandoned as impracticable. In the year 1800, the chemical effects of Volta's pile revived the idea of Electric Telegraphs by the employment of the *decomposing* effects of Voltaic electricity: and a telegraph, on this scientific fact, received a definite form in the complicated and unavailable plan of Soëmmerring, in 1811. In the year 1819, Oersted's discovery of the *deflection of the magnetic needle*, by the Voltaic current, gave to inventors a new fact in science, to combine with former facts, for the production of an Electric Telegraph. From this discovery of Oersted's, dates the era of needle telegraphs; for Ampère, in the year after, in 1820, suggested the plan of a needle telegraph, of seventy-two conductors and thirty-six needles, one for each letter of the alphabet, and the numerals: but it remained, for at least twelve years, a mere suggestion; and I have not been able to find that one of the most essential *points* requisite to the invention of an Electric Telegraph had, as yet, been ascertained: to wit, *its practicability at a distance*.

Four years after Ampère's suggestion, indeed, in 1824, Prof. Barlow, of the Royal Military Academy at Woolwich, instituted experiments upon the "*magnetic-needle*," through various lengths of wire up to 840 feet, for the purpose of determining this very point, to wit: *the practicability of producing magnetic effects at a distance*. With the Voltaic battery which he employed, he found the magnetizing effects of electricity diminishing

so greatly in that short distance, that he in consequence pronounces "*the idea of an Electric Telegraph to be* CHIMERICAL." If these experiments and results of Barlow are indicative of the state of opinion of the scientific mind of Europe, at that time, which may at least be presumed, from his position—then in 1824 the voice of science in Europe had declared *the idea of an Electric Telegraph to be* CHIMERICAL. I would draw your special attention to the fact, that the experiments of Prof. Barlow had no reference to the *electro-magnet*, as applied to telegraphic purposes. The state of science, indeed, forbids that he could have had any such reference; for it was not until the year after, in 1825, that *Sturgeon*, according to Jacobi, and *Dal Negro*, as quoted by Dr. Schulthess, made the first electro-magnet, by magnetizing soft-iron, *in a horse-shoe form*, by means of copper wires wound around it. In the interval of the years between 1824, when Barlow pronounced the Electric Telegraph chimerical, and 1829, I do not find any suggestions on the subject of Electric Telegraphs. The result of the experiments of Barlow seem to have effectually palsied all efforts in that direction. Experiments in electro-magnetism were now confined to the production of *motive power*, and the attainment of greater *magnetic power* in the electro-magnet. This was the state of electro-magnetism, when, in 1830, Prof. Henry, assisted by Dr. Ten Eyck, while engaged in experiments on "*the application of the principle of the galvanic multiplier to the development of great magnetic power in soft-iron*, made the important discovery that *a battery of intensity* overcame that resistance in a long wire, which Barlow had announced as an insuperable bar to the construction of Electric Telegraphs. Thus was opened the way for fresh efforts in devising a practicable Electric Telegraph; and Baron Schilling, in 1832, and Profs. Gauss and Weber, in 1833, had ample opportunity to learn of Henry's discovery, and avail themselves of it, before they constructed their needle telegraphs.

The fact should not be lost sight of, that up to this date, (1833,) and, indeed, up to the year 1841, there was no European Electro-magnetic Telegraph proposed on any other principle than the *deflection of the needle.* It is at the date, 1832, of Baron Schilling's invention of his Needle Telegraph, (since abandoned as impracticable, from various and obvious causes,) that I conceived my *Electro-magnetic Telegraph*, and first devised an apparatus applying *magnetism produced by electricity*, or the power of the *electro-magnet to imprint characters at a distance*, and these through a *single circuit* of conductors. Here are several substantial, novel, and distinct features of an Electric Telegraph never before suggested by any one. No one had ever before hinted at the employment of the *electro-magnet* for telegraphic purposes; no one had ever before hinted at the *possibility of im-*

printing signs at a distance; no one had ever before hinted at the possibility of even producing intelligible, distinct signs, by Voltaic magnetism at a distance, *through a single circuit of conductors*, much less to *imprint* them at a distance through a *single circuit of conductors.* These were all new features of a Telegraph, and when conceived, I was utterly ignorant that the idea of an Electric Telegraph, of any kind whatever, had been conceived by any other person. I took it for granted that the effects I desired could be produced at a distance, and accordingly in the confidence of this persuasion, I devised and constructed my apparatus for the purpose. I had never even heard or read of Prof. Henry's experiments, nor did I become acquainted with them until after all my apparatus was constructed, and in operation through half a mile of wire, at the New-York City University, in 1837. I then learned, for the first time, that an Electric Telegraph of some kind had been *thought of* before I had thought of it; that Barlow had had an idea of an Electric Telegraph, but what that idea was, I had not learned even till within a few weeks past. I also then learned the gratifying fact, that Prof. Henry had actually, two years before, my first conception in 1832, in 1830 settled the point of *practicability at a distance*, and had shown that magnetic effects could be produced at a distance, as well in magnetizing the *electro-magnet* as in *deflecting the needle.* While Prof. Henry, therefore, *does not suggest the use of the electro-magnet for telegraphic purposes*, but has direct reference only to *the magnetic needle telegraph*, when he remarks that "his experiments were directly applicable to Mr. Barlow's project of an Electro-magnetic Telegraph," (the *needle telegraph* only being "Barlow's project,") yet his experiments predetermined the practicability of using an electro-magnet also, so soon as I or any one else should propose a plan for its application. While, therefore, I claim to be *the first* to propose the use of *the electro-magnet for telegraphic purposes*, and *the first to construct a Telegraph on the basis of the electro-magnet*, yet to Prof. Henry is unquestionably due the honor of *the discovery of a fact in science*, which proves the practicability of exciting magnetism through a long coil, or at a distance, either *to deflect a needle* or *magnetize soft-iron.*

Let it be borne in mind that all the Electro-magnetic Telegraphs in Europe were *Magnetic Needle Telegraphs*, till the year 1841. My *Electro-magnetic Telegraph* had been publicly exhibited in New-York in 1837, in Paris in 1838, and in London in 1839. It was not till 1837 that Cooke & Wheatstone had invented even their *Needle* Telegraph; and Steinheil in the same year (1837) invented his *Needle* Telegraph; and then, in 1841, for the first time in Europe, is announced a Telegraph using the *electro-magnet*—to wit, "*Wheatstone's Rotating Disc Telegraph*;

and the object of this apparatus is, to *show*, not to *record* signs. It may be further allowed me to say, that, until the government experimental line from Washington to Baltimore had been fully and satisfactorily tested and proved successful, no plan of a Telegraph even proposing *to record permanent characters* by the *electro-magnet*, through *a single conductor*, *at a distance*, had been published in Europe or America.

With great respect, your obedient servant,

SAMUEL F. B. MORSE.

SEARS C. WALKER, Esq.

This note of mine was written, as I have said, immediately after the interview in January, 1848. If it shows errors of fact, these it will be seen are all deferential to Prof. Henry's assumptions, and manifest at least my own disposition to award full justice to him. Others may accuse me of injustice towards them; he cannot, towards himself. Prof. Henry's account of that interview is in his deposition, which was sworn to September, 1849, and, therefore, nearly two years after it was held. Prof. Henry had this note of mine submitted to him, by my request, through Mr. Walker, long before giving that deposition that he might criticise and approve it before it should be published. I wished to have full justice done to him; and promised Mr. Walker that I would incorporate into the statement any suggestions from Prof. Henry which would make it more accurate.

To this end, I wrote the following letter to Mr. Walker:—

WASHINGTON, *February* 1, 1848.

MY DEAR SIR:—I return your manuscript with many thanks. I have prepared a letter which, if consistent with the design of your Report, I should be pleased to see in the Appendix, or as a note. I am having it copied, and will then transmit it to you.

I should be glad to have Prof. Henry see it and approve of it, and criticise it before it is published. Should he make any suggestions that will constitute my statement more accurate, I should be glad to be apprised of them, that I may incorporate them into it. Is the year 1830, or 1829, the proper date of his discovery?

With great respect,

Your most obedient servant,

SAMUEL F. B. MORSE.

SEARS C. WALKER, Esq.

The copy alluded to was finished and sent to Mr. Walker the same day, (Feb. 1, 1848.) After waiting some days, and not hearing anything of the disposal of the note, I wrote again to Mr. Walker the following:—

WASHINGTON, *February* 10, 1848.

DEAR SIR:—I am about making a communication to the French Academy of Sciences, and should be glad to have the decision in regard to the disposal of the note I addressed to you on the subject of Prof. Henry's discovery, as soon as you can make it convenient. I shall be in the city but a few days longer.

Most truly your friend and servant,
SAMUEL F. B. MORSE.

SEARS C. WALKER, Esq.

To this I received from Mr. Walker the following reply:—

WASHINGTON, D. C., *February* 11, 1848.

DEAR SIR:—I hope you will excuse the delay in answering your several esteemed favors. I immediately forwarded my Report and your letters to my principal, Professor Bache, with a request that they should be shown to Prof. Henry. I called yesterday on Prof. Henry to know the result, but did not find him in, otherwise I should have been able to answer you yesterday. I will call again to-day, and will lose no time in communicating the result. I should have answered promptly, had the result depended on my action alone.

Yours, truly and respectfully,
SEARS C. WALKER.

To PROF. SAMUEL F. B. MORSE.

P. S.—I congratulate you on the recent accession to your new dignities. I am quite desirous of seeing the Turkish insignia. Yours, S. C. W.

No communication on the subject, however, was made to me from Prof. Henry, through Mr. Walker, or any one else; no approval, nor criticism, nor suggestions. The Report of Mr. Walker was published in the Coast Survey Report, and without my note appended, or any allusion to it; nor could I learn any reason for the silence maintained by all upon the subject. I had, however, done all that I conceived to be justly required of me under the circumstances. I had given full credit to Prof.

Henry for the discovery which he claimed, and to which I then thought him entitled. I had fulfilled my promise to him, made at the interview of 1846, to wit, that "when I had the opportunity, publicly, to say anything on the subject, I would endeavor to see that justice was done to him." But, presuming from his slight of the opportunity I had afforded him of setting the matter before the public, just as he would wish it to be represented, and that he preferred that nothing should be said or done, I, also, dismissed the subject from my thoughts, until brought up again by the manner in which it is set forth, nearly two years afterwards, in his deposition of 1849.

Now, in the light of these facts, let that part of his deposition, in which he assumes to set forth the matter, be examined. [See Deposition, "My researches, &c, page 109."]

The impression naturally made by this part of Prof. Henry's deposition, whether intended to be made or not, is clearly this: that I was indebted to a knowledge of his experiments, and to a law which he had deduced from them, for success in the early construction of my Telegraph; that this must be so, because Dr. Chilton had stated that he had referred me to Henry's paper in Silliman's Journal, before I made my experiments in the University; that the book published by Mr. Vail, on the Electro-magnetic Telegraph, although professedly edited by Mr. Vail, and copyrighted by him, was, nevertheless, my work, because Mr. Vail was my principal assistant, and was also interested in the telegraph patent, and, therefore, I was responsible for its contents; that this book of Mr. Vail's must contain some grievous wrong to Prof. Henry, worthy of severe reprehension, a just ground for the manifestation of a retaliatory feeling; that when complaint was made to my friends, by Prof. Henry, I wrote a letter to him under the name of Mr. Vail, while the letter was actually my own, and signed by Mr. Vail to keep up the deception, yet, I then had the weakness to confess the trick to him; that in the interview of January, 1847, I acknowledged that injustice had been done him, that is, that I had done him injustice, and promised him reparation, yet that another edition of Mr. Vail's book had been published, and still this grievous wrong remained. Is not this the impression left on the reader's mind?

I will stop at this point, and examine so much of this extraordinary narrative.

In the first place, I have not the slightest recollection of having been referred to Henry's paper by Dr. Chilton. I remember having casually seen at Dr. Chilton's store, in Broadway, in what year I do not recollect, the large magnet of Prof. Henry, like that delineated in Silliman's Journal of 1831. It was the *quantity* magnet, (*now* so called by Henry,) and it is very probable, although I do not recollect it, that Dr. Chilton in showing me its astonishing power, did speak of Henry's paper, in which he describes the manner of constructing it; but from the character of that magnet, so easily comprehended from inspection in a few minutes, with the thing itself embodied before me, I had no particular motive for consulting the published account of it. I needed no written description of a thing understood in a moment from sight, especially, too, as I could not but perceive, at a glance, that it had *no applicability whatever* to the Telegraph. This *quantity* magnet, as thus distinguished by Prof. Henry himself, is not *applicable* to the Telegraph, as I have before observed, is not necessary to it, and never has been applied to it anywhere, so far as I have any knowledge. If, therefore, Dr. Chilton spoke of Henry's paper to me at the time of explaining this *quantity* magnet, which he may well have done, there was nothing in the condition of my invention to induce me to seek for it, or to consult it, or to charge my memory with the fact, that it was mentioned to me. The general impression left on my memory, from seeing that magnet at Dr. Chilton's, is the same that has everywhere else been entertained, to wit, that Prof. Henry had succeeded in his attempts beyond all other previous attempts, in constructing a magnet capable of sustaining an immense weight. That this was the general impression in the scientific world I will presently show. In looking at that magnet, I do not think that, at that time, I could have associated the Telegraph naturally with it at all, any more than if I had been looking at a steam-engine. However this may be, the fact is, that I did not then see nor read Henry's paper, nor did I see or read it till the autumn of 1837.

But what shall I say of the manner and matter of Professor Henry's reference to Vail's book? I have already shown, by

letters and dates, the true position I held in relation to that work. I have shown that, on learning that there was any feeling of dissatisfaction on the part of Professor Henry, on account of its publication, I took the earliest opportunity to disabuse his mind in regard to the character of my relationship to it —and to show, also, that if there had been any error of commission, or omission, on Mr. Vail's part, that it was undoubtedly inadvertent. Notwithstanding all these efforts, however, in correspondence and in two interviews, the grievance seems to be of so flagrant a character, so unpardonable, so incapable of any apology, that it must be dragged into his solemn deposition, some two or three years after, altogether gratuitously, saving only to discolor and complicate the pertinent facts of the case. A grievance so inveterate, that has withstood so many efforts to allay and to remove, must surely be of a most serious character, and deserves being distinctly brought out and examined.

Professor Henry shall state this grievance in his own way: "I was, therefore, much surprised on the publication, in 1845, of a work, purporting to give a history of the Telegraph, and of the principles on which it was founded, by Mr. Vail, then principal assistant of Mr. Morse, and one of the proprietors of his patent, to find all my published researches, relating to the Telegraph, passed over, *with little more than the remark, that Dr. Mohl and myself had made large electro-magnetic magnets.*" Here is "the head and front of my offending;" the cause of the alienation and ill-feeling manifested towards me by Professor Henry ever since 1845, the date of the publication of Mr. Vail's book. I say, "of my offending:" for the offence, such as it is, is charged upon me, and the retaliation is visited upon me; although, I think, it is far from obvious that I am the offending party, notwithstanding the ingenious attempt to show that I stood towards Mr. Vail's book in the somewhat anomalous relationship of "*presumed*" godfather to it. But let that pass. Professor Henry has needlessly committed himself on a mere *presumption*, which proves to be without any foundation—and this, too, when the absolute truth in regard to it could be had for the simple asking. Nay more, he commits himself after this presumption of his *had been shown to be without foundation;* when, at least three years before he gave his deposition, *he knew* that I never had any responsibility whatever for the work.

But it is worth while for a moment to examine *the offence*, by whomsoever committed, and see if it be of a character to create such a perfect revolution in the mind of an ingenious and ingenuous philosopher, to turn it from confidence to suspicion—from friendship to hostility.

Mr. Vail, failing to obtain from Professor Henry himself a more detailed account of his scientific researches than he had found published, but desirous to do ample honor and justice to his scientific labors, found to his hand, in the "Encyclopædia Britannica," the paragraph *complimentary* to Professor Henry which he has quoted in his book, at page 134; it is in these words: "The next step in the progress of discovery, was that of making magnets of extraordinary power by means of a galvanic battery. This seems to have been first accomplished by Professor Mohl, of Utrecht, and Professor Henry, of Princeton, who was able to lift thousands of pounds weight by his apparatus." I say *complimentary*, for it gives him the credit of having made, about the same time with Professor Mohl, of Utrecht, electro-magnets of extraordinary power. That this was the great aim, the main object of Professor Henry, in his experiments—as given in his article in "Silliman's Journal," of 1831, the only great scientific fact developed in any of his researches up to that time—is manifest to any one who will read it. It is the only one deemed by the scientific world of sufficient importance to mention, so far as I have been able to discover—and I have searched with some diligence, so far as leading works have been accessible—and I find that the having developed great magnetic power, and that by a mode of winding the magnet quite original, (the mode exhibited, in the diagram in his article, in his *quantity-magnet*,) is the only fact Professor Henry had published which commanded the attention of the scientific world. For example:

Professor *Daniel*, in his "Introduction to Chemical Philosophy"—and Professor *Noad*, in his "Lectures on Electricity," while they speak quite at length of Henry's experiments on induction, published in his "Contributions," in 1838, say nothing of his experiments on the electro-magnet, in 1831.

Mr. *Sturgeon*, in his "Annals of Electricity," speaking of Prof. Henry, refers only to "his raising the magnetic action of soft-iron," developing "new and inexhaustible sources of force"—

"available as a mechanical agent," contemplating nothing more than an application of the magnet (the *quantity* magnet) to a magnetic engine, giving Henry the credit "for the first working model."

L'Abbe Moigno in treating, expressly, of Electric Telegraphs, with Henry's paper before him, finds nothing there worthy of mention, as bearing on telegraphs, but casually notices that "Sturgeon and Pouillet, Henry in the United States, and Robert, of Manchester, had obtained *astonishing results, in causing electro-magnets to lift many tons weight.*"

De la Rive, in his late elaborate work, "Treatise on Electricity," published this present year (1853), is as silent on the point of stating any other fact of importance as all the rest, and speaks of Henry only in connection with Mohl, Liphaus, and Quetelet, as engaged in researches, "whether it is better that the wire coiled round the two branches of the electro-magnet should be continuous, so as to be traversed successively by the whole of the current, or, if it would be preferable for it, to be divided into one or a greater number of wires, among which the total current should be divided." This latter being Prof. Henry's plan of the *quantity* magnet.

In the *Encyclopædia Britannica*, article *Magnetism*, there is a notice of Prof. Henry's experiments of 1831; but here, as elsewhere, the *great lifting power* of the *quantity* magnet is the sole burden of the writer's notice.

Dr. *Schulthess*, in a lecture on electro-magnetism, delivered to the Philosophical Society at Zurich, Feb., 1833., (see Taylor's Scientific Memoirs, vol. I., p. 534,) speaks also of Henry's experiments thus: "The experiments of Henry and Ten Eyck showed that the *power* of such magnets" (electro-magnets) "might be *greatly augmented*;" and again, "I could not refrain, when speaking of the *powerful electro-magnets* of Henry and Ten Eyck, from asking the question, whether such a *considerable power* as that which is obtained by interrupting the electric current and then restoring it, could not be applied, with advantage, to mechanical science?" In this case, also, it is seen that the *great power* of the quantity magnet of Henry, is that which attracted the attention of this eminent Swiss philosopher.

In vol. XX., 1831, of Silliman's Journal, under the head of

"*Galvano-magnetism*," I find that Henry's experiments, detailed in the January volume, induced *Dr. Hare*, of Philadelphia, and *Prof. Webster*, of Boston, each to repeat his experiments, and to communicate to the Journal their results. The whole burden of each of their statements, is the *increased lifting or sustaining power of the magnet.* No allusion, whatever, is made to any *law of propulsion*, or *adaptation to telegraphic purposes*, as the result of Henry's experiments.

In the same volume of Silliman's Journal appears also the following editorial remarks on a large magnet, made by Prof. Henry for the laboratory of Yale College, in accordance with the very experiments detailed in the preceding volume. Prof. *Silliman* says of Prof. Henry: "He has the honor of having constructed *by far the most powerful magnets* that have ever been known, and his last weighing, armature and all, but 82½ lbs., *sustains over a ton.* It is *eight times more powerful* than any magnet hitherto known in Europe, and between *six and seven times more powerful* than the great magnet in Philadelphia."

Of this tenor are all the allusions or notices in any scientific or other publication that I have met with, of all Prof. Henry's "published researches" up to 1831. Others may have been more fortunate than myself, and may have found notices of a different character; if so, they can be quoted. But that the general impression in the scientific world in regard to Henry's experiments of 1831, was that the great merit of his "published researches" consisted in his "*having made large electro-magetic magnets*," is certain; nor have I found the slightest allusion in any scientific work since 1831, to any discovery of his as having any bearing upon Telegraphs of any kind.

But in addition to all this evidence, that *an increase of the lifting power of the electro-magnet* was the great controlling object of Prof. Henry in his experiments, I cannot omit the testimony of one who has given it contemporaneously with the experiments themselves. This witness is no other than Prof. Henry himself, who, in the very paper in which he details them, gives their result.

After having arrived, in his Exp. 15, to the maximum of power in the magnet with which he was experimenting, to wit, 750 pounds, he says, "The strongest magnet of which we have

any account, is that in the possession of Mr. Peale, of Philadelphia; this weighs 53 pounds, and lifted 310 pounds, or about six times its own weight. *Our magnet weighs* 21 *pounds, and consequently lifts more than thirty-five times its own weight; it is probably, therefore, the most powerful magnet ever constructed.**

This, then, being the general impression made by his "published researches" among the scientific at home and abroad, uniformly for some fourteen years, with no attempt, so far as I can learn, on Prof. Henry's part to correct such impression, but on the contrary, corroborated by himself; was it such a crime in Mr. Vail to quote, in 1845, the language of the Encyclopædia Britannica as the current opinion of the day? What more, under all the circumstances, could Mr. Vail have said? What is *his crime*, that he should have said what he did say? But, especially, what is *my crime*, that Mr. Vail said what he did say?

I have now completed the unpleasant duty of defending myself from the ungenerous and untrue imputations educed from Prof. Henry's deposition. This duty has been performed with no unfriendly feeling, and, I trust, I have used no asperity of language, towards Prof. Henry, notwithstanding the just cause he has given me to feel aggrieved.

If I have shown that some discoveries, claimed for him by those selfishly interested in robbing me of my legal rights, do not belong to him; it is because they have been assumed to be his, and have been unnaturally exaggerated to militate against my claims, thus forcing me, critically, to scrutinize their pretensions to originality with him. In this scrutiny, multitudes are far more interested than myself.

For any success which may have attended Prof. Henry's labors to enlarge the boundaries of science, whether in the college laboratory, or in the honored position he holds at the head of the Smithsonian Institute, he deserves and will receive the reward of a just fame. As I gave my feeble influence heartily to his elevation to this post, because, at the time, I believed it eminently alike a place of honor to him, and of advantage to the cause of science, so now I deprecate the painful necessity of being the medium of exposing the weaknesses and errors of such a mind.

* Silliman's Journal of Science, Vol. XIX., p. 405.

Had these errors affected me only, I would gladly have buried them in oblivion, and suffered in silence; but justice to others, quite as much as to myself, and justice to historic truth, has demanded this exposure.

I have shown, as I promised in the outset to show, that any complaints against me, whether from opposing counsel, or from Prof. Henry himself, to the effect that I had not the disposition to do him justice in regard to discoveries, alleged to be his, and to have an essential bearing on the Telegraph, are without any foundation.

I have shown that his "published researches" disclose no new discoveries of any avail in the Telegraph.

I have shown that I did not receive from him, directly or indirectly, any facts whatever previous to the actual demonstration, experimentally, of my telegraphic instruments, nor any facts afterwards, of any service to me in perfecting the invention.

I have shown that in my sincere desire to give him due credit for scientific discoveries, which, from the high consideration in which I held him, I was but too ready to believe were in reality his, on superficial evidence, I had unwittingly given him credit for more than is due to him.

I have shown that the reiterated assertion which has been made by opposing counsel, that "to Prof. Henry is due the invention of the receiving magnet and combined circuits," actually receives no support from Prof. Henry's deposition, and has no foundation in fact.

With this very general summary, I shall, for the present, close my remarks, reserving any minor points for future correction, should I be called upon to defend what I have already advanced.

SAMUEL F. B. MORSE.

LOCUST GROVE, PO'KEEPSIE,

NEW-YORK, *December*, 1853.

APPENDIX.

DEPOSITION OF JOSEPH HENRY.

[*From the Record of the Supreme Court of the United States. With a few Notes, by way of Commentary, by S. F. B. Morse.*]

1. PLEASE state your place of residence and your occupation; also, what attention, if any, you have given to the subjects of electricity, magnetism, and electro-magnetism?

Answer.—I begin this deposition with the express statement that I do not voluntarily give my testimony; but that I appear on legal summons, and in submission to law. I am Secretary to the Smithsonian Institution, established in the City of Washington, where I now reside. The principal direction of the Institution is confided to me. As I do not expect to return to Washington until some time in October, I have been called upon to give my testimony here in Boston. On this account I labor under the disadvantage of being obliged to testify without my notes and papers, which are now in Washington.

I commenced the study of electro-magnetism in 1827;* and since then have, at different times, within the last two and a half years, when I became Secretary of the Smithsonian Institution, made original investigations in this and kindred branches of physical science. I know no person in our country who has paid more attention to the study of the principles of electro-magnetism than myself.

2. Please give a general account of the progress of the science of electro-magnetism, as connected with telegraphic communi-

* It will be noticed that at this date, (the commencement of his studies,) I had already a knowledge of *electro-magnetism*, imparted in attendance on the lectures of Prof. James Freeman Dana, in the beginning of the year 1827.

cation; and of any inventions or discoveries in electro-magnetism applicable to the telegraph made by yourself?

Answer.— I consider an Electro-magnetic Telegraph as one which operates by the combined influence of electricity and magnetism. Prior to the winter of 1819–20, no form of the Electro-magnetic Telegraph was possible. The scientific principles on which it is founded were then unknown. The first fact of electro-magnetism was discovered by Oersted, of Copenhagen, during that winter. It is this: A wire being placed close above, or below, and parallel to a magnetic needle, and a galvanic current being transmitted through the wire, the needle will place itself at right angles to it. This fact was widely published, and the account was everywhere received with interest.

The second fact of importance was discovered independently, and about the same time, by Arago, at Paris, and Davy, at London. It is this: During the transmission of a galvanic current through a wire of copper, or any other metal, the wire exhibits magnetic properties, attracting iron but not copper filings, and having the power of inducing permanent magnetism in steel needles. The next important fact was discovered by Ampère, of Paris, one of the most sagacious and successful cultivators of physical science in the present century. It is this: Two parallel wires through which galvanic currents are passing in the same direction, attract each other; but if the currents pass in opposite directions, they repel each other. On this fact Ampère founded his ingenious theory of magnetism and electro-magnetism. According to this theory, all magnetic phenomena result from the attraction or repulsion of electric currents, supposed to exist in the iron at right angles to the length of the bar; and that all the phenomena of magnetism and electro-magnetism are thus referred to one principle, namely—the action of electrical currents on one another.

Ampère deduced from this theory many interesting results, which were afterwards verified by experiment. He also proposed to the French Academy a plan for the application of electro-magnetism to the transmission of intelligence to a distance. This consisted in deflecting a number of needles at the place of receiving intelligence, by galvanic currents transmitted through long wires. This transmission was to be effected by completing a galvanic circuit. When completed, the needle was deflected. When interrupted, it returned to its ordinary position, under the influence of the attraction of the earth. This project of Ampère was never reduced to practice. All these discoveries and results were prior to 1823.

The next investigations relating to the Magnetic Telegraph were published in 1825. They were by Mr. Barlow, of the Royal Military Academy of Woolwich, England. He found

that there was great diminution in the power of the galvanic current to produce effects with an increase of distance; a diminution so great in a distance of two hundred feet was observed, as to convince him of the impracticability of the scheme of the Electro-magnetic Telegraph. His experiments led him to conclude that the power was inversely as the square root of the length of the wire. The publication of these results put at rest, for a time, all attempts to construct an Electro-magnetic Telegraph.

The next investigation in the order of time, bearing on the Telegraph, were made by Mr. Sturgeon, of England. He bent a piece of iron wire into the form of a horse-shoe, and put loosely around it a coil of copper wire, with wide intervals between the turns or spires, to prevent them touching each other; and through this coil he transmitted a current of galvanism. The iron, under the influence of this current, became magnetic; and thus was produced the first electro-magnetic magnet, sometimes called simply the electro-magnet. An account of this experiment was first published in November, 1825, in the transactions of the Society for the Encouragement of the Arts in England; and was made known in this country through the annals of philosophy, November, 1826.

Nothing further was done pertaining to the telegraph until my own researches in Electro-magnetism, which were commenced in 1828, and continued in 1829, 1830, and subsequently; Barlow's results, as I before observed, had prevented all attempts to construct a Magnetic Telegraph on the plan of Ampère, and our own knowledge of the development of magnetism in soft-iron, as left by Sturgeon, was not such as to be applicable to telegraphic purposes. The electro-magnet of Sturgeon could not be made to act by a current through a long wire, as will be apparent, hereafter, in this deposition.

After repeating the experiments of Oersted, Ampère, and others, and publishing an account, in 1828, of various modifications of electro-magnetic apparatus, I commenced, in that year, the investigation of the laws of the development of magnetism in soft-iron, by means of the electrical current. The first idea that occurred to me, in accordance with the theory of Ampère, with reference to increasing the power of the electro-magnet, was that of using a longer wire than had before been employed. A wire of sixty feet in length, covered with silk, was wound round a whole length of an iron bar, either straight, or in the form of a U, so as to cover its whole length with several thicknesses of the wire.

The results of this arrangement were such as I had anticipated, and electro-magnets of this kind, exhibited to the Albany Institute in March, 1829, possessed magnetic power superior to that of any before known.

The idea afterwards occurred to me, that the quantity of galvanism supplied by a small galvanic battery, might be applied to develop a still greater amount of magnetic power in a large bar of iron. On experiment, I found this idea correct. A battery of two and a half square inches of zinc, developed magnetism, in a large bar, sufficient to lift fourteen pounds.

The next suggestion which occurred to me was that of using a number of wires, of the same length, around the same bar, so as to lessen the resistance which the galvanic current experienced in passing from the zinc to the copper, through the coil. To bring this to the test of experiment, a second wire, equal in length to the first, was wound around the last mentioned magnet, and its ends soldered to the plates of the same battery.

The magnet, with this additional wire, lifted twenty-eight pounds; or, in other words, its power was doubled.

A series of experiments was afterwards made, to determine the resistance to conduction of wires of different lengths and diameters, and the proper lengths and number of wires for producing, with different kinds of galvanic batteries, the maximum of amount of magnetic development, with a given quantity of zinc surface. For this purpose, a bar of sof-tiron, two inches square and twenty inches long, weighing twenty-one pounds, and much larger than any before used, was bent in the form of a horse-shoe. Around this were wound nine strands of copper wire, each sixty feet long, the ends left projecting so that one or more coils could be used at once, either connected with a battery or with each other, thus forming several coils with several battery connections, or one long coil with single battery connections. The greatest effect obtained with this magnet, using a battery of a single pair, with a zinc plate of two-fifths of a square foot of surface, and all the wire arranged as separate coils, was to lift a weight of six hundred and fifty pounds; with a large battery the effect was increased to seven hundred and fifty pounds. In a subsequent series of experiments, not published with the preceding, the same magnet was made to sustain one thousand pounds. When a compound battery was employed, of a number of pairs, it was found that the greatest effect was produced when all the wires were arranged as a single long coil. I subsequently constructed electro-magnets, on the same plan, which supported much greater weights. One of these, now in the cabinet of Princeton, will sustain three thousand six hundred pounds, with a battery occupying about a cubic foot of space. It consists of thirty strands of wire, each about forty feet in length.*

*** The natural inference from this narration, from bottom of page 98 to page 101 is a fallacious one. It seems impossible not to infer from it that Prof. Henry, in his experiments from 1828 onward, had the distinct and prominent purpose before his mind, of removing the obstacles to the practicability of an Electro-magnetic Tel-**

The above-mentioned experiments exhibit the important fact, that when a galvanic battery of intensity, (that is to say, a battery consisting of a number of pairs,) is employed, the electro-magnet connected with it must be wound with one long wire, in order to produce the greatest effect; and that when a battery of quantity, (that is, one of a single pair,) is employed, the proper form of the magnet connected with it is that in which several shorter wires are wound around the iron. The first of these magnets, which is the one now employed in the long or main circuit of the telegraph, may be called an intensity magnet; and the *second, which is used in the local circuit*, may be denominated the *quantity*.*

The quantity of electricity which can be passed through a long circuit of ordinary-sized wire is, under the most favorable circumstances, exceedingly small; and in order that this may develop magnetism in a bar of iron, it was necessary that it should be made to revolve many times around the iron, that its effects may be multiplied; and this is effected by using a long, single coil. Hence it will be seen, that the electro-magnet of Mr. Sturgeon was not applicable to telegraphic purposes in a long circuit.

Previous to making the last experiments above mentioned, in order to guide myself, I instituted a series of preliminary experiments on the conduction of wires, of different lengths and diameters, with different batteries. In these experiments a galvanometer, or an instrument consisting of a magnetic needle, freely suspended within a coil of wire, was first employed to denote, by the deflection of its needle, the power of the current. The result from a number of experiments, with a battery of a single pair, was the same as that obtained by Barlow—namely, that the power diminished rapidly with the increase of distance.

egraph, by aiming, *first*, to disprove the inference of Barlow, adverse to the project, from having observed the rapid diminution of power in an electric current as distance increased; and *second*, to improve the electro-magnet as left by Sturgeon, for the special purpose of making it applicable to *telegraphic* purposes. All that he had ever published, previous to this deposition, (in which, for the first time, he intimates such an intent,) may be safely challenged for a particle of proof to sustain such an unwarrantable assumption. There is but a *single* allusion, in anything he had ever published, to an Electric Telegraph of any kind; and this is the casual episodical remark in relation to Barlow, in his paper of 1831. Is this ingenuous? What he had *published*, previous to 1835, at least—not what he had *concealed* till 1849—is the only legitimate history for a Court.

* Here is a manifest perversion in the description of my arrangements of magnets, leading to the false impression, that I had adopted the two kinds of magnets which he claims to have perfected; and, to strengthen the impression, names respectively one, the *intensity* magnet, for the long line; and the other, *quantity* magnet, for the short line. The magnet of both lines of my combined circuits, is the common electro-magnet, wound, as suggested by Dana, in 1827. The *quantity* magnet of Henry, the only one possessing novelty, is not necessary in the telegraph, and has never been used in its arrangements, so far as I have learned.

With the same battery, and a larger wire, the diminution was less. The galvanometer was next removed, and a small electro-magnet substituted in its place. With a single battery, the same result was again obtained—a great diminution of lifting power with the increase of distance. After this, the battery of a single pair was removed, and its place supplied by one of intensity, consisting of twenty-five pairs. With this the important fact was observed, that no perceptible diminution of the lifting power took place, when the current was transmitted through an intervening wire, between the battery and the magnet, of upwards of one thousand feet.

This was the first discovery of the fact, that a galvanic current could be transmitted to a great distance with so little a diminution of force as to produce mechanical effects, and of the means by which the transmission could be accomplished.* I saw that the Electric Telegraph was now practicable; and in publishing my experiments and their results, I stated that the fact just mentioned was applicable to Barlow's project of such a telegraph. I had not the paper of Barlow before me, and erred in attributing to him a project of a telegraph, as he only disproved, as he thought, the practicability of one. But the intention† of this statement was to show that I had established the fact, that a mechanical effect‡ could be produced by the galvanic current at a great distance, operating upon a magnet or needle, and that the telegraph was therefore possible. In arriving at these results, and announcing their applicability to the telegraph, I had not in mind any particular form of telegraph, but referred only to the general fact, that it was now demonstrated that a galvanic current could be transmitted to great distances, with sufficient power to produce mechanical effects adequate to the desired object.

The investigations above mentioned were all devised and originated, and the experiments planned, by myself. In con-

* A mistake. [See page 33, Defence.] Soëmmerring had projected a galvanic current to a distance of 2,248 feet, with a force *sufficient* to produce mechanical effects, and used the same electro-motive power as Henry, and this, in 1812, eighteen years before Henry published his experiments. Ampère had, also, actually produced mechanical effects at a distance, in 1820, eleven years before.

† Whatever the *intention* of his statement in his published paper, as here attempted to be explained, the statement itself confines his application to a *needle telegraph*, and *that only*; nor could it have, in his own mind, at the time, any other application, so far as telegraphs were concerned, since the *electro-magnet* had then never been proposed for telegraphic purposes, and Henry does not here propose it, nor even suggest it.

‡ For the perfect securing of "mechanical effects," at a distance, by electro motive force, all that was necessary to know, after Schweigger had invented h i multiplier, but especially after Soëmmerring's and Ampère's experiments, was th law establishing the relation between the *resistance* to be overcome, and the *powe* to overcome that resistance; and this law was educed by Professor Ohm, o Nuremberg, in 1827, and is known at this day as "*Ohm's law, or formula.*"

ducting the latter, however, I was assisted by Dr. Philip Ten Eyck, of Albany. An account of the whole* was published in the 19th volume of "Silliman's Journal," in 1831, with the exception of the account of the large magnet afterwards constructed, at Princeton, in 1833, and the experiment mentioned of lifting a thousand pounds with one of my first magnets. While I was engaged in these researches, Professor Mohl, of the University of Utrecht, was pursuing investigations somewhat similar, and succeeded in making powerful electro-magnets, but made no discovery as to the distinction between the two kinds of magnets, or the transmissibility of the galvanic current to a great distance, with power to produce mechanical effects.† In fact, his experiments were but a repetition on a large scale of those of Sturgeon.

After completing the investigations above mentioned, I commenced a series of experiments on another branch of electricity closely connected with this subject. Among other things, I applied the principles above mentioned to the construction of an electro-magnetic machine, which has since excited much attention in reference to the application of electro-magnetism as a motive power in the arts.‡

In 1832 I was called to the chair of Natural Philosophy in the College of New-Jersey, at Princeton; and, in my first course of lectures in that institutio n, in 1833, and in every sub sequent year during my connection with that institution, I mentioned the project of the Electro-magnetic Telegraph, and explained how the electro-magnet might be used to produce mechanical effects at a distance, adequate to making signals of various kinds. I never myself attempted to reduce these principles to practice, or to apply any of my discoveries to processes in the arts. My whole attention, exclusive of my duties to the College, was devoted to original scientific investigations, and I left to others what I considered in a scientific view of subordinate importance, the application of my discoveries to useful purposes in the arts. Besides this, I partook of the feeling

* How far this statement is correct, may readily be ascertained by comparing i with his account of his experiments in his paper, in "Silliman's Journal," which paper is herewith appended.

† Compare this narration with his statement in the last paragraph of his paper in "Silliman's Journal." Here the *magnets*, as applicable to a *telegraph*, are put forward as the principal object of his researches. There the principal object is a magnet of great power, with a small expenditure of galvanism. Not a word respecting the bearing of the magnets upon a *telegraph*.

‡ How is this *electro-magnetic machine* applicable to any telegraph known to Professor Henry, at the time he published his paper describing it? In this deposition there is an attempt to connect them, as if he had my telegraph in his mind at the time. This is all wrong. For Professor Henry's opinion of this, as well as other machines of the same character, see his letter to me of February, 1842, on p. 16, Defence; and for his opinion of its intrinsic value, see the paper itself.

common to men of science, which disinclines them to secure to themselves the advantages of their discoveries by a patent.

In February, 1837, I went to Europe; and early in April of that year, Prof. Wheatstone, of London, in the course of a visit to him in King's College, London, with Prof. Bache, now of the Coast Survey, explained to us his plans of an Electro-magnetic Telegraph; and among other things, exhibited to us his method of bringing into action a second galvanic circuit. This consisted in closing the second circuit by the deflection of a needle, so placed that the two ends projecting upwards, of the open circuit, would be united by the contact of the end of the needle when deflected; and on opening or breaking of the circuit so closed by opening the first circuit, and thus interrupting the current, when the needle would resume its ordinary position under the influence of the magnetism of the earth. I informed him that I had devised another method of producing effects somewhat similar. This consisted in opening the circuit of my large quantity magnet, at Princeton, when loaded with many hundred pounds weight, by attracting upward a small piece of moveable wire with a small intensity magnet, connected with a long wire circuit. When the circuit of the large battery was thus broken by an action from a distance, the weights would fall, and great mechanical effect could thus be produced, such as the ringing of church bells at a distance of a hundred miles or more, an illustration which I had previously given to my class at Princeton. My impression is strong, that I had explained the precise process to my class before I went to Europe; but testifying now without the opportunity of reference to my notes, I cannot speak positively.* I am, however, certain of having mentioned in my lectures every year previously, at Princeton, the project of ringing bells at a distance, by the use of the electro-magnet, and of having frequently illustrated the principle to my class, by causing in some cases a thousand pounds to fall on the floor, by merely lifting a piece of wire from two cups of mercury closing the circuit.

The object of Prof. Wheatstone, as I understood it, in bringing into action a second circuit, was to provide a remedy for the diminution of force in a long circuit. My object in the process described by me, was to bring into operation a large quantity magnet, connected with a quantity battery in a local circuit, by means of a small intensity magnet, and an intensity battery at a distance†.

The only other scientific facts of importance to the practical operation of the telegraph not already mentioned, are the dis-

* See page [55] Defence.

† See remarks on ross examination, p. [57] Defence.

covery by Steinheil, in 1837, in Germany, of the practicability of completing a galvanic circuit, by using the earth for completing the circuit, and the construction of the constant battery in 1836, or about that time, by Prof. Daniel, of King's College, London. I believe that I was the first to repeat the experiments of Steinheil and Daniel in this country. I stretched a wire from my study to my laboratory, through a distance in the air of several hundred yards, and used the earth as a return conductor, with a very minute battery, the negative element of which was a common pin, such as is used in dress, and the positive element the point of a zinc wire immersed in a single drop of acid. With this arrangement, a needle was deflected in my laboratory before my class. I afterwards transmitted currents in various directions, through the college grounds at Princeton. The exact date of these experiments I am unable to give without reference to my notes. They were previous, however, to the unsuccessful attempt of Mr. Morse to transmit currents of electricity through wires buried in the earth, between Washington and Baltimore, and before he attempted to use the earth as a part of the circuit. Previous to this time, and after the above-mentioned experiments, Mr. Morse visited me at Princeton, to consult me on the arrangement of his conductors. During this visit, we conversed freely on the subject of insulation and conduction of wires. I urged him to put his wires on poles, and stated to him my experiments and their results.

In the course of the years 1836 and 1837, various plans of more or less merit were devised, and more or less carried into effect, for applying the principles already discovered to the construction of Electro-magnetic Telegraphs, in different parts of the world; but of these I do not undertake to give any particular account. I would say, however, that of these plans, that for which Mr. Morse subsequently obtained a patent was, in my judgment, the best.

3. Please state whether or not you are acquainted with the Electro-magnetic Telegraph, for which S. F. B. Morse obtained a patent in 1846? If you are, please state whether any; and if any, which of the principles or plans which you have described as discovered or announced by yourself or others, are used in the construction or operation of it? Statealso what principles used in the telegraph are, so far as you know, original with Prof. Morse?

Answer.—I am acquainted with the principles and general mode of operation of the telegraph and improvement referred to. The telegraph is based upon the facts discovered by myself,* and others of which I have already given an account.

* It will be perceived that the answer, for the most part, to this inter-

The plan which was first described to me, in the autumn of 1837, by Mr. Morse, or by Prof. Gale,* (who was associated with him in the construction of the telegraph,) was, to employ a single entire circuit of wire, with an intensity battery to excite the current, and an intensity magnet to receive it and produce a mechanical action which would work the recording apparatus. Mr. Morse afterwards employed the intensity battery in a long circuit, and an intensity magnet to receive its current at a distant point, and produce the mechanical effect of closing a secondary circuit. The secondary circuit may be either employed to transmit a second current to a distant point and there close a third circuit, and thus continue the line, or for working a recording apparatus in the secondary circuit; or it may be employed without reference to the continuation of the line, as a short local circuit to work a local magnet. In the first case there must be in the secondary circuit an intensity battery and intensity magnet; in the last case, a quantity magnet and quantity battery are required.†

rogatory, is evasive. He is distinctly asked to point out which of the *principles* or *plans* which he had discovered, are used in the construction of my telegraph. Yet he specifies nothing distinctly as his. He says, in general terms, that it is based on facts, discovered by him. What fact? Is it that of a mode of obtaining the greatest amount of magnetic power, with the smallest amount of galvanism? this is the great fact he announces as his discovery, the only new fact not known before; and with this, as I have said, my telegraph has nothing to do. Does he mean, when describing my plan of employing the usual Cruikshank's battery with an electro-magnet in the circuit, to intimate that this magnet or battery was derived from him? He is in error; Prof. Dana used them in 1827, in connection, and exhibited them to his audience, (to me among the number,) before Prof. Henry had even commenced his studies in electro-magnetism. If he means to intimate that the combination of circuits was his plan, he is in error, as I have shown at length in the Defence at p. [50] and onward. If he means in describing the local circuit arrangement, that the magnet I use is his *quantity* magnet, he is again in error. If he means any other kind of magnet, then it is not his.

* He says, "by Mr. Morse, or by Prof. Gale." If either of us described the telegraph to him at that period, it must have been Prof. Gale; since I have shown that my first acquaintance with him was not till May, 1839.

† Much stress, it will be seen, is laid by Prof. Henry on the terms, '*intensity*' and '*quantity*;' and he has applied these terms to two kinds of magnets: *intensity*, to the usual and common magnet, with a helix of a single long wire; and *quantity*, to a magnet with a helix composed of numerous short wires—this latter being the magnet which he invented to obtain "great magnetic power, at a small expenditure of galvanism." These terms he has borrowed from the two kinds of Voltaic battery—the battery of *intensity*, or one with many elements, plates, or pairs; and the battery of *quantity*, or one with a single element, plate, or pair. It is somewhat difficult to understand what he claims as new in these particulars, as applicable to a telegraph. Both kinds of battery have been known from the very birth of galvanism. The *intensity* forms of the battery were the kinds earliest in general use. Volta's original pile, the first galvanic battery ever made, is an intensity battery. Volta's "chapelet de tasses,"(*a*) or, as it is usually called, "couronne des tasses," is another form of intensity battery; and Cruikshank's improvement on Volta's, made as early as 1804, is also an intensity battery; and the improved batteries of the present day, and those most in use for general pur-

(*a*) Wilkinson's Elements of Galvanism. Vol. II., p. 139.

I heard nothing of the secondary circuit as a part of Mr. Morse's plan, until after his return from Europe, whither he went in 1838.* It was not till long after this that Mr. Morse used the earth as a part of the circuit, in accordance with the discovery of Steinheil.

I am not aware that Mr. Morse ever made a single original discovery, in electricity, magnetism, or electro-magnetism, applicable to the invention of the telegraph. I have always considered his merit to consist in combining and applying the discoveries of others in the invention of a particular instrument and process for telegraphic purposes. I have no means of determining how far this invention is original with himself, or how much is due to those associated with him.

4. Please state when you first became acquainted with Prof. Morse, and what knowledge he possessed of electricity, magnetism, and electro-magnetism; and what information you or others communicated to him, relating to the telegraph? State, also, all you know of the attempts of himself and others associated with him, to construct an Electro-magnetic Telegraph, either from your own observation or from statements made by himself or byothers, in your presence? State, particularly, any conversation, if any, you may have had with him, in reference to your own discoveries, applied to the telegraph?

Answer.—Shortly after my return from Europe, in the autumn of 1837, I learned that Mr. Morse was about to petition Congress for assistance in constructing the Electro-magnetic Tele-

poses in the arts and for scientific investigation, are, for the most part, intensity batteries. The distinctive qualities, too, of *intensity* and *quantity*, in relation to batteries, were among the very earliest discovered and commented on by savans. An *intensity* battery was recognised as having greater *power*, according to the number(a) of its plates, and, of course, ability to propel a galvanic current with greater velocity; while a *quantity* battery was perceived to have but a *feeble* power for this purpose. These, therefore, are no recent discoveries. I have used both kinds of battery in the telegraph, from the beginning. The *intensity* battery, on Cruikshank's plan, was first used by me, on a circuit of great length; a battery which may now be used for the telegraph, but with less convenience than Grove's & Daniel's improvements upon it; these latter having the great advantage of *sustaining power*; yet, so far as practicability is concerned, of no superior efficacy in accomplishing the result. The quantity battery is used in my local circuit, because it is sufficient for my purpose; but not the *quantity magnet* invented and so called by Prof. Henry. I employ, and have always employed, the usual electro-magnet, in one of its earliest forms. Sturgeon's magnet, the kind of magnet first exhibited to me by Prof. Dana, has been tried, and anwers perfectly well, in the local circuit.

* I returned in 1839. So far as this is understood as intimating that I had no such plan as the secondary circuit before I went to Europe, because he was not made acquainted with it, it is sufficient to say the evidence was before the court, that I described the two circuits in combination in 1836, constructed and used them in March, 1837, and specified them at the Patent Office in 1838, *before* I went to Europe.

(a) Wilkinson. Vol. II., pp. 360, 149, 153, 157.

graph. Some of my friends in Princeton, knowing what I had done in developing the principles of the telegraph, urged me to make the representations to Congress, which I expressed some thought of doing, namely—that the principles of the Electro-magnetic Telegraph belonged to the science of the world; and that any appropriation which might be made by Congress, should be a premium for the best plan, and the means of testing the same, which the ingenuity of the country might offer. Shortly after this, I visited New-York, and there accidentally made the personal acquaintance of Mr. Morse. He appeared to be an unassuming and prepossessing gentleman, with very little knowledge of the general principles of electricity, magnetism, or electro-magnetism.* He made no claims, in conversation with me, to any scientific discovery, or to anything beyond his particular machine, and process of applying known principles to telegraphic purpos He explained to me his plan of a telegraph with which he had recently made a successful experiment. I thought this plan better than any with which I had been made acquainted in Europe. I became interested in him; and, instead of interfering in his application to Congress, I gave him a certificate in the form of a letter,‡ stating my confidence in the practicability of the Electro-magnetic Telegraph, and my belief that the form proposed by himself was the best which had been published.

Mr. Morse subsequently visited Princeton several times,§ to confer with me on the principles of electricity and magnetism, which might be applicable to the telegraph. I freely gave him any information I possessed.

I learned in 1837, or thereabouts, that Prof. Gale and Dr. Fisher were the scientific assistants of Mr. Morse in preparing the telegraph. Mr. Vail was also employed, but I know not in

* It will be thought that Prof Henry must have very industriously improved the few moments of this confessedly casual interview, to examine me in the extent of my acquirements in electricity, magnetism, and electro-magnetism. One would suppose he was rather giving to the Faculty of College the result of his examination of a candidate for entering college, than speaking to a court of one, his equal in *academic position*, (I say not—equal in scientific acquirements.) This tone savors not a little of pique, and would not have been used by him previous to the publication of Vail's book. But, let it pass. His narration is unfortunately erroneous in dates, as usual. His memory is at fault in making the *first* interview with me in 1837, in New-York, when it has been shown that it was in 1839, two years later, and in Princeton.

† Scientific reputation follows, presumedly, on "scientific discovery." If the former is awarded by a competent judge, to any one, it may be presumed that he deserves it, on account of *scientific discovery*. Prof. Henry, in his letter of February, 1842, awards to me "scientific reputation," as a "*just claim*;" but this was before the fatal year 1845, before Vail's book appeared. *Tempora mutantur*, &c.

‡ The letter of February, 1842, which speaks for itself, written *five years* after this supposititious interview.

§ "Several times!" *twice*, if that is several times; first, in May, 1839, and second, and last, in Feb., 1844.

what capacity, and I am not personally acquainted with him. With Prof. Gale I have been intimately acquainted for several years; he had been a pupil in chemistry of my friend Dr. Torrey, and had studied my papers on electro-magnetism, and, as he informed me, had applied them in the arrangement of the apparatus for the construction of Morse's Telegraph.*

My researches had been given to the world several years before the attempt was made to reduce the Magnetic Telegraph to practice. Mr. Chilton, of New-York, informed me that he had referred Mr. Morse to them previous to his experiments in the New-York University.† I was, therefore, much surprised on the publication, in 1845, of a work purporting to give a history of the telegraph, and of the principles on which it was founded, by Mr. Vail, then principal assistant of Mr. Morse, and one of the proprietors of his patent, to find all my published researches relating to the telegraph passed over with little more than the remark, that Dr. Mohl and myself had made large electro-magnetic magnets. Presuming that this publication was authorized by Mr. Morse, and the proprietors of the telegraph, I complained to some of his friends of the injustice, and after his return from Europe, (for he was absent at the time the book was issued,) I received a letter, copied and signed by Mr. Vail, but written by Mr. Morse, as the latter afterwards informed me, excusing the publication on the ground that he, (Mr. Vail,) was ignorant of what I had done, and asking me for an account of my researches. This letter was addressed to me after the book had been translated into French, and, I believe, published in Paris. To the letter I did not think fit to make any reply. I afterwards received a letter from Mr. Morse, in his own name, on the same subject, to which I gave a verbal reply in January, 1847, in Washington. In this interview, Mr. Morse acknowledged that injustice had been done me, but said that proper reparation would be made. Another issue of the same work was made, bearing date 1847, in which there is no change in the statement relative to my researches.

About the beginning of 1848, Mr. Walker, of the Coast Survey, in a report on the application of the telegraph to the determination of differences of longitude, alluded to my researches. A copy of this was sent to Mr. Morse, which led to an interview between Mr. Walker, Prof. Gale, Mr. Morse, and

*** It is intended here to insinuate that if I did not get information *directly* from him or his writings, I got it *indirectly* through Dr. Gale. The fallaciousness of this is shown in the *second* note on the next page.**

† As my first experiments in the University in 1835, and onward until 1837, were known to comparatively a small number of persons, my pupils and others, Dr. Chilton could speak only of those that were more publicly shown in 1837, but at which time the telegraph was essentially completed It could have derived no aid at this time from anything published by Prof. Henry.

myself. At this meeting, which took place at my office in Washington, Mr. Morse stated that he had not known until reading my paper in January, 1847,* that I had two years before his first conception in 1832, settled the point of practicability of the telegraph, and shown how mechanical effects could be produced at a distance, both in the deflection of a needle and in the action of an electro-magnet; that he did not know, at the time of his experiments in 1837, that there had been any doubts of the action of a current at a distance, and that in the confidence of the persuasion that the effect could be produced, he had devised the proper apparatus by which his telegraph was put in operation. Prof. Gale being then referred to, stated that Mr. Morse had forgotten the precise state of the case; that he, (Mr. Morse,) previous to his, (Dr. Gale's,) connection with him, had not succeeded in producing effects at a distance; that when he was first called in he found Mr. Morse attempting to make an electro-magnet act through a circuit of a few yards of copper wire, suspended around a room in the University of New-York, and that he could not succeed in producing the desired effect, even in *this*, that circuit; that he, (Dr. Gale,) asked him if he had studied Prof. Henry's paper on the subject, and that the answer was "No;" that he then informed Mr. Morse that he would find the principles necessary to success explained in that paper; that instead of the battery of a single element, he should employ one of a number of pairs; and that, in place of the magnet with a short single wire, he should use one with a long coil. Dr. Gale further stated that his apparatus was in the same building, and that having articles of the kind he had mentioned, he procured them, and that with these the action was produced through a circuit of half a mile of wire. To this statement Mr. Morse made no reply. The interview then terminated, and I have since had no further communication with him on the subject.†

* Here dates are misapprehended. It was in 1847, that in passing through Philadelphia, I had access, in the library of the American Philosophical Society, to the Edinburgh Philos. Journal for Jan., 1825, Vol. XII., p. 195, which gives all that I can find respecting "Barlow's project," as Henry styles it. I had endeavored to find this work in the New-York libraries, but in vain; and Henry has confounded the two dates, to wit, the date of 1837, the time of my first knowledge of his paper in Silliman's Journal, and the date of 1847, the time of my first knowledge of the "project of Barlow."

† The whole narration of the incidents of this interview on this page, from line eleven to the bottom, is, from beginning to end, fallacious. The conversation, questions and answers are misrecollected, misrepresented, and untrue. As legal testimony, it was certainly open to exception, and should have been excepted to by legal counsel, but, fortunately, it had no weight with the courts.

Dr. Gale is made by Henry to say, that previous to his (Gale's) connection with me, I had not succeeded in producing effects at a distance, &c., and that I "*had not succeeded, even in a few yards of wire, to produce the desired effect.*" This

5. Please state whether or not you ever constructed any machine, for producing motion, by magnetic attraction and repulsion; if yea, what was it, and what led to the making of it?

Answer. After developing the great magnetic power of the electro-magnet, as already described, the thought occurred to me, that this power might be applied to give motion to a machine. The simplest arrangement which suggested itself to my mind was one already referred to, namely; causing a moveable bar, supported on a horizontal axis, like a scale beam, to be attracted and repelled by two permanent magnets. This could be readily effected by transmitting, through a coil of wire around the suspended bar, a current of galvanism, first in one direction, and then in the opposite direction, the alternations of the current being produced by dipping the ends of wires, projecting from the coil, into cups of mercury, connected with batteries, one on either side. An account of this was published in Silliman's Journal, for 1831, Vol. XX., p. 340. It was the first successful attempt to produce a mechanical motion which might apparently be employed in the arts, as a motive power. This little machine attracted much attention at home and abroad, and various modifications of it were made by myself, and others. I never, however, regarded it as practically applicable in the arts, because of the great expense of producing power by this means, except, perhaps, in particular cases, where expense of power is of little consequence.

6. Please look at the drawings of the Columbian Telegraph, now shown you, marked G. W. B., and N. B. C., and certified by G. S. Hilliard, Commissioner. Describe, generally, the apparatus represented, and its mode of operation, and state in what respects, if any, it differs from the telegraphic apparatus patented by Mr. Morse?

is Prof. Henry's statement of what he says Dr. Gale stated at the interview. Was it Prof. Henry's object to show, that through Dr. Gale, who had a knowledge of his "published researches," these researches were made available to me in my invention? What, then, does Dr. Gale testify when on the witness's stand? When questioned, without any reference to this interview, he says—*First.* "That he became, for the first time, acquainted with my telegraph in January, 1836." *Second.* When questioned, "Was not such machinery," (the telegraph,) "completed when you first saw it, and if not, what remained to be done?" He answers—"*It was in perfect order when I first saw it.*" And again, when asked, "Could said Morse successfully operate his telegraph, *prior to your communicating to him scientific intelligence?* He replies, "Said Morse *could have successfully operated his telegraph*, and DID SO OPERATE IT, PRIOR TO MY COMMUNICATING ANY SCIENTIFIC INTELLIGENCE." A memory defective in an unusual degree, is the most charitable construction for Prof. Henry, that can be put on such manifest aberrations from fact, in attempting to recollect what was said by another. I have evidence that Dr. Gale "*has no recollection*" of making any such remarks at this interview as Prof. Henry has put into his mouth. I certainly have no recollection of any such conversation myself, and I emphatically deny what he reports of the part I took in the conversation.

Answer. I have looked at the drawings, and I find, on examination, that it will be impossible for me to give a definite answer to the question, unless I have more time than is now at my disposal, and the means of examining and comparing the operations of the machines.

7. Please state, if you can, how many original experiments you have made, in the course of your investigation, in electricity, magnetism, and electro-magnetism?

Answer. The experiments I have mentioned, in this deposition, form but a small part of my original investigations. Besides many that I made in Albany, which I have not mentioned, since my removal to Princeton, I have made several thousand on electricity, magnetism, and electro-magnetism; particularly the former, which have more or less bearing on practical applications, of this branch of science, brief minutes of which fill several hundred folio pages. Many of these have not been published in detail. They have cost me years of labor and much expense.

The only reward I ever expected was the consciousness of advancing science, the pleasure of discovering new truths, and the scientific reputation to which these labors would entitle me.

JOSEPH HENRY.

Sworn to before me,
September 7th, 1849.
GEO. S. HILLIARD,
Commissioner.

PROF. HENRY'S PAPER, PUBLISHED IN VOL. XIX. OF SILLIMAN'S JOURNAL OF SCIENCE—JANUARY, 1831.

*On the application of the principle of the Galvanic Multiplier to Electro-magnetic Apparatus, and also to the development of great magnetic power in soft-iron, with a small galvanic element.** By Prof. JOSEPH HENRY, of the Albany Academy.

FOR a long time after the discovery of the principal facts in electro-magnetism, the experiments in this interesting department of science could be repeated only by those who were so fortunate as to possess a large and expensive galvanic apparatus. Mr. Sturgeon, of Woolwich, did much towards making the subject more generally known, by showing that when powerful magnets are used, many of the most interesting experiments can be performed with a very small galvanic combination. His articles of apparatus, constructed on this principle, are of a much larger size, and more convenient, than any before used. They do not, however, form a complete set, as it is evident that strong magnets cannot be applied to every article required, and particularly to those intended to exhibit the action of terrestrial magnetism on a galvanic wire, or the operation of two galvanic wires on each other.

In a paper, published in the Transactions of the Albany Institute, June, 1828, I described some modifications of apparatus, intended to supply this deficiency of Mr. Sturgeon, by introducing the spiral coil, on the principle of the galvanic multiplier of Prof. Schweigger; and this, I think, is applicable in every case where strong magnets cannot be used. The coil is formed by covering copper wire, from $\frac{1}{40}$ to $\frac{1}{25}$ of an inch in diameter, with silk; and in every case which will permit, instead of using a single conducting wire, the effect is multiplied by introducing a coil of this wire, closely turned upon itself. This will be readily understood by an example: thus, in the experiment of Ampère, to show the action of terrestrial magnetism on a galvanic current, instead of using a short single wire, suspended on steel points, 60 feet of wire, covered with silk, are coiled so as to form a ring of about 20 inches in diameter, the several strands of which are bound together by wrapping a narrow silk ribbon around them. The copper and zinc of a pair of small galvanic plates are attached to the ends of the coil, and the whole suspended

* The term galvanic element is used, in this paper, to denote a single pair of galvanic plates.

by a silk fibre, with the galvanic element hanging in a tumbler of diluted acid. After a few oscillations, the apparatus never fails to place itself at right-angles to the magnetic meridian. This article is nothing more than a modification of De la Rive's ring, on a larger scale.

Shortly after the publication mentioned, several other applications of the coil, besides those described in that paper, were made, in order to increase the size of electro-magnetic apparatus, and to diminish the necessary galvanic power. The most interesting of these, was its application to a development of magnetism in soft-iron much more extensively than, to my knowledge, had been previously effected by a small galvanic element.

A round piece of iron, about ¼ of an inch in diameter, was bent into the usual form of a horse-shoe, and instead of loosely coiling around it a few feet of wire, as is usually described, it was tightly wound with 35 feet of wire, covered with silk, so as to form about 400 turns; 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. With these small plates, the horse-shoe became much more powerfully magnetic than another of the same size, and wound in the usual manner, by the application of a battery composed of 28 plates of copper and zinc, each 8 inches square. Another convenient form of this apparatus was contrived by winding a straight bar of iron, 9 inches long, with 35 feet of wire, and supporting it horizontally on a small cup of copper, containing a cylinder of zinc; when this cup, which served the double purpose of a stand and the galvanic element, was filled with dilute acid, the bar became a portable electro-magnetic magnet. These articles were exhibited to the Institute in March, 1829.

The idea afterwards occurred to me, that a sufficient quantity of galvanism was furnished by the two small plates to develop, by means of the coil, a much greater magnetic power in a larger piece of iron. To test this, a cylindrical bar of iron, ½ an inch in diameter, and about 10 inches long, was bent into the form of a horse-shoe, and wound with 30 feet of wire; with a pair of plates containing only 2½ square inches of zinc, it lifted 14 lbs., avoirdupois. At the same time, a very material improvement in the formation of the coil suggested itself to me, on reading a more detailed account of Prof. Schweigger's galvanometer, and which was also tested, with complete success, upon the same horse-shoe: it consisted in using several strands of wire, each covered with silk, instead of one; agreeably to this construction, a second wire, of the same length as the first, was wound over it, and the ends soldered to the zinc and copper in such a

manner that the galvanic current might circulate in the same direction in both, or, in other words, that the two wires might act as one; the effect by this addition was doubled, as the horse-shoe, with the same plates before used, now supported 28 lbs.

With a pair of plates, 4 inches by 6, it lifted 39 lbs., or more than 50 times its own weight.

These experiments conclusively proved that a great development of magnetism could be effected by a very small galvanic element, and also that the power of the coil was materially increased by multiplying the number of wires, without increasing the length of each. The multiplication of the wires increases the power in two ways: first, by conducting a greater quantity of galvanism, and, secondly, by giving it a more proper direction; for since the action of a galvanic current is directly at right-angles to the axis of a magnetic needle, by using several shorter wires, we can wind one on each inch of the length of the bar to be magnetized, so that the magnetism of each inch will be developed by a separate wire; in this way, the action of each particular coil becomes very nearly at right-angles to the axis of the bar, and, consequently, the effect is the greatest possible. This principle is of much greater importance when large bars are used. The advantage of a greater conducting power from using several wires, might, in a less degree, be obtained by substituting for them one large wire of equal sectional area; but, in this case, the obliquity of the spiral would be much greater, and, consequently, the magnetic action less; besides this, the effect appears to depend, in some degree, on the number of turns, which is much increased by using a number of small wires.*

In order to determine to what extent the coil could be applied in developing magnetism in soft-iron; and also to ascertain, if possible, the most proper length of the wires to be used—

A series of experiments were instituted, jointly, by Dr. Philip Ten Eyck and myself. For this purpose, 1,060 feet (a little more than $\frac{1}{5}$ of a mile) of copper wire, of the kind called bell wire, 0·45 $\frac{45}{1000}$ of an inch in diameter, were stretched, several times, across the large room of the Academy.

Experiment 1. A galvanic current, from a single pair of plates, of copper and zinc, two inches square, was passed through the whole length of the wire, and the effect on a galvanometer noted. From the mean of several observations, the deflection of the needle was 15°.

* Several small wires conduct more common electricity from the machine than one large wire, of equal sectional area; the same is probably the case, though in a less degree, in galvanism.

Ex. 2. A current from the same plates was passed through half the above length (or 530 feet) of wire; the deflection, in this instance, was 21°.

By a reference to a trigonometrical table, it will be seen that the natural tangents of 15° and 21° are very nearly in the ratio of the square roots of 1 and 2, or of the relative lengths of the wires in these two experiments.

The length of the wire forming the galvanometer may be neglected, as it was only eight feet long. This result agrees remarkably with the law discovered by Mr. Ritchie, and published in the last number of the "Journal of the Royal Institution of Great Britain."

Ex. 3. The galvanometer was now removed, and the whole length of the wire attached to the ends of the wire of a small, soft-iron horse-shoe, ¼ of an inch in diameter, and wound with about eight feet of copper wire, with a galvanic current from the plates used in *Exs.* 1 and 2; the magnetism was scarcely observable in the horse-shoe.

Ex. 4. The small plates were removed, and a battery, composed of a piece of zinc plate, 4 inches by 7, surrounded with copper, was substituted; when this was attached immediately to the ends of the 8 feet of wire wound round the horse-shoe, the weight lifted was 4½ lbs.; when the current was passed through the whole length of wire, (1,060 feet,) it lifted about half an ounce.

Ex. 5. The current was passed through half the length of wire (530 feet) with the same battery; it then lifted 2 oz.

Ex. 6. Two wires of the same length, as in the last experiment, were used, so as to form two strands from the zinc and copper of the battery; in this case the weight lifted was 4 oz.

Ex. 7. The whole length of the wire was attached to a small trough, on Mr. Cruikshank's plan, containing 25 double plates, and presenting exactly the same extent of zinc surface to the action of the acid, as the battery used in the last experiment. The weight lifted in this case was 8 oz.; when the intervening wire was removed, and the trough attached directly to the ends of the wire surrounding the horse-shoe, it lifted only 7 oz. From this experiment, it appears that the current from a galvanic trough is capable of producing greater magnetic effect on soft-iron, after traversing more than ⅕ of a mile of intervening wire, than when it passes only through the wire surrounding the magnet. It is possible that the different states of the trough, with respect to dryness, may have exerted some influence on this remarkable result; but that the effect of a current from a trough, if not increased, is but slightly diminished in passing through a long wire, is certain. A number of other experiments would have been made to verify this, had not our

use of the room been limited, by its being required for public exercises.

On a little consideration, however, the above result does not appear so extraordinary as at the first sight, since a current from a trough possesses more projectile force, (to use Professor Hare's expression,) and approximates somewhat in intensity to the electricity from the common machine. May it not also be a fact that the galvanic fluid, in order to produce the greatest magnetic effect, should move with a small velocity; and that, in passing through one-fifth of a mile, its velocity is so retarded as to produce a greater magnetic action? But, be this as it may, the fact, that the magnetic action of a current from a trough, is, *at least*, not sensibly diminished by passing through a long wire, is directly applicable to Mr. Barlow's project of forming an Electro-magnetic Telegraph, and also of material consequence in the construction of the galvanic coil. From these experiments, it is evident that in forming the coil, we may either use one very long wire, or several shorter ones, as the circumstances may require; in the first case, our galvanic combinations must consist of a number of plates, so as to give projectile force; in the second, it must be formed of a single pair.

In order to test, on a large scale, the truth of these preliminary results, a bar of soft-iron, 2 inches square and 20 inches long, was bent into the form of a horse-shoe, 9½ inches high, the sharp edges of the bar were first a little rounded by the hammer: it weighed 21 lbs; a piece of iron, from the same bar, weighing 7 lbs., was filed perfectly flat on one surface, for an armature or lifter; the extremities of the legs of the horse-shoe were also truly ground to the surface of the armature: around this horse-shoe 540 feet of copper bell wire were wound in 9 coils, of 60 feet each; these coils were not continued around the whole length of the bar, but each strand of wire, according to the principle before mentioned, occupied about two inches, and was coiled several times, backward and forward, over itself; the several ends of the wires were left projecting, and all numbered, so that the first and the last end of each strand might be readily distinguished. In this manner, we formed an experimental magnet on a large scale, with which several combinations of wire could be made, by merely uniting the different projecting ends. Thus, if the second end of the first wire be soldered to the first end of the second wire, and so on through all the series, the whole will form a continued coil of one long wire. By soldering different ends, the whole may be formed into a double coil of half the length, or into a triple coil of one-third the length, &c. The horse-shoe was suspended in a strong, octangular wooden frame, 3 feet 9 inches high, and 20 inches

wide; an iron bar was fixed below the magnet, so as to act as a lever of the second order; the different weights supported, were estimated by a sliding weight, in the same manner as with a common steel-yard. See the sketch of the magnet.

In the experiments immediately following, a small single battery was used, consisting of two concentric copper cylinders, with zinc between them; the whole amount of zinc surface exposed to the acid from both sides of the zinc, was $\frac{2}{5}$ of a square foot; the battery required only half a pint of dilute acid for its submersion.

Ex. 8. Each wire of the horse-shoe was soldered to the battery in succession, one at a time; the magnetism developed by each was just sufficient to support the weight of the armature, weighing 7 lbs.

Ex. 9. Two wires, one on each side of the arch of the horse-shoe, were attached; the weight lifted was 145 lbs.

Ex. 10. With two wires, one from each extremity of the legs, the weight lifted was 200 lbs.

Ex. 11. With three wires, one from each extremity of the legs, and the other from the middle of the arch, the weight supported was 300 lbs.

Ex. 12. With four wires, two from each extremity, the weight lifted was 500 lbs., and the armature; when the acid was removed from the zinc, the magnet continued to support, for a few minutes, 130 lbs.

Ex. 13. With six wires, the weight supported was 570 lbs; in all these experiments, the wires were soldered to the galvanic element; the connexion, in no instance, was formed with mercury.

Ex. 14. When all the wires (nine in number) were attached, *the maximum weight lifted was* 650 *lbs.*, and this astonishing result, it must be remembered, was produced by a battery containing only $\frac{2}{5}$ of a square foot of zinc surface, and requiring only half a pint of diluted acid for its submersion.

Ex. 15. *A small battery, formed with a plate of zinc* 12 *inches long and six wide, and surrounded by copper, was substituted for the galvanic element used in the last experiment; the weight lifted in this case was* 750 *lbs.* This is probably the maximum of magnetic power which can be developed in this horse-shoe, as with a large calorimoter, containing 28 plates of copper and zinc, each 8 inches square, the effect was not increased, and, indeed, we could not succeed in making it lift as much as with the small battery.

The strongest magnet of which we have any account, is that in the possession of Mr. Peale, of Philadelphia; this weighs 53 lbs., and lifted 310 lbs., or about six times its own weight. Our magnet weighs 21 lbs., and consequently lifts more than thirty-

five times its own weight; it is probably, therefore, the most powerful magnet ever constructed. This, however, is by no means the maximum which can be produced by a small galvanic element, as in every experiment we have made, the power increases by increasing the quantity of iron; with a bar, similar to the one used in these experiments, but of double the diameter, or of 8 times the weight, the power would doubtless be quadruple, and that, too, without increasing the size of the galvanic element.

Ex. 16. *In order to ascertain the effect of a very small galvanic element on this large quantity of iron, a pair of plates, exactly one inch square, was attached to all the wires; the weight lifted was* 85 *lbs.*

The following experiments were made with wires of different lengths, on the same horse-shoe:—

Ex.. 17. With six wires, each thirty feet long, attached to the galvanic element; the weight lifted was 375 lbs.

*Ex*d 18. The same wires used in the last experiment, were united so as to form three coils of 60 feet each; the weight supporte was 290 lbs. This result agrees nearly with that of Exp. 11, though the same individual wires were not used; from this it appears, that six short wires are more powerful than three of double the length.

Ex. 19. The wires used in Ex. 10, but united so as to form a single coil of 120 feet of wire, lifted 60 lbs.; in Ex. 10, the weight lifted was 200 lbs.; this is a confirmation of the result in the last experiment.

Ex. 20. The same wires used in the last experiment, were attached to a small compound battery, consisting of two plates of zinc, and two of copper, after the plan of Prof. Hare, and containing exactly the same quantity of zinc surface as the element in the last experiment; in this case the weight lifted was 110 lbs., or nearly double of that in the last. This result is in strict accordance with that of Ex. 7, the two plates having more projectile force, and thus produce a greater effect with a long wire.

In these experiments a fact was observed which appears somewhat surprising; when the large battery was attached, and the armature touching both poles of the magnet, it was capable of supporting more than 700 lbs.; but when only one pole is in contact, it did not support more than 5 or 6 lbs., and in this case we never succeeded in making it lift the armature (weighing 7 lbs.) This fact may, perhaps, be common to all large magnets, but we have never seen the circumstance noticed of so great a difference between a single pole and both.

A number of experiments were also made with reference to the best form of the iron to receive magnetism, but no very

satisfactory results were obtained; of these, however, the following are considered as not uninteresting:—

Ex. 21. A cylindrical bar of iron, weighing 13 oz. 4½ drachms, and bent into a horse-shoe, was covered with two coils of wire, each 60 feet long; with the small battery used in last experiment, it lifted 42 lbs.

Ex. 22. A rectangular flat bar $\frac{15}{16}$ of an inch wide, and $\frac{1}{3}$ of an inch thick, also bent into a horse-shoe, weighing 9 oz. 3 dr., and of exactly the same surface as the bar used in the last experiment, lifted with the same wires and battery 35 lbs.

Ex. 23. A piece of a gun barrel, little less than an inch in diameter, and about 8 inches long, and from $\frac{1}{12}$ to $\frac{1}{15}$ of an inch thick, weighing 8 oz. 3⅔ dr., with the wires and battery as before, lifted 40 lbs.

From the last experiment, it appears that a given quantity of iron, in the form of a hollow cylinder is capable of receiving more magnetism than that of a solid cylinder of less diameter; but it is evident, from Ex. 21, that a solid bar of the same diameter as the gun barrel, and of greater weight, would have lifted more; perhaps the gun barrel was not sufficiently thick for the full development of magnetism, which, according to Barlow's experiments, resides near the surface.* A series of experiments† were separately instituted by Dr. Ten Eyck, in order to determine the maximum development of magnetism in a small quantity of soft-iron; From these the following interesting results were obtained:—

Ex. 1. A horse-shoe of round iron $\frac{36}{100}$ of an inch in diameter, 4 inches long, weighing 2,314 grains, and wound with 23 feet copper wire, diameter $\frac{45}{1000}$ of an inch, with a pair of one inch plates, lifted 19 lbs., 5 oz., 6 dwts., 16 grs.; with a pair of 4 inch plates, lifted 25 lbs., 6 oz., 5 dwts.; with the cylindrical element used in Exps. 8, 9, and 10, of former series, it lifted 42 lbs., 6oz., 8 dwts., 8 grs., or 105 times its own weight.

Ex. 2. A horse-shoe of round iron ¼ inch in diameter, 3½ inches in length, weighing 310 grains, and wound with 15 feet copper wire, diameter $\frac{45}{1000}$ inch, with a pair of one inch plates, lifted 3 lbs., 11 oz., 7 dwts., 22 grs.; with four inch plates it lifted 5 lbs., 5 oz., 12 dwts., 12 grs.; with the cylindrical element, 8 lbs., 2 oz., 8 dwts., 18 grs., or 152 times its weight.

Ex. 3. A horse-shoe formed of a flat bar $2\frac{1}{10}$ inches long, $\frac{3}{10}$ broad, and $\frac{6}{100}$ thick, weighing 84 grains, and wound with 16 feet of brass wire $\frac{2}{100}$ of an inch in diameter, with a pair of one inch plates, lifted 3 lbs., 2 oz., 3 dwts., 8 grs.; with 4 inch plates, lifted 2 lbs., 10 oz., 2 dwts., 12 grs.; with the

* See Barlow's Essay on Magnetic Attractions, page 50.

† Troy weight is used in these experiments.

cylindrical element, 2 lbs., 10 oz., 13 dwts., 2 grs., or 198 times its own weight.

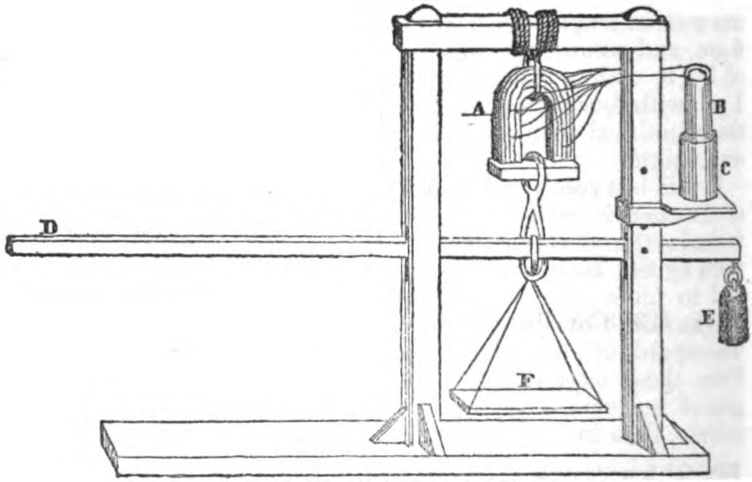
Ex. 4. A horse-shoe of round iron, slightly flattened, one inch in length, diameter (before flattening) $\frac{6}{100}$ inch, weight 6 grs., and wound with 3 feet brass wire, same diameter as that of No. 3, with a pair of one inch plates, lifted 2 oz., 15 dwts., 1 gr.; with four inch plates, lifted 3 oz., 17 dwts., 10 grs.; with the cylindrical element, 5 oz., 5 dwts., 4 grs., or 420 times its own weight.

In this last result, the ratio of the weight lifted to the weight of the magnet, is much greater than any we have ever seen noticed; the strongest magnet we can find described, is one worn by Sir Isaac Newton, in a ring, weighing 3 grains; it is said to have taken up 746 grs., or nearly 250 times its own weight. M. Cavallo has seen one of 6 or 7 grs. weight, which was capable of lifting 300 grs., or about 50 times its own weight. From these experiments, it is evident that a much greater degree of magnetism can be developed in soft-iron, by a galvanic current, than in steel, by the ordinary method of touching.

Most of the results given in this paper were witnessed by Dr. L. C. Beck, and to this gentleman we are indebted for several suggestions, and particularly that of substituting cotton, well waxed, for silk thread, which, in these investigations, became a very considerable item of expense: he also made a number of experiments with iron bonnet wire, which, being found in commerce already wound, might possibly be substituted in place of copper. The result was, that with very short wire the effect was nearly the same as with copper, but in coils of long wire, with a small galvanic element, it was not found to answer. Dr. Beck, also, constructed a horse-shoe of round iron, one inch in diameter, with four coils, on the plan before described, with one wire it lifted 30 lbs., with two wires 60 lbs., with three wires 85 lbs., and with four wires 112 lbs.

While engaged in these investigations, the last No. of the Edinburgh Journal of Science was received, containing Prof. Mohl's paper on Electro-Magnetism, some of his results are in a degree similar to those here ascribed; his object, however, was different, it being only to induce strong magnetism on soft-iron with a powerful galvanic battery. The principal object in these experiments was to produce the greatest magnetic effect with the smallest quantity of galvanism. The only effect Prof. Mohl's paper has had over these investigations has been to hasten their publication: the principle on which they were

instituted was known to us nearly two years since, and at that time exhibited to the Albany Institute.



A, the magnet covered with linen, the ends of the wires projecting so as to be soldered to the galvanic element B. C, a cup with dilute acid on a moveable shelf. D, a graduated lever. E, a counterpoise. F, a scale for supporting weights; when a small sliding weight on the lever is not used; a second galvanic element is attached to the apparatus so that the poles of the magnet can be instantly reversed, this is omitted in the figure.

By inverting the large magnet, it sets in motion a very large revolving cylinder of March and Ampère.

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PROF. MORSE'S DEFENCE AGAINST THE ATTACK OF PROF. HENRY.

ERRATA.

Page 38, line 16, dele "both."
Page 33, line 6th from bottom, for "were" and "are" read "was" and "is."
Page 48, line 15, for "eight" read "nine."
Page 96, date at the bottom, for "1853" read "1854."

Editorial.

PROF. MORSE'S DEFENCE AGAINST PROF. HENRY'S ATTACK.

It is a matter deeply to be regretted, when it becomes necessary for one to defend himself against the unjust aspersions of a fellow-man, but more particularly so in the case given in the present number of the "Telegraph Companion." Although we most heartily concur in the utterance of every word expressed by Prof. Morse, we are, nevertheless, pained to feel, that it is a necessary infliction of a just punishment, and one, too, that is administered with the most moderate feeling, upon the part of Prof. Morse, towards one who has done so much to his injury.

After reading the exposé of Prof. Morse, of what Prof. Henry has done and what he claims to have done, and his incomprehensible course, no one, it occurs to us, can consider the conduct of Prof. Henry as other than evidence of hallucination. Prof. Henry has been regarded as a distinguished man in American science. He has occupied stations of honor in our institutions of learning, and his energy and presumed talents have given him a name of distinction throughout his own land, and have also won for him the admiration of the savans of Europe. The promulgation of the facts, by Prof. Morse, will startle those who have accorded to Prof. Henry unmeasured praise. The question as to what he has really discovered, will naturally arise in the minds of all. It now seems that the whole of his claims to discoveries in science, are to be considered with doubt. Prof. Morse proves his statements so grossly incorrect, that in future no dependence can be placed upon the statistics or assertions put forth by Prof. Henry. The defence of Prof. Morse is sustained by evidence which cannot be questioned, and the tone and words used by him, in repelling such an unjust attack, are certainly marked with as much candor and moderation, as can be desired by the most fastidious reader.

We have not the room in the present number to give a review of the questions under consideration, and so ably set forth by Prof. Morse. In the next number of the "Companion," we may have something to say on the subject.

SHAFFNER'S
TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. II. **APRIL, 1855.** **No. 2.**

Art. I.—ELECTRIC INDUCTION.

BY PROFESSOR M. FARADAY, F. R. S.

[Presented to the Royal Institution of Great Britain.]

ON ELECTRIC INDUCTION—ASSOCIATED CASES OF CURRENT AND STATIC EFFECTS.

CERTAIN phenomena that have presented themselves in the course of the extraordinary expansion which the works of the Electric Telegraph Company have undergone, appeared to me to offer remarkable illustrations of some fundamental principles of Electricity, and strong confirmation of the truthfulness of the view which I put forth sixteen years ago, respecting the mutually dependent nature of induction, conduction, and insulation, (Experimental Researches, 1318, &c.) I am deeply indebted to the Company; to the Gutta Percha works, and to Mr. Latimer Clarke, for the facts; and also for the opportunity both of seeing and showing them well.

Copper wire is perfectly covered with gutta percha at the Company's works, the metal and the covering being in every part regular and concentric. The covered wire is usually made into half mile lengths, the necessary junctions being effected by twisting or binding, and ultimately, soldering; after which the place is covered with fine gutta percha, in such a manner as to make the coating as perfect there as elsewhere: the perfection of the whole operation is finally tried in the following striking manner, by Mr. Statham, the manager of the works. The half mile coils are suspended from the sides of barges floating in a canal, so that the coils are immersed in the water whilst the two ends of each coil rise into the air: as many as 200 coils are thus immersed at once, and when their ends are connected in series, one great length of 100 miles of submerged wire is produced,

the two extremities of which can be brought into a room for experiment. An insulated voltaic battery of many pairs of zinc and copper, with dilute sulphuric acid, has one end connected with the earth, and the other, through a galvanometer, with either end of the submerged wire. Passing by the first effect, and continuing the contact, it is evident that the battery current can take advantage of the whole accumulated conduction or defective insulation in the 100 miles of gutta percha on the wire, and that whatever portion of electricity passes through to the water will be shown by the galvanometer. Now the battery is made one of intensity, in order to raise the character of the proof, and the galvanometer employed is of considerable delicacy; yet so high is the insulation, that the deflection is not more than 5°. As another test of the perfect state of the wire, when the two ends of the battery are connected with the two ends of the wire, there is a powerful current of electricity shown by a much coarser instrument; but when any one junction in the course of the 100 miles is separated, the current is stopped, and the leak or deficiency of insulation rendered as small as before. The perfection and condition of the wire may be judged of by these facts.

The 100 miles, by means of which I saw the phenomena, were thus good as to insulation. The copper wire was $\frac{1}{16}$ of an inch in diameter:—the covered wire was $\frac{4}{16}$; some was a little less, being $\frac{7}{32}$ in diameter:—the gutta percha on the metal may therefore be considered as 0.1 of an inch in thickness. 100 miles of like covered wire in coils were heaped up on the floor of a dry warehouse and connected in one series, for comparison with that under water.

Consider now an insulated battery of 360 pairs of plates (4 × 3 inches) having one extremity to the earth; the water wire with both its insulated ends in the room, and a good earth discharge wire ready for the requisite communications:—when the free battery end was placed in contact with the water wire and then removed, and, afterwards, a person touching the earth discharge touched also the wire, he received a powerful shock. The shock was rather that of a voltaic than of a Leyden battery; it occupied *time*, and by quick tapping touches could be divided into numerous small shocks. I obtained as many as 40 sensible shocks from one charge of the wire. If *time* were allowed to intervene between the charge and discharge of the wire, the shock was less; but it was sensible after 2, 3, or 4 minutes, or even a longer period.

When, after the wire had been in contact with the battery, it was placed in contact with a Statham's fuze, it ignited the fuze

(or even 6 fuzes in succession) vividly:—it could ignite the fuze 3 or 4 seconds after separation from the battery. When, having been in contact with the battery, it was separated and placed in contact with a galvanometer, it affected the instrument very powerfully:—it acted on it, though less powerfully, after the lapse of 4 or 5 minutes, and even affected it sensibly 20 or 30 minutes after it had been separated from the battery. When the insulated galvanometer was permanently attached to the end of the water wire, and the battery pole was brought in contact with the free end of the instrument, it was most instructive to see the great rush of electricity into the wire; yet after that was over, though the contact was continued, the deflection was not more than 5°, so high was the insulation. Then separating the battery from the galvanometer, and touching the latter with the earth wire, it was just as striking to see the electricity rush out of the wire, holding for a time the magnet of the instrument in the reverse direction to that due to the ingress or charge.

These effects were produced equally well with either pole of the battery, or with either end of the wire; and whether the electric condition was conferred and withdrawn at the same end, or at the opposite ends of the 100 miles, made no difference in the results. An intensity battery was required, for reasons which will be very evident in the sequel. That employed was able to decompose only a very small quantity of water in a given time. A Grove's battery of 8 or 10 pair of plates, which would have far surpassed it in this respect, would have had scarcely a sensible power in affecting the wire.

When the 100 miles of wire in the air were experimented with in like manner, not the slightest signs of any of these effects were produced. There is reason, from principle, to believe that an infinitesimal result is obtainable, but as compared to the water wire the action was nothing. Yet the wire was equally well and better insulated, and as regarded a constant current, it was an equally good conductor. This point was ascertained, by attaching the end of the water wire to one galvanometer, and the end of the air wire to another like instrument; the two other ends of the wires were fastened together, and to the earth contact; the two free galvanometer ends were fastened together, and to the free pole of the battery; in this manner the current was divided between the air and water wires, but the galvanometers were affected to precisely the same amount. To make the result more certain, these instruments were changed one for the other, but the deviations were still alike: so that the two wires conducted with equal facility.

The cause of the first results is, upon consideration, evident

enough. In consequence of the perfection of the workmanship, a Leyden arrrangement is produced upon a large scale; the copper wire becomes charged statically with that electricity which the pole of the battery connected with it can supply;* it acts by induction through the gutta percha, (without which induction it could not itself become charged, Exp. Res. 1177,) producing the opposite state on the surface of the water touching the gutta percha, which forms the outer coating of this curious arrangement. The gutta percha across which the induction occurs, is only 0.1 of an inch thick, and the extent of the coating is enormous. The surface of the copper wire is nearly 8,300 square feet, and the surface of the outer coating of water is four times that amount, or 33,000 square feet. Hence the striking character of the results. The intensity of the static charge acquired is only equal to the intensity at the pole of the battery whence it is derived; but its quantity is enormous, because of the immense extent of the Leyden arrangement; and hence when the wire is separated from the battery and the charge employed, it has all the powers of a considerable voltaic current, and gives results which the best ordinary electric machines and Leyden arrangements cannot as yet approach.

That the air wire produces none of these effects is simply because there is no outer coating correspondent to the water, or only one so far removed as to allow of no sensible induction, and therefore the inner wire cannot become charged. In the air wire of the warehouse, the floor, walls, and ceiling of the place constituted the outer coating, and this was at a considerable distance; and in any case could only affect the outside portions of the coils of wire. I understand that 100 miles of wire, stretched in a line through the air, so as to have its whole extent opposed to earth, is equally inefficient in showing the effects, and there it must be the distance of the inductric and inducteous surfaces (1483), combined with the lower specific inductive capacity of air, as compared with gutta percha, which causes the negative result. The phenomena altogether offer a beautiful case of the identity of static and dynamic electricity. The whole power of a considerable battery may in this way be worked off in separate portions, and measured out in units of static force, and yet be employed afterwards for any or every purpose of voltaic electricity.

I now proceed to further consequences of associated static and dynamic effects. Wires covered with gutta percha, and then inclosed in tubes of lead or of iron, or buried in the earth, or

* Davy, Elements of Chemical Philosophy, p. 154.

sunk in the sea, exhibit the same phenomena as those described; the like static inductive action being in all these cases permitted by the conditions. Such subterraneous wires exist between London and Manchester, and when they are all connected together so as to make one series, offer above 1,500 miles; which, as the duplications return to London, can be observed by one experimenter at intervals of about 400 miles, by the introduction of galvanometers at these returns. This wire, or the half, or fourth of it, presented all the phenomena already described; the only difference was, that as the insulation was not so perfect, the charged condition fell more rapidly. Consider 750 miles of the wire in one length, a galvanometer *a* being at the beginning of the wire, a second galvanometer *b* in the middle, and a third *c* at the end:—these three galvanometers being in the room with the experimenter, and the third *c* perfectly connected with the earth. On bringing the pole of the battery into contact with the wire through the galvanometer *a*, that instrument was instantly affected; after a sensible time *b* was affected, and after a still longer time *c*: when the whole 1,500 miles were included, it required two seconds for the electric stream to reach the last instrument. Again;—all the instruments being deflected, (of course not equally, because of the electric leakage along the line,) if the battery were cut off at *a*, that instrument instantly fell to zero; but *b* did not fall until a little while after; and *c* only after a still longer interval;—a current flowing on to the end of the wire whilst there was none flowing in at the beginning. Again; by a short touch of the battery pole against *a*, it could be deflected and could fall back into its neutral condition, before the electric power had reached *b*; which in its turn would be for an instant affected, and then left neutral before the power had reached *c*: a wave of force having been sent into the wire, which gradually travelled along it, and made itself evident at successive intervals of time, in different parts of the wire. It was even possible, by adjusted touches of the battery, to have two simultaneous waves in the wire, following each other, so that at the same moment that *c* was affected by the first wave, *a* or *b* was affected by the second; and there is no doubt that by the multiplication of instruments and close attention, four or five waves might be obtained at once.

If after making and breaking battery contact at *a*, *a* be immediately connected with the earth, then additional interesting effects occur. Part of the electricity which is in the wire will return, and passing through *a* will deflect it in the reverse direction; so that currents will flow out of both extremities of the

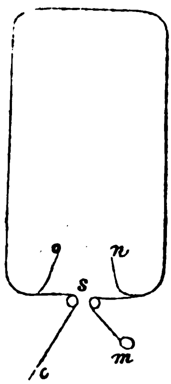
wire in opposite directions, whilst no current is going into it from any source. Or if *a* be quickly put to the battery and then to the earth, it will show a current first entering into the wire, and then returning out of the wire at the same place; no sensible part of it ever travelling on to *b* or *c*.

When an air wire of equal extent is experimented with in like manner, no such effects as these are perceived: or, if guided by principle, the arrangements are such as to be searching, they are perceived only in a very slight degree, and disappear in comparison with the former gross results. The effect at the end of the very long air wire (or *c*) is in the smallest degree behind the effect at galvanometer *a;* and the accumulation of a charge in the wire is not sensible.

All these results as to *time*, &c., evidently depend upon the same condition as that which produced the former effect of static charge, namely, *lateral induction;* and are necessary consequences of the principles of conduction, insulation, and induction, three terms which, in their meaning, are inseparable from each other, (Exp. Res. 1320, 1326,* 1338, 1561, &c.) If we put a plate of shellac upon a gold leaf electrometer and a charged carrier (an insulated metal ball of two or three inches diameter) upon it, the electrometer is diverged; removing the carrier, this divergence instantly falls; this is *insulation* and *induction*. If we replace the shellac by metal, the carrier causes the leaves to diverge as before, but when removed, though after the shortest possible contact, the electroscope is left diverged; this is *conduction*. If we employ a plate of spermaceti instead of the metal, and repeat the experiment, we find the divergence partly falls and partly remains, because the spermaceti insulates and also conducts, doing both imperfectly: but the shellac also conducts, as is shown, if time be allowed; and the metal also obstructs conduction, and therefore insulates, as is shown by simple arrangements. For if a copper wire, 74 feet in length and $\frac{1}{12}$ of

* 1326. All these considerations impress my mind strongly with the conviction, that insulation and ordinary conduction cannot be properly separated when we are examining into their nature: that is, into the general law or laws under which their phenomena are produced. They appear to me to consist in an action of contiguous particles, dependent on the forces developed in electrical excitement; these forces bring the particles into a state of tension or polarity, which constitutes both *induction* and *insulation;* and being in this state the contiguous particles have a power or capability of communicating these forces, one to the other, by which they are lowered, and discharge occurs. Every body appears to discharge (444.987); but the possession of this capability in a *greater or smaller degree* in different bodies, makes them better or worse conductors, worse or better insulators: and both *induction* and *conduction* appear to be the same in their principle and action (1320), except that in the latter, an effect common to both is raised to the highest degree, whereas in the former, it occurs in the best cases, in only an almost insensible quantity.

an inch in diameter, be insulated in the air, having its end *m* a metal ball; its end *e* connected with the earth, and the parts near *m* and *e* brought within half an inch of each other, as at *s*; then an ordinary Leyden jar being charged sufficiently, its outside connected with *e* and its inside with *m*, will give a charge to the wire, which, instead of travelling wholly through it, though it be so excellent a conductor, will pass in large proportion through the air at *s*, as a bright spark; for with such a length of wire, the resistance in it is accumulated until it becomes as much, or perhaps even more, than that of the air, for electricity of such high intensity.



Admitting that such and similar experiments show that conduction through a wire is preceded by the act of induction (1338), then all the phenomena presented by the submerged or subterranean wires are explained; and in their explanation confirm, as I think, the principles given. After Mr. Wheatstone had, in 1834, measured the velocity of a wave of electricity through a copper wire, and given it as 288.000 miles in a second, I said, in 1838, upon the strength of these principles (1333), "that the velocity of discharge through the *same wire* may be greatly varied, by attending to the circumstances which cause variations of discharge through spermaceti or sulphur. Thus, for instance, it must vary with the tension or intensity of the first urging force, which tension is charge and induction. So if the two ends of the wire, in Professor Wheatstone's experiment, were immediately connected with two large insulated metallic surfaces exposed to the air, so that the primary act of induction, after making the contact for discharge, might be in part removed from the internal portion of the wire at the first instant, and disposed for the moment on its surface jointly with the air and surrounding conductors, then I venture to anticipate, that the middle spark would be more retarded than before: and if these two plates were the inner and outer coating of a large jar, or a Leyden battery, then the retardation of that spark would be still greater." Now this is precisely the case of the submerged or subterraneous wires, except that, instead of carrying their surfaces towards the inducteous coatings (1483), the latter are brought near the former; in both cases the induction consequent upon charge, instead of being exerted almost entirely at the moment within the wire, is to a very large extent determined externally; and so the discharge or conduc-

tion being caused by a lower tension, therefore requires a longer time. Hence, the reason why, with 1,500 miles of subterraneous wire, the wave was two seconds in passing from end to end; whilst with the same length of air wire, the time was almost inappreciable.

With these lights it is interesting to look at the measured velocities of electricity in wires of metal, as given by different experimenters.

	Miles per second.
* Wheatstone in 1834, with copper wire, made it	288,000
* Walker in America, with telegraph iron wire	18,780
* O. Mitchell, ditto. ditto.	28,524
* Fizeau and Gonnelle, (copper wire)	112,680
* Ditto. - - (iron wire)	62,600
† A. B. G. (copper) London and Brussels Telegraph	2,700
† Ditto. (copper) London and Edinburgh Telegraph	7,600

Here the difference in copper is seen by the first and fifth result to be above a hundred fold. It is further remarked in Liebig's report of Fizeau's and Gonnelle's experiments, that the velocity is not proportional to the conductive capacity, and is independent of the thickness of the wire. All these circumstances and incompatibilities appear rapidly to vanish, as we recognize and take into consideration the lateral induction of the wire carrying the current. If the velocity of a brief electric discharge is to be ascertained in a given length of wire, the simple circumstances of the latter being twined round a frame in small space, or spread through the air through a large space, or adhering to walls, or lying on the ground, will make a difference in the results. And in regard to long circuits such as those described, their conducting power cannot be understood, whilst no reference is made to their lateral static induction, or to the conditions of intensity and quantity which then come into play; especially in the case of short or intermitting currents—for then static and dynamic are continually passing into each other.

It has already been said that the conducting power of the air and water wires are alike for a constant current. This is in perfect accordance with the principles and with the definite character of the electric force, whether in the static, or current, or transition state. When a voltaic current of a certain intensity is sent into a long water wire, connected at the further extremity with the earth, part of the force is in the first instance occupied in raising a lateral induction round the wire, ultimately equal in intensity at the near end to the intensity of the battery stream,

* Liebig and Kopp's report 1850, (translated,) p. 168.
† Athenæum, 14th January, 1854, p. 54.

and decreasing gradually to the earth end, where it becomes nothing. Whilst this induction is rising, that within the wire amongst its particles is beneath what it would otherwise be; but as soon as the first has attained its maximum state, then that in the wire becomes proportionate to the battery intensity, and therefore equals that in the air wire, in which the same state is (because of the absence of lateral induction) almost instantly attained. Then of course they discharge alike, and therefore conduct alike.

A striking proof of the variation of the conduction of a wire, by variation of its lateral static induction, is given in the experiment proposed 16 years ago, (1333.) If, using a constant charged jar, the interval *s*, page 6, be adjusted so that the spark shall freely pass there, (though it would not if a little wider,) whilst the short connecting wires *n* and *o* are insulated in the air, the experiment may be repeated twenty times without a single failure; but, if after that, *n* and *o* be connected with the inside and outside of an insulated Leyden jar, as described, the spark will never pass across *s*, but all the charge will go round the whole of the long wire. Why is this? The quantity of electricity is the same, the wire is the same, its resistance is the same, and that of the air remains unaltered; but because the intensity is lowered, through the lateral induction momentarily allowed, it is never enough to strike across the air at *s*; and it is finally altogether occupied in the wire, which, in a little longer time than before, effects the whole discharge. M. Fizeau has applied the same expedient to the primary voltaic currents of Ruhmkorff's beautiful inducting apparatus, with great advantage. He thereby reduces the intensity of these currents at the moment when it would be very disadvantageous, and gives us a striking instance of the advantage of viewing static and dynamic phenomena as the result of the same laws.

Mr. Clarke arranged a Bain's printing telegraph with three pens, so that it gave beautiful illustrations and records of facts like those stated: the pens are iron wires, under which a band of paper, imbued with ferro-prussiate of potassa, passes at a regular rate by clock-work; and thus regular lines of prussian blue are produced whenever a current is transmitted, and the time of the current is recorded. In the case to be described, the three lines were side by side, and about 0.1 of an inch apart. The pen *m* belonged to a circuit of only a few feet of wire, and a separate battery; it told whenever the contact key was put down by the finger; the pen *n* was at the earth end of the long air wire, and the pen *o* at the earth end of the long subterraneous wire; and by arrangement, the key could be made to throw the electricity of the chief battery into either of these

wires, simultaneously with the passage of the short circuit current through pen *m*. When pens *m* and *n* were in action, the *m* record was a regular line of equal thickness, showing by its length the actual time during which the electricity flowed into the wires; and the *n* record was an equally regular line, parallel to, and of equal length with the former, but the least degree behind it; thus indicating that the long air wire conveyed its electric current almost instantaneously to the further end. But when pens *m* and *o* were in action, the *o* line did not begin until some time after the *m* line, and it continued after the *m* line had ceased, *i. e.*, after the *o* battery was cut of. Furthermore, it was faint at first, grew up to a maximum of intensity, continued at that as long as battery contact was continued, and then gradually diminished to nothing. Thus the record *o* showed that the wave of power took time in the water wire to reach the further extremity; by its first faintness, it showed that power was consumed in the exertion of lateral static induction along the wire; by the attainment of a maximum and the after equality, it showed when this induction had become proportionate to the intensity of the battery current; by its beginning to diminish, it showed when the battery current was cut off; and its prolongation and gradual diminution, showed the time of the outflow of the static electricity laid up in the wire, and the consequent regular falling of the induction which had been as regularly raised.

With the pens *m* and *o* the conversion of an intermitting into a continuous current could be beautifully shown; the earth wire, by the static induction which it permitted, acting in a manner analogous to the fly-wheel of a steam engine, or the air-spring of a pump. Thus, when the contact key was regularly but rapidly depressed and raised, the pen *m* made a series of short lines separated by intervals of equal length. After four or more of these had passed, then pen *o*, belonging to the subterraneous wire, began to make its mark, weak at first, then rising to a maximum, but always continuous. If the action of the contact key was less rapid, then alternate thickening, and attenuations appeared in the *o* record; and if the introductions of the electric current at the one end of the earth wire were at still longer intervals, the records of action at the other end became entirely separated from each other. All showing most beautifully, how the individual current or wave, once introduced into the wire, and never ceasing to go onward in its course, could be effected in its intensity, its time, and other circumstances, by its partial occupation in static induction.

By other arrangements of the pens *n* and *o*, the near end of the subterraneous wire could be connected with the earth im-

mediately after separation from the battery; and then the back flow of the electricity, and the time and manner thereof, were beautifully recorded; but I must refrain from detailing results which have already been described in principle.

Many variations of these experiments have been made and may be devised. Thus, the ends of the insulated battery have been attached to the ends of the long subterraneous wire, and then the two halves of the wire have given back opposite return currents when connected with the earth. In such a case the wire is positive and negative at the two extremities, being permanently sustained by its length and the battery, in the same condition which is given to the short wire for a moment by the Leyden discharge, p. 6; or, for an extreme but like case, to a filament of shellac having its extremities charged positive and negative. Colomb pointed out the difference of long and short as to the insulating or conducting power of such filaments, and like difference occurs with long and short metal wires.

The character of the phenomena described in this report, induces me to refer to the terms *intensity* and *quantity* as applied to electricity; terms which I have had such frequent occasion to employ. These terms, or equivalents for them, cannot be dispensed with by those who study both the static and the dynamic relations of electricity; every current where there is resistance, has the static element and induction involved in it, whilst every case of insulation has more or less of the dynamic element and conduction; and we have seen that, with the same voltaic source, the same current in the same length of the same wire gives a different result as the intensity is made to vary, with variations of the induction around the wire. The idea of intensity or the power of overcoming resistance, is as necessary to that of electricity, either static or current, as the idea of pressure is to steam in a boiler, or to air passing through apertures or tubes; and we must have language competent to express these conditions and these ideas. Furthermore, I have never found either of these terms lead to any mistakes regarding electrical action, or give rise to any false view of the character of electricity or its unity. I cannot find other terms of equal useful significance with these; or any which, conveying the same ideas, are not liable to such misuse as these may be subject to. It would be affectation, therefore, in me, to search about for other words; and besides that, the present subject has shown me more than ever their great value and peculiar advantage in electrical language.

The fuze referred to in page 3, is of the following nature: Some copper wire was covered with sulphureted gutta percha;

after some months it was found that a film of sulphuret of copper was formed between the metal and the envelope; and further, that when half the gutta percha was cut away in any place, and then the copper wire removed for about ¼ of an inch, so as to remain connected only by the film of sulphuret adhering to the remaining gutta percha, an intensity battery could cause this sulphuret to enter into vivid ignition, and fire gunpowder with the utmost ease. The experiment was shown in the lecture room, of firing gunpowder at the end of eight miles of single wire. Mr. Faraday reported that he had seen it fired through 100 miles of covered wire immersed in the canal, by the use of this fuze.

ART. II.—ATLANTIC AND PACIFIC OCEANS TELEGRAPH.

REPORT OF MR. FARLEY TO THE HOUSE OF REPRESENTATIVES OF THE CONGRESS OF THE UNITED STATES.

[In volume one, of the Companion, we published an account of a proposed Telegraph, to connect the Atlantic and Pacific Oceans. The bill has been passed by both Houses of Congress and signed by the President. Proper energy will be devoted to its early completion, and the line, when done, will be of the utmost import to the nation. We earnestly solicit for this enterprise the energies and co-operation of our telegraph people. Messrs. Alden and Eddy deserve much credit for their successful efforts in getting the attention of Congress in the consideration of this important national enterprise.]—Editor.

The project contemplated in the bill is of transcendent public concern, and possesses the merits of *practicability* and *early completion*, if it can have the encouragement of the government. It provides—

Firstly. That a right of way shall be given through the public lands of the United States for the construction of a subterranean line of telegraph, (of at least two independent conductors,) from the Mississippi or Missouri rivers to the Pacific Ocean, at San Francisco, in California.

Secondly. That it be constructed by individual enterprise, and at individual expense.

Thirdly. That after its completion, in a specified and most permanent manner, the free use thereof, to the extent of eight thousand words per month, shall be tendered to the general government, and the enjoyment of that privilege secured to it in perpetuity, with the reservation to the government of the further *prior* use to any extent within the capacity of said line,

at such rates of compensation for messages transmitted as Congress may by law provide.

Fourthly. That thereupon, and in consideration of such free use and said reservation, the government shall permit the parties to select from the public lands not before sold or appropriated, in the territories along and within fifteen miles of said line of telegraph, any quantity, not more than a section and in alternate sections, two millions of acres, which shall then be conveyed to them.

The citizens of the United States residing upon the Pacific coast have the strongest ties connecting them with the older States. They have established themselves there, organized a powerful State, and are rapidly creating a commerce reaching to the islands and the Asiatic coast. Their peculiar position gives them claims of an imperative character upon the protection and care of the government. Europe is extending lines of telegraph into Asia and Africa, and lines of great length have been constructed in India. When this proposed link shall be completed, the Pacific Ocean will be touched upon either shore by lines which, spanning continents, reach to the opposite shores of the Atlantic Ocean, and are destined, perhaps, to cross the latter and unite together.

The benefits which will follow the execution of this enterprise cannot be partial or sectional; they must necessarily be of incalculable national importance, and the moral influences resulting therefrom will be co-extensive with the world of civilization and commerce. The results of such a work can hardly be overrated, in the enlivening spirit which it will infuse into the business and other relations existing between the Atlantic and Pacific coasts, in its influence upon the varied interests of that vast population which is destined so soon to occupy every part of the territory embraced within the limits of the republic, and in the facilities which it will be able to render the government in peace and in war. While immense advantages must flow from the construction of the proposed line, your committee are not aware that a single evil can; and objections, if any there be, must be directed against the mode recommended to insure its success, rather than the object sought to be accomplished.

It may be contended that the precise point for the location of the line, at its eastern terminus, should be fixed in the bill. This is not important. It is left discretionary with the memorialist to commence from "such point on the Mississippi or Missouri rivers as they may hereafter select." It will undoubtedly be for their interest to start from some prominent

point of population and business. The best route cannot be determined upon without an examination and survey; and as the public interests cannot suffer thereby, it is thought expedient to leave the eastern terminus and general direction of the line entirely open. The fact that from the point selected for an eastern terminus, wherever it may be, diverging lines running in any direction may and will be made to connect with it, is a sufficient answer to any desire for fixing it in the bill.

It has been said that the building of a telegraph line to the Pacific should be connected with that of a railroad; and, further, that the construction of a telegraph line, as an independent measure, will be marking out a line for the Pacific railroad. The force of these objections is not seen by the committee. If the telegraph is to await the construction of the railroad, it is evident that its completion must be postponed for some years, even if the latter be commenced immediately, while two years will suffice for the construction of the former. The plan of the memorialist cannot mark out the route for a railroad, or influence the decision of that question, for the reason that the *straightest* practicable line between the termini is the most desirable. It would cross mountains, valleys, and rivers, in directions utterly unsuitable and impracticable for the route of a railroad; its location would be controlled by other considerations than those of grades, bridges, excavations and embankments, which must enter so largely into the location of the former.

Connect the Atlantic and Pacific coasts by telegraph communication, and the impulse which it will give to business, and that great tide of emigration setting towards California, will add to the necessity for railroad communication. In this instance, the telegraph should precede the railway.

The bill provides that the telegraph line shall be completed within two years from its passage, and after such State legislation shall have been secured as may be necessary to authorize its construction in the States through which it may pass. The parties having had much experience in similar undertakings, have full confidence in their success and their ability to complete the work within the time specified. The benefits, therefore, which will accrue from this measure, are not to be postponed to an indefinite future; they are close at hand and within our immediate grasp.

The line is to be constructed in the most permanent manner, with two independent conductors, placed under ground, where they will be exempt from all the causes which operate to prevent the efficiency and reliability of lines constructed in the ordinary

way. The wires are to be so completely protected by the insulating material, itself imperishable, that they will not corrode; and, being securely placed in the earth, no accidental breaking can occur. The electrical state of the atmosphere, or the most violent storms, can have no effect to interrupt the working of lines thus laid down. The plan proposed also includes the location of testing-tubes at intervals of five miles, and working stations at average distances of one hundred miles. Under such arrangements, should the line from any cause be interrupted, it could be speedily repaired. The parties are entirely confident that they will be able to work the line at *all* times as readily as air-lines are operated in the most favorable weather, and consequently that they can always transmit despatches directly through. This mode of construction, which has been attended with satisfactory success in Europe, will, it is confidently believed, secure all the advantages claimed for it by the memorialists, who have a practical knowledge of the building and operating lines of telegraph; being connected with the management of some of the best regulated telegraph companies in the country. The bill provides for two lines of wire, which will insure the transaction of a larger amount of business, and a degree of certainty and reliability to the government and the citizen in the transmission of despatches, which might, for obvious reasons, be sometimes interrupted, if the dependence was upon but *one* line of wire.

A subterranean line of two wires, such as the bill provides for, is estimated to cost eleven hundred and fifty dollars per mile. Calling the distance twenty-four hundred miles, the entire cost of the line, including the buildings necessary at the working stations, together with incidental expenses to be incurred in its construction, such as explorations and engineering, land transportation of materials, cost of supplies, and erection of forts to protect way stations, would be not less than two million seven hundred and sixty thousand dollars. The annual cost of operating the line is estimated at three hundred and fifty thousand dollars. Fifty operators will be necessary, and a force of two hundred and fifty other men will be required, constantly in the work of repairing and protecting the line. These men will be posted in small parties at the different working stations. It is proposed to have a double set of operators, so that the line may be worked by night as well as by day.

The value of the lands located along and near the telegraph line, if estimated as the government valued its bounty lands given to its soldiers in the Mexican war, when it commuted with them, giving one hundred dollars in scrip, or one hundred

and sixty acres of land, would be only at the rate of sixty-two and a half cents per acre. Valuing the proposed grant of two millions of acres at the same rate, it would be worth twelve hundred and fifty thousand dollars, considerably less than one-half the estimated cost of the line. It should be remembered that the bill confines the grant to the *Territories*, while those soldiers had the right of locating in both Territories and States. It is thought, therefore, than the sum of twelve hundred and fifty thousand dollars, is a fair valuation of their worth, if estimated as aid in the construction of the line. These lands are so far remote that it must be years before they can became of value to the government. No person could afford to purchase them at the government price of one dollar and twenty-five cents per acre, and retain them until they became marketable; he never would realize the cost and interest. The value to the government of the privilege of transmitting without charge eight thousand words per month is, at the rates named in the bill, equal to a yearly interest account of one hundred thousand dollars, a sum equivalent to an annual interest at eight per centum on the value of two millions of acres of land, according to the foregoing estimate. In addition to this privilege, the government is to have the prior use of the line for all its business, without restriction, at rates to be established by itself.

The principle so frequently regarded of selecting alternate sections where grants have been made by the government, in aid of great works of public importance, is incorporated into this bill.

It may be inquired why the government is asked to aid in this enterprise? The answer is clear, and, we think satisfactory. Telegraphic lines are of recent origin, and the profits of their business uncertain. As an investment, they have not yet acquired that favor with the public which will induce the capitalist to take stock in a line like the proposed, running thousands of miles through a savage country. It is believed that the numerous telegraphic lines put in operation in this country, exceeding in their aggregate length the united lines of all other countries, have not, on the whole, been a profitable investment to those interested. This project does not hold out sufficient grounds for success as a profitable investment, to induce subscriptions, without government encouragement. Without that assistance it is not to be expected that a telegraph line, as an independent measure, can, for years to come, be carried through, with reasonable hopes of remuneration for the outlay of capital which would be required. A grant of land under the conditions named, will give to the enterprise a degree of confi-

dence in the public estimation which cannot otherwise be created. It will give those engaged in it a credit and responsibility which will enable them to command means at once to carry on the work to an early completion, and overcome a great many obstacles which would be fatal to its success, if confined strictly to the efforts of private enterprise alone.

The aid of the government is invoked. Can it be granted with *safety* and *security* to the public interests? It is evident that it can. It is provided in the bill that no lands can be selected until *after* the completion of the line, and the free use of it tendered to the government. This condition is ample security. Again, it is provided that the line becomes forfeited to the government, in case of neglect on the part of the memorialists to operate it for a period of six months after its completion. The proposed grant in aid of the undertaking is not a *gift* of a portion of the public lands, but such a disposition of them as will confer great and lasting advantages to the citizen and the government. Looking at it in a pecuniary point of view, it is an investment by the government, upon which it will annually receive, in the transmission of its various orders, civil, military, and naval, a consideration of eight per centum on the value of the lands appropriated. This privilege, together with the "further prior use, to any extent within the capacity of the line, at such rates of compensation for messages transmitted as Congress may by law provide," are not of a temporary character; they are perpetual. The risk, labor, and responsibility are all upon the side of the memorialists. The government incurs no expense in the construction of the line; in a word, it hazards nothing.

The committee report back the Senate bill with amendments, with a recommendation that they be adopted, and that the bill, thus amended, do pass.

ART. III.—THE ATMOSPHERIC TELEGRAPH.

REPORT OF MR. MALLORY TO THE SENATE OF THE UNITED STATES, ON THE ATMOSPHERIC TELEGRAPH.

[In the first volume of the Telegraph Companion, we noticed the plan of Mr. Richardson, for the establishment of a means of conveying substances between distant points by the force of air. The name "Telegraph," we consider as not appropriate. That word means to write from a distance. This new art conveys matter from a distance. We have not the room necessary to discuss the subject as to its practicability. Gentlemen of much scientific intelligence regard the invention as worthy of patronage. We concur in this opinion, and hope that Congress will, at an early day, advance the required

assistance to put it in operation upon a large scale. We do not think it will interfere with the Electric Telegraph. If, however, it should prove useful, and wholly supersede the Telegraph, let it triumph. We believe in adopting the best of all things.]—Editor.

That Ithiel S. Richardson has obtained letters patent for what he denominates the "Atmospheric Telegraph;" but as these terms convey no distinct image to the mind, and but a very imperfect idea of the character and design of his proposition, your committee will briefly state them.

The idea of moving a piston within an exhausted cylinder by atmospheric pressure, and thereby transporting letters, merchandise, and even persons, is not new, and various experiments to attain this object have been made within the last thirty or forty years.

In 1810, Mr. Medhurst, a Danish engineer, proposed to carry letters and merchandise, by means of the rarification and compression of air, in a canal six feet high by five feet wide, containing a road of stone or iron. He was succeeded by the experiments of Mr. Pinkus, an American engineer; and about thirty years ago, John Vallance, Esq., of Brighton, (England,) took out a patent for a new method of carrying passengers and freight, which attracted much attention and speculation at the time, but which was considered more ingenious than practical. He proposed to construct from town to town, throughout the United Kingdom, air-tight cylinders of sufficient magnitude to enable ordinary wagons and cars to pass through them upon rail tracks by the alternate rarification and expansion of air.

Mr. Vallance seems to have constructed a model, and with it some experiments were made; but he probably realised the immeasurable space which too often separates theory from practice.

About the year 1838, public attention was arrested by the successful experiment at Chaillot (England) with the atmospheric railroad. Subsequently, about the year 1840, the atmospheric railroad was established between Kingstown and Dalkey, for the transportation of merchandise, passengers, &c., a distance of about thirty-five hundred yards, and this was followed by one in France.

Some ten years ago, Mr. W. H. James, son of the Mr. James so honorably identified with the origin of the British railroads, proposed a mode of carrying mails and small packages through air-tight tubes by atmospheric pressure, very similar to the plan under consideration.

He proposes to have two tubular passages, or carriage ways, running parallel to each other from end to end of any given

distance. These tubular passages are to be placed either above or below the surface of the ground, as found most convenient, and to be constructed of metal, wood, brick-work, or any other suitable material. At one termination of these tubular passages, and between them, there is to be fixed an air exhausting and forcing machine, connected by means of curved tubes with each of the tubular passages; which machine is to be actuated by a steam-engine or any other suitable and competent power, and so arranged, that when put in motion it may cause the air to flow from one passage into the other with very great rapidity. A similar machine is to be placed at the other termination of the tubular passages, and connected thereto and worked in the same manner; or intermediate machines may be employed, if found necessary, so as to produce an extremely rapid and continuous current of air in both directions throughout the whole distance. The vessels or carriages for containing the letters or parcels to be transmitted are to consist of spherical-shaped vehicles, or bags, *formed of caoutchouc*, or other suitable materials, and are to be so constructed as to be perfectly elastic, and to retain their shape independently of what they contain, and capable of being *beaten* or *buffetted* about like a foot-ball or boxing-glove without injury; being of the least possible weight, and having at the same time the requisite strength. It is further proposed that these spherical bags or letter carriages should be about fifteen inches diameter when the tubular passages are about eighteen inches, and that each shall contain only about a hundred letters at a time, so as to have great surface in proportion to weight. It is *imagined* that, on being introduced into the current of air, they will be carried forward, one after the other, like so many small balloons in a strong gale of wind, without, perhaps, even rolling against or *touching* the inner circumference of the tubular passages.

The distinction between this method and that of Mr. Richardson is not one of principle, but of detail; but this distinction seems to involve the *impracticability* of the one, and the *practicability* of the other; while in Mr. James's plan the letters enveloped in spheroid caoutchouc bags of a diameter *three inches less than that of the tube* through which they pass, leaving thereby a *clear space upon all sides of an inch and a half for a free passage of air*, Mr. Richardson's *plunger exactly conforms to the tube*, and admits *not the passage of air beyond it.*

These various propositions are *all based upon certain well established facts and principles.*

The atmosphere presses with equal intensity in all directions, whether on vertical or horizontal surfaces. And this pressure

may be taken to be equal to fourteen and three-quarter pounds to the square inch.

If we place upon the ground a tube of uniform diameter open at both extremities, and accurately adjust within it a piston capable of sliding in either direction, the piston of course remains stationary, the atmospheric pressure upon its surfaces being equal. But if we insert and confine the piston at one end, and, by means of an air pump at the other, exhaust the tube, the piston, upon being released, will pass through the tube at a speed equal to about (635) six hundred and thirty-five miles per hour, modified by its weight and friction.

Partial exhaustion would reduce this velocity; and if we insert the piston at one end, leaving it free to act, and work the air-pump at the other, the piston will move after a very slight rarification, dependent, as before stated, upon its weight and friction.

When the operation is performed in this manner, the air-pump has the control of the plunger's momentum, and may check or accelerate it at pleasure by the aid of a valve in the tube; and the pump, by exhausting the air in front of the advancing plunger, seems, in fact, to be drawing it onward, rather than clearing the way for the pressure of the following atmosphere.

Mr. Richardson exhibits a very beautiful model of his telegraph, which has been for some weeks past in one of the committee rooms of the Senate for inspection, and which your committee has frequently and carefully examined. It consists of a horizontal tube of one inch clear diameter, one-half of which is straight, while the other half contains curves, designed to represent the sinuosities of the tube passing over uneven ground. One small air-pump, placed near its centre, and communicating with either end of it, exhausts it at pleasure from left to right, or from right to left. A piston, or plunger, three inches long, and fitting the tube loosely, but followed by several detached disks, or washers of leather, which accurately fit it, is inserted in one end of the tube, separated by a cut-off; and a few strokes of the pump produce in the tube a partial vacuum. The cut-off is then reversed, and the plunger *set free on the side of the vacuum, relieved from the resistance of the air in the tube*, and, propelled alone by the pressure of the atmosphere, passes through it in a time wholly unappreciable by ordinary means. The cut-off may be dispensed with; for if the plunger, with its miniature mail-bag attached, be placed in one end of the tube, and the pump be worked, it will move (*supposing an absence of weight and friction*) with the first stroke of the pump, which destroys the equilibrium between the internal and external atmosphere;

and the degree of exhaustion necessary to produce this momentum must depend upon the weight and friction of the plunger and its attachments.

This model works admirably; and, without going into details of its construction, it seems to have *overcome all difficulties, and some which have been long supposed insuperable in the practicable operations of the* "Atmospheric Telegraph."

A mercurial barometer, whose base connects with the interior of the tube, instantly exhibits the changes in the rarification of the air within it, produced by every stroke of the air-pump; and this device is useful, enabling us to perceive at a glance, how slight a rarification of the atmosphere within the tube causes the piston, or plunger, with its "mail-bag," to move forwards.

Whatever differences of opinion may exist as to the properties of our atmosphere, its origin, its utmost limits from the earth, its laws of motion and expansion, sufficient reliable data are established to enable us to arrive at correct conclusions with reference to the principles involved in this proposition.

The density of the atmosphere decreases as we ascend from the earth, and whatever the height may be, we know that its pressure or weight on a square inch of surface is capable of supporting a column in the barometer tube about 30 inches high; and as mercury weighs 13,580 ounces, or 848¾ lbs. avoirdupois to the cubic foot, a simple proposition, 1,728 : 848¾ : : 30, gives 14.73 or 14¾ lbs. as the pressure of the atmosphere on every square inch of surface. Now, as mercury is about 10,800 times heavier than our air at the surface of the earth of medium density, a column of such air of equivalent weight to the atmospheric column would be 10,800 times 30 inches, which is about 27,000 feet. If we suppose a column of airiform fluid of this height to rest on a large exhausted receiver, as soon as a communication is formed between both, this tall column will force the air next the receiver in with a velocity equal to that acquired by a body falling *half the height of the fluid column* (as is supported by writers on natural philosophy); hence an atmospheric column (whatever height it may be) will force the air at the surface of the earth into an exhausted receiver with this velocity. Now, a body in falling 13,500, the half of 27,000 feet, will acquire, by the force of gravity, 932 feet at the last of its fall. This we easily found by dividing 13,500 by 16½, the fall in one second, the square root of the quotient gave nearly 29 seconds as the time of falling; this time, at the rate of 32⅙ of an increase of velocity per second gives the above. Nine hundrde and thirty-two feet per second is 635 miles per hour, as 932 × 3,600 and divided by 5,280 gives 635.

Assuming, then, that the tube is thoroughly exhausted, and the closely fitting plunger permitted to pass though it unresisted and free, and without weight or friction, by atmospheric pressure, it would preserve an uniform velocity throughout its whole extent, of 635 miles per hour.

But, in practice, a perfect vacuum is neither possible nor desirable; and it is believed that a degree of exhaustion, very easily attainable, will be amply sufficient for the accomplishment of a speed and power equivalent to the propulsion of fifty tons two hundred miles per hour.

The ordinary pressure of our atmosphere, as we have seen, may be taken at $14\frac{3}{4}$ pounds to the square inch; but wind, which is but atmosphere in motion, acts with a force dependent upon its velocity. When moving at thirty-five miles an hour, it exerts a force of six pounds on each square foot of an obstructing surface; at fifty miles an hour (the speed of an ordinary tempest) a force of $12\frac{1}{3}$ pounds; and at one hundred miles the (hurricane's rate) $49\frac{1}{3}$ pounds.

The weight of our atmosphere being found equal to that of a column of thirty inches of mercury, it follows that, at the hurricane velocity and pressure of $49\frac{1}{3}$ pounds per square foot, the exhaustion or rarification indicated by the mercurial guage would only be about two-thirds of an inch; *and this result, we find, accords with the actual observations upon hurricanes.*

With these and other established data before us, we can approximate at least the degree of exhaustion of the tube necessary to cause a current of air to pass through it with twice or three times the velocity of a hurricane.

In addition to the model to which your committee has referred, Mr. Richardson has tested the working and capacity of his telegraph, by laying down a tube one mile long, of three inches clear diameter, and following the elevations and depressions of an ordinary ungraded field; and he has produced numerous certificates, from highly scientific and reliable sources, of its accurate performance and entire success. The certificates all say that the mile was traversed by the piston or plunger, to which was attached a weight of several pounds, in less than "*a minute;*" but it is understood that the time was much less than this, and that this expression was used as a maximum, and to preserve uniformity in the certificates.

Your committee do not deem it necessary to present, in this report, all the details which have determined its judgment; but the relation which the atmospheric pressure, of which it has spoken, bears to the weight to be moved and its velocity, is too important to pass entirely unnoticed.

It is found, upon level railroads, that eight pounds pressure moves a ton in weight.

Now, the piston, 24 inches in diameter, would expose 452 square inches of surface to be operated upon, by an atmospheric pressure of 14¾ pounds to the inch, equal to 6,667 pounds. And hence the moving power of the atmosphere upon the weight expressed in tons, would be as 8 to 6,667, or a moving force of 833 tons, on the supposition that friction would not interfere.

Many practical difficulties and objections will doubtless develope themselves whenever the "Atmospheric Telegraph" shall be established upon a large scale; such, for example, as wastage of power in the air-pumps, the wear and tear in the mail-bags, pistons, and interior suface of the tubes, by high velocities, the admission of air in the tubes, the effect of climate upon them, the expense of establishing them, &c., &c.; but your committee, after weighing these and other objections which have been suggested, deem it proper to recommend an appropriation, small in its comparison with the national interests involved in its success, to test its utility and capacity.

It is deemed expedient that the experiment should be made for a short distance upon an established mail route, in order that, if successful, it might constitute a part of a more extended work; and your committee has been disposed to prescribe a direct line between Washington and Baltimore. It has, therefore, concluded to leave the question to the Postmaster General, and report a bill accordingly.

It is impossible to foreshadow the multiplied and incalculable advantages which will result from such a mail carrier as Mr. Richardson's proposition discloses.

All the business pursuits and habits of our country were radically changed by the introduction of railroads.

Not only do we find men, whose ancestors for generations never travelled beyond their native counties, passing from State to State in the daily transaction of their affairs, identifying themselves with the various sections of the Union, and bringing it together by the multiplying bonds of mutual confidence, pursuits and self interests, but under the railroads' fruitful developing and creative influence, we find the pathless forest of the west, the rich river lands of the south, and the cold granite hills of the north, yielding vast treasures, hitherto locked in their unyielding grasp, to a free, happy and prosperous people. We find new States springing into existence at the call of the steam whistle; and in the train of the resistless iron horse, the people and products, of distant, widely separated lands, mingle together in the commercial marts of our country.

The hand of an all-wise Providence, guiding and controlling the destinies of men and nations by his inscrutable laws, enabled us to devise, in a happy moment, those iron links of brotherhood, the physical bonds, without which our widely extended and extending republic could hardly continue its beautiful, happy and glorious unity.

But railroads proved too slow for our progress; and the magnetic telegraph came to our aid in the abolition of time and space, for which the age seems to be struggling.

It was but yesterday, as it were, that the genius of Morse gave us the telegraph, and enabled us to write with a long pen from one city of the Union to another; and though it was received at first with doubt, nay, with derision, it is now one of the great facts, as well as one of the necessities of the age.

At this moment, when every man seems to be a special competitor against time; when Mammon is in the ascendant, and the dictum, that "time is money," impresses itself upon all the affairs of life; when hours, minutes and seconds, are pounds, shillings and pence, Mr. Richardson's proposition comes upon us to supply a link which is confessedly wanting.

It was but yesterday, as it were, that a speed beyond fifteen miles per hour upon railways, or beyond seven miles by ocean steam navigation, and the transmission of intelligence by means of electric currents, beyond a single mile, were denounced by philosophers, and proved by mathematicians, to be the chimeras of the dreamer; and yet our Union is reticulated and clamped together by railways, whose moral power transcends that of laws and constitutions, and upon which thousands are hourly demonstrating the philosopher's error; and by magnetic wires, wherein truth outstrips not only the mathematician's calculations, but even the lightning, and beats time itself.

The mail between Washington and New-York is now carried upon railroads in twelve hours. If your committee do not greatly err, the same mails may be carried between these cities in two hours, by the proposed atmospheric telegraph; and the expenditure now necessary for the transmission of one set of mails, would enable the Post Office Department to send six sets of mails every twelve hours.

The impulse which such a frequent, rapid and certain delivery of the mails between distant points would give to all the business of the country, is incalculable; operating with as much safety and unerring certainty in night as in day-light; unaffected by changes of seasons or weather—and exempt from liability to those mischances, accidents and delays which are daily retarding the delivery of the mails throughout the country, the atmospheric telegraph seems destined to become the exclusive mail carrier of the age.

ART. IV.—STEINHEIL ON MORSE'S TELEGRAPH.

CONDUCTIVE PROPERTY OF THE EARTH—VALUABLE DISCOVERIES IN EARTH CIRCUITS—EXTENSION OF MORSE'S TELEGRAPH IN EUROPE.

Letter from Prof. Steinheil of Munich.

MUNICH, *the 9th July*, 1854.

ESTEEMED SIR:—In answer to your favor of the 23d ult., and with reference to its contents, I send you herewith enclosed my Academical Discourse of 1838,* in which I have published my experiments on galvanic telegraphy made in 1837. In Schumacher's Austrian Annals of 1839, published in Stuttgard and Tubingen, you will find further notice of these original experiments, the principal results of which are, that I established the principles upon which an effective telegraphy must be based, and which even now, after 16 years, form the foundation of our present system. That on this occasion I found the conductive property of the earth for galvanic currents, by means of which the construction of galvanic telegraphs has been effected with one single conductor, and freed from all the inconveniences of double and multiplied conductors, such as resistance, contact, expense, &c.; that I demonstrated under what circumstances and modifications telegraphing may be effected between two telegraph stations, even without any metallic connection at all. Further records, with reference to this period, and my respective labors, you will find in Dr. Schellen's "Electric Telegraph, Brunswick, 1850, 8vo.;" in the Abbé Moigno's writings on Telegraphy in the Augsburg Gazette, &c.

Our government did not encourage, at that time, this promising enterprise any further, and, as pecuniary means were wanting, the experiments were compelled to be discontinued, until it was perceived from the newspapers what rapid progress, and what development, galvanic telegraphy had made in North America. It was not till 1849, when the net of railroads had reached so great an extension in Bavaria, that steps were taken to establish telegraphic lines. In order to ascertain with exactness what had already been done in this respect in Germany, I was commissioned by the Government to travel for this purpose through Germany, and I enclose my printed report, "*Description and Comparison of the Galvanic Telegraphs of Germany, April*, 1849."

In this document is also comprised the description of a railroad telegraph which I caused to be established, some years

* This discourse was translated and published in Sturgeon's Annals of Electricity, in March, 1839.

previous, between Munich and Augsburg. (See page 49, &c.) In the same year, 1849, I received from the Austrian Government an appointment in the department of the Ministry of Commerce, for the purpose of organizing, on a permanent system, the Austrian telegraphy, and was placed at the head of it. In a short time, under the powerful patronage of the intelligent minister Bruck, over 1,500 German miles of telegraphic connections had been constructed. Sixty stations had been furnished. *A treaty with Germany for a common system* (the Germano-Austrian Telegraph Union,) was entered into and ratified, and the Telegraph was made accessible to the public for its use, in all of which Austria constantly took the lead. Thus, the purpose which I had proposed to myself when I accepted the Directorship of Austrian telegraphy was soon attained, and I was enabled to accept a subsequent call from the Swiss Government in 1852, to organize the telegraphic net-work of that country on the same system. In six months, two hundred miles of connections were constructed: seventy-three stations established; the employees of the Post Office trained for telegraph service, by assembling them together and addressing them a course of lectures; the junction arranged with the Germano-Austrian Telegraph Union, and the lines delivered for public use. The whole enterprise, construction, public regulation, apparatus, school, &c., was accomplished with 400,000 francs. The conductors, however, are only made of iron wire, constructed after your plan in North America, for there they have mercantile ideas, and know how, with small outlay, to realize large profits.

The instructions for the telegraph operators in Switzerland I also inclose.

Since my mission to Switzerland, I have been called to Bavaria, and placed in a very pleasant and independent position, which enables me to realize my long cherished scientific wishes; and in accepting it, it is on the condition that I shall not be obliged to devote any more thought to telegraphy, to which problem I feel that I have already devoted sufficient time, since other subjects solicit my investigations.

In the inclosed *Instructions*, you will find the whole system of our Germano-Austrian Telegraphy developed in its most minute details. You will notice, at this period, the "Translators," which I devised in Vienna in 1850, and which were adopted by the Germano-Austrian Telegraph Union, in 1851; also the plan of loop-shaped construction of the telegraphic net-work, by means of which, freedom from interruptions increases in the ratio of the extension of the net-work. You will note also the introduction of very small chain batteries, the theory of which

is given in pages 16–19 of the "Instructions;" and lastly, the teaching of the technical parts, by means of which the service is regulated, and the telegraphed net-work rendered accessible at any time and at any point in all its parts, (sectional circuits,) and at the same moment.

In said Instructions, you will find towards the close, information for acquiring the telegraphic art, which I introduced originally in Vienna, and which proved very practical, about 500 telegraphists having been trained by it.

In this way I have been able effectually to labor for the adoption of Morse's system throughout all Europe; and that I have thereby extended his well-earned fame, has been to me the source of peculiar pleasure, which I beg you to testify to Professor Morse in proper time, together with my most friendly respects.

With perfect esteem,
Yours respectfully,
DR. STEINHEIL,
Royal Ministerial Counsellor and Member of the Academy, &c.

TAL. P. SHAFFNER, Esq.,

ART. V.—FIRE ALARM TELEGRAPH.

MORSE TELEGRAPH APPLIED TO FIRE ALARMS, BY CHANNING AND FARMER—SUCCESSFULLY ESTABLISHED IN BOSTON—GREAT BENEFIT TO SOCIETY—ITS MODE OF OPERATION DESCRIBED.

WE have intended, for some time past, to describe this new and wonderful achievement in art. We now give a few facts for the consideration of the reader, and in a future number we hope to be able to give a full and perfect description of the system, so successfully put in operation by Messrs. Dr. Channing and Farmer, in the City of Boston.

A description of the system, as given in the present number, will show that the Morse Telegraph is ingeniously applied to mechanics, and the alarm system made complete. We do not fully understand in what consists the patent parts of the Fire Alarm Telegraph, as it is mostly included in the original Morse patent; but, we suppose it is in the ingenious arrangement for giving the signal, and the compiling of the different branches of mechanics to produce the desired result according to the described mode. We do not deem it material to discuss the question as to how much of the system is embraced in the

Morse patents, nor how much to Messrs. Channing and Farmer. It is enough for us to know, that it abounds in usefulness. No city in the world can do as well without as with it. It saves labor, time, and money. It promotes security of life and property. It lessens insurance and benefits the rich and poor. It prevents disturbances of society by riots, and diffuses a spirit of peace and safety throughout the entire people. Everything can be said in its favor, and nothing against it. Dr. Channing and Mr. Farmer have done much for the age, in devising the system and presenting it in a useful and practicable form.

We give some notices of the system from memorials and circulars upon the subject, which will be all that we can present to the reader's consideration at present.

"This system differs essentially from all other Fire and Police Telegraphs, and possesses advantages proved by constant experience for over two years, which place it beyond comparison with any other in point of rapidity, variety, and extent of communication. In a scientific point of view, its great and peculiar success is in its power of *acting* at great distances, itself producing effects which other systems have only sought to direct by instructions to agents. Practically, it is the only existing means of communicating a fact from as many points as may be desired to a Central Station; of giving instant alarm from thence by ringing bells in different places at the same moment, by one person; and of sending any instructions or making any inquiries between the Central Stations and the remote points.

The only telegraph of this description is established in Boston, and has been visited and examined with admiration by great numbers of practical and scientific men, both of this country and Europe, and recently has been examined by Committees from the City Governments both of New-York and Philadelphia. * * * * * *

The first peculiarity is, that it provides a sufficient number of Signal Stations to place one of them in the immediate neighborhood of every house in the city. These Signal Stations require no attendance, but are so arranged that any authorized person, by turning a small crank, may communicate an alarm from that neighborhood to the Central Office.

At these stations also, while the alarm is being rung on the bells, any one, by listening to certain intimations from the Central Office, may learn the precise neighborhood in which the fire or other trouble may have arisen.

These stations are not merely used in cases of fire or riot, but messages of any length, upon any subject, may be sent or received through them by any one acquainted with the telegraph

key. They are constantly used as means of communication between the Central Office and remote points on occasions of municipal business.

Another peculiarity of the system is, that when an alarm has been notified to the Central Office from any one of the Signal Stations, it may instantly, by the pressure of a single finger, be rung upon any or all the alarm bells in the city, and this without the aid of watchmen or bell-ringers. There is no limit to the force of the blow that may be given to the bells, and an alarm may at the same instant be rung by one person in the Central Office from any desired number of bells, in any degree of loudness that they can produce.

This telegraph possesses one advantage which is peculiar to itself, in that it prevents any injury arising from the breaking of a wire, by having duplicate circuits between the Signal Stations and the Central Office, and between that office and the bells, so that if one part should be destroyed by storms or otherwise, the communication would remain uninjured.

Under this system, the moment a fire is discovered, the alarm is carried to the neighboring Signal Station, through which, by turning a crank, the fact of a fire and its locality is instantaneously communicated to the Central Office. When received there, the officer in attendance, by a motion of his hand, immediately tolls the district number on all the fire bells, and at the same time *taps* with the other hand to every Signal Station the number of the particular station where the alarm originated. Thus, in less than a minute from giving the alarm through the Signal Station, it may be rung on all the alarm bells in the city; and the firemen, by listening at the Signal Stations, may learn and be able to head their engines for the precise locality. All this is done by means of only one person at the Central Office.

To contrast this with the present condition of our city:* We have only eight points through which an alarm of fire can be communicated, and when once received, it must be entrusted at each station to bell-ringers, who must separately ring it from each bell-tower. Before a general alarm can be given, an often fatal delay must elapse, and the precise locality in a district can in no way be indicated. The difficulty of finding a fire, even after the district alarm has been rung, is too well known to require specific instances.

It would be absurd to attribute all the difference of loss by fires in the two cities to the possession of the Fire Alarm Telegraph by one, and not by the other. But after every consid-

* New-York City.

eration of difference of size and police organization, there remains no doubt that the small loss which Boston has sustained by fire during this last year, is mainly due to this valuable invention. According to the last Report of the Fire Department of that city, extending from September 1st, 1853, to September 1st, 1854, the whole amount of losses by fire has been ascertained to have been but $150,772. The losses in *our* city,* during the same period, must be estimated by millions."

We copy the following from a circular upon the American Fire Alarm Telegraph, which gives a description of the system ample for comprehension:

"Its object is to give an *instantaneous*, *universal*, and *definite* alarm in case of fire. This object, which has been hardly proposed by any other system, is fully accomplished by the Fire Alarm Telegraph. It presents, therefore, a claim to the attention of insurers, of property holders, and of municipal governments throughout the United States.

The Fire Alarm Telegraph consists essentially of two parts: First, *the Signal apparatus and wires*, by which the intelligence of a fire is communicated from any part of a city to the Central Station. Second, *the Alarm apparatus and wires*, by which the alarm bells in different parts of a city are struck from the Central Station by the touch of a single finger, without the intervention of hands, watchmen, or bell-ringers at the belfries or bell towers.

For example: there are in the City of Boston forty-three Signal Stations, or "*Signal Boxes*," distributed over the city, from any one of which the intelligence of a fire in the neighborhood can be communicated instantly to the Central Station by the simple turning of a crank. The operator at the Central Station—the sole watchman of the system—is then able, by simply depressing a key with his finger, to strike the District number simultaneously on twenty-two church, school-house, and engine bells in every quarter of the city; and not only this, but also to tap back on all the Signal Boxes the number of the Signal Box in the District from which the alarm proceeded. The engines are thus directed not only to the District, but actually to the very box originating the alarm. The time between the first discovery of a fire by the inmates of a dwelling, and its definite announcement from all the steeples and by all the Signal Boxes, is thus, on an average, not more than three minutes in the City of Boston at the present time, and is often within a single minute.

* New-York City.

The best example of a system of District Alarm, in which the bells are rung by hand, is probably that in the City of New-York. There the eight bell-towers are provided with watchmen, and are connected with telegraph wires, so that when one watchman discovers a fire he can notify it to all the others. There are thus only *eight* stations in the City of New-York from which an alarm can originate, whereas the Fire Alarm Telegraph provides forty-three Signal Boxes for the comparatively small territory of Boston, from any one of which the alarm is communicated instantly. The alarm system in New-York also requires eight watchmen constantly on the alert, who must each ring his bell according to the District number. The Fire Alarm Telegraph requires only one watchman at the Centre, who strikes any number of bells by the touch of a single finger. Moreover, in New-York, after the alarm is actually given, the engines are only directed to the District, which may be a mile or two square, and in which they may run about for half an hour without finding the fire. The Fire Alarm Telegraph, on the other hand, directs the engines to the District by the bells, and to the Signal Box, in the District from which the alarm came, by tapping its number, from time to time, on all the Signal Boxes in the city. The engines, therefore, may always be headed from the start to within at least two hundred and fifty yards of the fire. It may be added, that the adaptation of the Alarm apparatus to the eight bell-towers in New-York, and similar large bells in other cities, would furnish a much more simple and beautiful application of the Fire Alarm Telegraph than that in Boston, where twenty-two comparatively small bells are struck simultaneously.

The reports of the Fire Departments of New-York and Boston illustrate strikingly the practical operation of the two systems. In Boston, during the last year, there were a large number of *small* fires, many of which would have been destructive, if the first ten minutes had not been saved to the firemen by the Fire Alarm Telegraph. In 1853 there were 168 fires in Boston, with a loss of $268,621; while in New-York there were 335 fires, with a loss of nearly $5,000,000—that is, a *nine* times greater loss for each fire in New-York than in Boston. While the existence of immense warehouses, hotels, &c., in our cities, makes it impossible to guarantee them absolutely from large fires, it is all the more important to provide a system which shall give an immediate and certain alarm, when the only hope in the case of such conflagrations is confessedly in arresting them at the commencement.

A more detailed description will now be given of the Ameri-

can Fire Alarm Telegraph, in its various parts, and of the safeguards by which its permanence, and the regularity and certainty of its operations are insured.

The wires connected with the signalizing and alarm apparatus, forming the "Signal Circuits" and "Alarm Circuits," are carried over the houses, on the highest and most isolated of which they are supported by insulators held in brackets. The wires themselves are of the best Swedish iron, No. 9, and are to be erected in the most substantial manner. There are always duplicate wires, following different routes, between every two Stations, so that if one is broken from any cause, the second remains good until the first can be repaired. The ground is not used as any part of the circuit, so that the falling of a wire produces no false connection, and double insulation also results. These precautions are found to preserve the circuits practically intact. The wires, properly erected in a city, are very rarely interrupted from any cause; and the probability against the interruption of the two corresponding wires, between neighboring stations, at the same time, amounts almost to an impossibility. But, besides this, the Central Station is furnished with testing apparatus, by which the integrity of each circuit is constantly ascertained.

For convenience and security, the Signal Boxes and the Alarm Bells, in any great city, are not strung respectively upon one great Signal Circuit, and one great Alarm Circuit, but the number of circuits of each class is multiplied, all of them radiating from the Central Station, like the petals of a flower. Thus, Signal Circuits may traverse different parts of the city. To work on the bells, turn to one or more finger keys, which communicate back with the Signal Boxes, and tap on these occasionally *five* times; a little magnet and armature in each Signal Box gives a sharp click for every tap, and the firemen, who run to the nearest box and listen, know that the alarm comes from District *three*, Station *five*, and their pocket map tells them exactly where this station is, and the nearest route to it.

The machinery in the bell towers consists of a striking machine, carried by the water in the city pipes or by weight, and let off by telegraph at each blow. The blows are of any power required, there being no practical limit in this respect.

The advantages of the American Fire Alarm Telegraph may be recapitulated as follows:—

1. It furnishes an indefinite number of Signal Stations, scattered broadcast over a city, from which an alarm may be com-

municated. No time is lost, therefore, between the fire itself and the telegraph.

2. The operator, or the watchman at the Centre, receives the intelligence immediately, and forthwith strikes the District number on one or all the Alarm bells by telegraphic agency.

3. The number of the *Station*, from which the alarm proceeded, as well as the District, is telegraphed to the Fire Department, so that the engines are headed from the first, to almost the exact locality of the fire.

4. The arrangements of the system protect it from interruption, either by accident or design, and it works with equal certainty and promptitude in sunshine or storm, by day or by night.

5. It prevents almost entirely the occurrence of false alarms, which entail a great expense on a city, on account of the wear and tear of engines.*

6. It provides a system of organization, by which the whole Fire Department of a city is brought into communication with a single Centre, receiving directions from this Centre, either by the bells or Signal Boxes, and communicating back to it by a finger key, which, in addition to the crank, is placed in every Signal Box.

7. Telegraphic conversation may be held between any of the Signal Boxes and the Central Station, which is generally placed at the City Hall, for police purposes.

*The following facts are from official documents: The false alarms in New-York, in 1848, were 98; in 1847, 125; in 1849, 162; in 1853, 239. In 1846, '7 and '8, the false alarms were one-fourth of the alarms given, and in 1849, they were more than one-third.

In Boston, the average number of false alarms annually, for six years previous to 1850, was 50—about one-seventh the whole number of alarms given. Under the present system, in 1852, the false alarms were only 7, and, in 1853, only 10—an average, for those two years, of only one-twentieth of the alarms for fire. Both in New-York and Boston the expense of a false alarm is said to be about $100. The present number of annual false alarms costs the City of Boston $700 or $800, while in New-York the false alarms for 1849 cost the city more than $16,000, and at the same rate for 1850, over $23,000.

Epigram.—A correspondent of the National Intelligencer has furnished to the editor of that print the following translation of an "epigrama," from the Latin, which recently appeared in the Southern Chronicle, viz:

On Morse, the Ceraunographer.—Nature Complaining of her Sons' Spoliations.

What daring men, cries Nature, will ye spare?
See Franklin force the clouds their bolts to bury;
The Sun resigns his pencil to Daguerre,
While Morse the lightning makes his Secretary.

ART. VI.—MAGNETO-ELECTRIC BATTERY.

TELEGRAPH BATTERIES USED IN AMERICA AND EUROPE—SUPERIORITY OF MAGNETO-ELECTRICITY OVER GALVANIC FOR TELEGRAPHIC PURPOSES, CLAIMED—ITS ECONOMY AND PRACTICABILITY—HENLEY'S IMPROVEMENT—TELEGRAPHS SUCCESSFULLY WORKED BY MAGNETO-CURRENTS.

IN AMERICA, nearly all the telegraph lines have been worked, from their commencement, by the Grove galvanic battery. It has proved to be the most successful over all others, and, with the Morse and House systems, it seems likely to be the most favored. Efforts have been made to devise another and a better battery—one that will not be so expensive, and that will require less labor in keeping it in order. Many improvements have been made in its construction and application. For the present, we will only mention one of the most important, which was devised by Mr. Anson Stager, while Manager of the Morse lines at Cincinnati, Ohio. He applied a battery commonly used for one line, to four others, and, in this manner, successfully worked five lines, each running in independent directions, and of unequal lengths. The battery had one ground or earth-wire. This was a great achievement, and one that will prove of material importance, if properly considered.

A modification of the Smee battery has been arranged by Mr. Charles T. Chester, and it claims particular attention on account of its cheapness and economy of labor in taking care of it. The Daniel battery has also been, to a limited extent, used by some lines. A few lines have worked the copper and blue vitriol battery on the local circuits. A few years ago, the sand battery was used on the Bain line, but was not wholly successful. The Magneto-electricity has never been satisfactorily produced in America to work a telegraphic line practically. Mr. Calvin Carpenter, of Providence, Rhode Island, has claimed to have invented a new and novel machine which can effect the desired end. To what extent, however, Mr. Carpenter has succeeded, we are not informed.

In England, the sand battery is in general use. The Gutta Percha Works of Mr. Statham has produced gutta percha cells, which renders the sand battery the most popular and serviceable. The telegraphs of England are mostly the needle system, and the quantity required is very moderate. On the Hamburg and Copenhagen line the sand battery has been used very satisfactorily. This line works the Morse system. We saw the sand

battery used in France, Belgium, Denmark, Prussia, Austria, and Russia. We also saw many of the Daniel battery in use; but its construction was modified. The magneto-electricity, as proposed by Mr. Henley, is in service in England, Ireland and Scotland only. The Magnetic Company, or the English and Irish line, employs it, and with very great satisfaction. Mr. Henley is an expert of rare merit, and his ingenuity in constructing practical telegraph apparata entitle him to the most favorable consideration of the telegraph community. We give below his views as to the mode of generating an electric current suitable for telegraph purposes, which will give an idea of the true merits of the magneto-power. We saw the system very satisfactorily worked in England, and we think its claims are not overrated. How it would answer the American system, we are unable to say, nor can we express an opinion without a thorough trial. We give Mr. Henley's remarks, without further comment, at present.

"The Magneto-Electro Telegraph presents many very important advantages over all telegraphs hitherto invented. It is extremely compact and portable.

The instrument is worked by magneto-electricity, and from the simplicity of construction, is always ready for immediate use without the least preparation or trouble, and can therefore not only be used as a stationary telegraph, *but from its portability is peculiarly adapted for the use of guards on all lines of railways, who could, in the event of accident or any emergency, immediately apply the instrument to the existing telegraph wires on any part of the line.* It is free from any expense whatever, after the first outlay, and not only dispensing with the cost and inconvenience of chemicals, repairs, and superintendence involved in the use of the voltaic batteries, but actually substituting for the present uncertain system of transmission one absolutely unerring, and that to an extent far beyond the power of any other telegraph, which has been proved by actual experiments on existing lines.

A very severe test of the capability of a telegraph is a damp state of the atmosphere, especially when the earth is used (as it always is now) as part of the circuit. Every supporting post, when its insulators become covered with moisture, conveys a great part of the current to the earth; but from experiments tried on the South Devon Railway, (known to be the worst insulated line in the kingdom,) and in the most unfavorable weather, the magneto-electric current from this machine was found to pass the whole distance of the line, and also through a great length of wire at each station, without any loss whatever;

this arises not from the electricity being of a different kind, but from its quantity and intensity being so adjusted that the wet posts should offer more resistance than the whole length of the metallic wire. The magneto-electric apparatus (18 inches long by 4 inches wide) will transmit a current much farther than twelve 24-cell batteries, occupying a space of 19½ square feet.

Another advantage is, that the needles never move sluggishly when worked from a great distance; they move as rapidly and distinctly through 500 miles as one mile; and the clockwork for alarums may be entirely dispensed with, quite sufficient sound being obtained to call attention from an adjoining room by the mere vibration of the needle between two bells, when moved by a machine many hundred miles off, and to persons acquainted with the trouble and annoyance attending the ordinary telegraph alarums, this will be considered no small advantage.

It is a well-known fact that the ordinary needle telegraph is entirely deranged by lightning; the polarity of the needles becoming displaced or destroyed, notwithstanding the protection of lightning conductors. With the Magneto-Electric Telegraph this can never occur; the only effect of the lightning is to deflect the needles as in the ordinary working.

One of the peculiar features of this invention is the use of electro-magnets, having four poles, formed by two segments of a circle, with a magnetic bar freely suspended within them; thereby doing away with the retarding force of springs or other contrivances generally resorted to, to cause the needle to point to any particular direction; and, by placing the needles on vertical axes with a horizontal dial, a very feeble current is quite sufficient to move them.

From the absence of springs and adjustments, this instrument is peculiarly adapted for working a one wire letter telegraph, or a recording telegraph, by which the message is marked or dotted on paper, and the dials for which can be substituted for the present.

The magneto-telegraph instrument is not affected by any variations in the state of the weather.

The permanent magnets are entirely protected from the loss of power by a peculiar and simple arrangement of the armatures, and the apparatus is free from the complications of the ordinary telegraphs for reversing and stopping the current, there being one unbroken circuit throughout.

The importance of being able to communicate *several thousand miles* with an instrument so portable and so simple, can readily

be understood, when it is considered that the telegraph instruments at present in use, require for a distance of only three hundred miles the aid of several voltaic batteries, and in damp weather it is difficult with any number of cells to obtain a perfect communication.

From the advantages offered by this invention a considerable saving is effected in the cost of the wires, much smaller ones than those now in use being sufficient, and the additional wire required in other instruments for ringing the alarm bell being entirely dispensed with, as the wires conveying the messages serve for both purposes.

From the portability, economy, and impossibility of derangement of this instrument, which never requires any preparation or renewal, telegraphic messages will now be brought within the reach of more limited enterprise, such as dockyards, detached factories, mines, hospitals, and all other establishments and institutions, *both public and private*, as well as of individuals who, from the cost of the present system, are entirely precluded from the benefits of this rapid means of intercommunication; and railway companies having telegraphs already established, would find in the adoption of this instrument a considerable saving.

The magneto-telegraph instrument has been subjected to the severest trials, in all weathers, on existing lines of railway, in this country and on the Continent, and has received the unqualified approbation of many of the leading scientific men in Europe (including engineers of the highest repute) who have pronounced it to be the most simple, powerful, and economical instrument for telegraphic purposes yet invented. To illustrate its extreme simplicity, it is only necessary to state (*its action being entirely mechanical and free from all chemical agency*) that a boy twelve years of age is perfectly competent to superintend and effectually work the instrument."

We take the following notices of trials, in regard to Henley's magneto-battery. The first was in England, and the second was in France.

1st.—" Some interesting experiments have been made with Henley's Magneto-Electric Telegraph, from one side of the Serpentine to the other, near to the Kensington Garden's bridge, under the inspection of the following gentlemen:—Jury of Class 10—Sir John Herschel, Mr. Glaisher, Baron Seguir, Professor Schubarlt, Professor Potter, Professor Quetelet. Mr. Dobson, and another gentleman, both from Mr. Cubitt, the Engineer, Great George-street, Westminster.

"*First Experiment.*—Two lengths of gutta percha covered

wire were taken across and immersed in the water, and connected to the instruments; each length of wire had a portion of the gutta percha cut away from the wire; the wire well scraped to a bright surface, and allowed to remain under the water. The instruments worked well through the attractive power of the water.

"*Second.*—The water not having taken the expected effect of deviating the course of electricity, one length of wire was cut in two, and a long length of uncovered bright wire was inserted between, and again let fall into the water. The instruments again worked well.

"*Third.*—The wire was again cut asunder, and each end let fall into the water, a distance apart from each other, whereby the current had to be made complete by the water intervening between the ends of the wire; even through this defective insulation the instrument worked to the greatest satisfaction.

"*Fourth.*—A greater quantity of the gutta percha insulation was taken from off the wire which had not been cut, and the instruments continuing to work well, a correspondence was then commenced, and kept up for half an hour, from one side of the Serpentine to the other, between Mr. Dobson and the gentleman who was with him.

"Mr. Henley was highly complimented after the completion of the experiments, which occupied five hours.

2d.—"Two most successful and satisfactory trials have be en made with Henley's magnetic telegraph instruments, one on the wires of the Paris and Rouen Railway, at the office of the French Minister of the interior, in the presence of the Director in Chief of Telegraphs, and the other on the wires of the railway from Paris to Valenciennes. At the Paris end the Director in Chief of Telegraphs for the French Government superintended; while at Valenciennes were present the Belgian Minister of Public Works, Count Shekendorff; the Prussian Ambassador, M. Mosay; the Chief Engineer of the Belgian Railways, Baron Devaux; M. Quetelet, and M. Cabry, Chief Engineer of the Belgian Government. The distance is 180 miles, being the longest telegraphic line in France. After a most satisfactory series of trials on the single distance, first with the full power, and afterwards with one-twentieth of the power, the wires were connected so as to treble the total length of wire, making 540 miles to and from Paris and back—the magnetic message being communicated through the first wire, back by the second, through the third, and back again by the earth; and, contrary to what was antcipated, it worked through an enormous resistance as distinctly and rapidly as when only made to traverse

the 180 miles with full power. The ordinary telegraph with battery power used by the French Government was then put in requisition; but not the slightest effect was produced. The government officers and others inspected the working operations from 10 to 3 o'clock, and expressed themselves perfectly satisfied with the success of the trial."

ART. VII.—MAGNETO-ELECTRICITY ON SUBTERRANEAN TELEGRAPHS.

SCIENCE OF MAGNETO-ELECTRICITY—APPLICATION TO SUBTERRANEAN TELEGRAPHS—SPEED OF MAGNETO AND FRICTIONAL ELECTRICITY—PRACTICABILITY OF SUBTERRANEAN TELEGRAPHS.

BY EDWARD B. BRIGHT, ESQ.

Secretary of the English and Irish Magnetic Telegraph Company, Liverpool, England.

[Substance of an address delivered before the British Association of Science and Art.]

In the paper now submitted to the Association, I propose to explain some peculiar features connected with the development and use of magneto-electricity and underground wires in long circuits for telegraphic purposes.

Magneto-electricity consists in the development of a species of the electric fluid discovered by Dr. Faraday, and resulting from the induction of polarity in a coil of insulated wire, when placed in propinquity to a magnet; the positive current manifesting its presence at one end of the coil, and the negative at the other, according to the position of the coil with reference to the poles of the magnet.

For practical purposes it is found that the greatest demonstration of magnetic power takes place when the coil of insulated wire is wound upon a soft iron rod, and applied to the poles of a permanent steel magnet; the process of excitation being exactly reversed, as compared with the polarization of an electro-magnet by galvanic power; for whereas, in the latter, the soft-iron centre of the coil is polarized by a current of electricity passing through the convolution of insulated wire wound around it, in magnetic induction the flow of electricity is occasioned in the helix of wire, by the temporarily developed polar state of the soft iron coil, when acting as the keeper to a magnet. In the use of galvanic electricity, the voltaic battery generates a current, which, on passing through the wire of the coil, communicates polarity to the iron centre; and in magnetic electricity, the core being polarized by near approach to a magnet, occasions

the flow of electricity in the wire surrounding it. In early experiments, with a view to the application of this electricity to the telegraph, much difficulty was found from the apparently evanescent nature of the effect produced by its excitation; and although various attempts were made to introduce it into the commercial system of this country and America, none proved successful, until the invention of the system carried out in the operations of the Magnetic Telegraph Company.

The apparatus, founded on the magnetic principle, will therefore, I believe, interest all who have watched the extension of the telegraph in this country, differing as it does from the principle adopted by other companies, both at home and abroad, who all make use of the voltaic battery, generating their electric current by the decomposition of water and oxidation of metals, when subjected to the chemical action and excitation of acids or salts. I have already referred to the manner in which a magnetic current is produced in a coil when in proximity to a permanent magnet; and in continuance, should mention that the direction of the current is changed at will, by simply reversing the position of the coil, and its iron core, as regards the poles of the magnet, (as shown by experiment on apparatus,) an alteration of polarity resulting with each movement. Such changes in position are effected as shown by an upward or downward movement of a finger key, fixed upon an axis, to which the coil is attached; the soft iron centre of the coil is so adjusted as to move freely before the poles of the magnet without actual contact, and under the manipulation of an experienced clerk, as many as 400 to 500 changes of polarity may be induced in the coil in a minute. The electricity, when generated, is passed into the wire extending from the station by simple connections, and actuates the indicating apparatus fixed in the various instruments at a distance to which it communicates the magnetic sensation.

I have alluded to the evanescent effect of the magnetic fluid upon ordinary coils, and will now explain how, so to speak, this current is fixed in the present apparatus:—The electro-magnetic coils in the indicating portion of the machine have soft iron horns continuing their poles, which, by their elongation and position as regards one another, imbibe and fix a certain amount of polarity, termed residual magnetism, which remains in the iron after each change of the current passing through the helix. A small magnetic needle, on an axis, is so placed within the influence of the horns, that upon any alteration in their polarity, a corresponding movement of the magnetic needle takes place, forming the signal to be communicated, or actuating an alarm.

It was considered at first that the magnetic system was capable of but limited application, owing to the supposed quantitative nature of the current generated not possessing sufficient intensity to pass through long circuits; but experience does not show such to be the case: for with the improved apparatus now employed by the company, messages can be passed between Liverpool and Dublin direct, a distance of about 420 miles, the line of communication extending via. Portpatrick and Belfast, and signals can be interchanged when necessary between London and Dublin, a distance by the wire of 660 miles, without any break of circuit, or renewal of the magnetic circuit. The invariability of the current generated is a principal feature of the apparatus; and it is found that with careful treatment, no diminution of the current need take place. Generating magnets have been in use for three years, without change in the strength or polarity of the magnets employed—the magnetism induced being in consequence similar throughout—while, in an equal period, a dozen sets of voltaic batteries would have been worn out.

As most interesting phenomena have resulted from the application of the subterranean system of communication where long circuits are made use of, a cursory notice of the conditions involved in the production of the phenomena will not be out of place.

The Magnetic Company, in 1851, applied underground gutta percha covered wires for the purpose of communication between various towns. The gutta percha encasing the wires being protected from injury by various appliances, and buried two feet below the surface of high roads.

On extending this system throughout the United Kingdom, where circuits of several hundred miles were brought into operation, it was found upon communicating a current to such wires, that after the withdrawal of the excitation, (whether galvanic or magnetic electricity was employed,) an electrical recoil immediately took place at the end of the wire to which the current had been previously communicated. This recoil was apparently analogous in all respects to the discharge of electricity from a Leyden jar, except that the current flowing from the wire partook of a quantitative rather than an intense nature; thus, however, finishing the remaining link of comparison, and establishing the identity as regards primary characteristics of all species of electricity.

Although this phenomena, as analyzed by Dr. Faraday, has proved highly gratifying in a philosophical point of view, its existence interfered materially with the working of all the pre-

vious existing telegraphic apparatus, not having been at all contemplated or provided for; and up to this time, I am not aware that, as regards the galvanic system, any adequate remedy has been applied. The nature of the interference will be easily understood, when I mention that, with a letter printing telegraph, the surplus current has the tendency to carry the machinery on further, and to make other letters than those intended. With the chemical and other recording telegraphs, the surplus flow of electricity will continue nearly a minute, entirely confounding the marks representing one letter with the next. And lastly, with Cooke and Wheatstone's and other needle telegraphs, a beat more is made by the back current than intended with every letter formed.

In the magnetic telegraph, however, this current has been turned to account by the engineer of the company and myself, in an arrangement of the apparatus, by which the recoil current serves to keep the indicating needle at zero; consequently, under such conditions the effect of the recoil is neutralized, and it conduces to the effective working of the telegraph.

Another remarkable feature to be noticed in connection with the underground system, is the small comparative velocity with which the electric impulse is communicated through each conductor in long circuits.

In experiments conducted by my brother and myself upon a circuit of four hundred and eighty miles (480) of the underground wires, a *marked* difference between the communication of the electric impulse, and its arrival at the other end, has been observed; the interval required for the passage of the sensation amounting to rather more than a third part of a second.

The rate of transmission of the galvanic or magnetic fluids, through such conductors, is therefore only about 1000 (one thousand) miles per second.

Professor Wheatstone's experiments, showing the passage of *frictional electricity* through a short length of wire in a room, to take place at a speed approaching 300,000 miles per second, are well known, and incontestible.

A subsequent experiment, conducted by Prof. Walker, on some of the overground wires comprised in the American system, gives the velocity of the galvanic current, through two hundred and fifty (250) mile circuits, at about sixteen thousand miles (16,000) per second.

The underground wires, however, as just mentioned, give a far lower result; and hence it appears evident that the velocity of frictional electricity far exceeds the voltaic or magnetic current—owing, doubtless, to the far greater intensity and comparatively small quantitative development of the former.

The retardation experienced in underground wires, as regards the propagation of the electric impulse, is not, however, due to any resistance of the conducting medium; for, as it is found in the instance of the Leyden jar, that the frictional electricity communicated is temporarily absorbed by the metal in the interior of the jar; so the galvanic or magnetic currents, during their passage through the underground wires, are partly absorbed, until the mass of copper constituting the wire is saturated with electricity; and it would also appear that a definite time is occupied in the absorption of the electricity by the successive portions of the wire, such as is found to occur in charging a Leyden jar; and, until this process of impregnation has been completed, the sensation cannot be communicated to the other end of the conductor.

The retardation will, therefore, result not from resistance, but from the first portion of the charge communicated being absorbed, for the time, by the conductor through which it passes; for, in addition to the foregoing, copper wire conducts far more freely than the iron wire made use of in the overground wires.

Consequently, the speed with which an electric impulse is communicated varies with the energy or intensity of the current employed, and the nature or conditions of the conductor interposed.

I find the underground systems of wires are but very little affected by any flow of terrestrial electricity, as compared with the overground wires, owing, I believe, to the electrical 'status' of the latter being disturbed whenever the electric condition of the *atmosphere* changes as regards the earth, principally with the rising or falling of the dew; and during Aurora Borealis, while the subterranean conductors are, on the contrary, only affected to any extent when the magnetic condition of *one district* of the *earth's surface* differs as regards the terrestrial magnetism of another, and the wires form a connection between such districts, affording an easy path for an interchange to take place; and to the flow of such currents, the suspended wires are, of course, equally exposed.

Both overground and underground wires are, to a certain extent, subject to the inductive influence exercised by thunder storms in approaching or receding, the former being liable to direct percussion from lightning.

In concluding this notice of certain characteristics and phenomena of the English system, I cannot refrain from alluding, in a few words, to an article on telegraphs that appeared in the Quarterly Review of June, 1854, in which a very unjust and

incorrect comparison is instituted between the American tariff for messages and the English rate of charge.

A message of fourteen words is instanced, and the Quarterly Review says:—

"Now, the London charge for the above, if forwarded to Liverpool, would be five and sixpence; but the American tariff for the same, on the Louisville and Pittsburgh Railroad, would be only one cent a word, or sixpence halfpenny, English." To prevent an erroneous opinion prevailing on this subject, which would be calculated to prejudice the English system, I refer to the "Abstract of the Seventh Census," printed by order of the American Congress, and published in 1853, which states* that the usual charge for transmission is twenty-five cents for ten words, or less, sent one hundred miles.

I will also quote the American Telegraph Tariff, published in April, 1854, by authority of Mr. Shaffner, the Secretary of the American Telegraph Confederation, which gives the charge for a message of ten words from Louisville to Pittsburg, as fifty cents, and an extra three cents for every additional word; or for a message, such as instanced by the Quarterly Review, two shillings and eightpence; and for a message of twenty words, three shillings and sixpence.

The English tariff, for a message of twenty words between Liverpool and London, in May last, was two shillings and sixpence, without charge for address or delivery within a short distance. So that, instead of the English charge being ten times that of America, as stated by the Quarterly Review, the English scale, prior to the publication of the number, was very considerably under the American rates for an equal distance.

The Quarterly Review further remarks, that "a message of ten words can be sent on O'Reilly's Line, from New-York to New-Orleans, for sixty cents, or two shillings and sevenpence."

Such is not the case. The American tariff gives the charge for ten words from New-York to New-Orleans, at 240 cents, or ten shillings, the distance being about 1500 miles, or for twenty words, a pound sterling. The charge for twenty words from London to Queenstown, a distance of about 900 miles, is ten shillings, a lower rate, in proportion to distance, than the American scale for a like message, although a sub-marine cable is included in the circuit to Queenstown, and much greater risk of capital originally incurred in its submersion.

Both instances show, therefore, that the greater economy of system claimed for America by the Quarterly Review does not exist.

* Abstract of the Seventh Census, page 109. Pub. Washington, 1853.

Various other inaccuracies have crept into the article I have referred to, which do not, however, call for special refutation, though calculated to mislead any one forming an opinion upon the statements of the Review.

In conclusion, I shall be happy to show and explain the magnetic machines and system carried out at our offices in this town, to any scientific gentlemen wishing to have a practical view into the working of apparatus of such a nature.

ART. VIII.—ELECTRIC TELEGRAPHS IN EUROPE.

QUESTIONS PROPOUNDED BY TAL. P. SHAFFNER, ESQ., TO TELEGRAPHIC AND SCIENTIFIC GENTLEMEN IN EUROPE.

WITH a view to receive authentic information relative to the science and art of telegraphy in Europe, we hurriedly prepared the following questions, and presented them to many gentlemen, and from whom we received very interesting answers. The American reader will see from the questions that there is a difference of work, management and system in Europe, when compared with the American telegraphs.

We would gladly give full details of our observations while visiting the many telegraph lines of our transatlantic friends, but time and room will not permit.

We will give the essence of what we saw and learned, in the present and future numbers, as opportunities occur.

On arriving in England, we soon found that there was much to be learned, and we spared no pains in procuring all the information possible. Of course, our expenses were large, and the sacrifice of time very great. We shall be gratified to diffuse our knowledge among the American telegraphers, and hope they will be benefited thereby.

In the present number we give the answers of Messrs. Chas. T. Bright, Engineer of the English and Irish Magnetic Telegraph Company, and also the answers given by Mr. Edward B. Bright, Secretary of the same Company. These gentlemen did not give their views with the expectation of their publication; but we find them so exceedingly interesting, that we take the responsibility of publishing them for the benefit of others. If there should be found in them any imperfections, the reader must overlook the same, as they were not written for publication.

Messrs. Brights have charge of the Company's lines on which they are engaged. Their manner of business, and management generally, compare favorably with the best-governed

lines of any country. They are gentlemen, well educated, and they understand their business thoroughly. We regard them as experts in all departments of telegraphing, and worthy of the most elevated consideration. We feel under many obligations to Messrs. Brights for their many attentions in presenting us with so much valuable information, and we assure them that their presence in America would be received with much pleasure and congratulation.

At the earliest opportunity we will feel pleased to reciprocate the favors shown us; and if it should be out of our power to return them equal favors, we hope it may fall to the lot of some generous American to square the account for us. We give the questions propounded by us, and then the answers by Messrs. Brights. In future numbers we will continue the subject by the publication of answers from other gentlemen.

QUESTIONS.

1. Do the wires of your company run over ground or under ground—and to what extent?

2. If on poles, what kind of timber do you find the most durable—and, if possible, please state about what age are the poles (or timber) thus employed?

3. Do you use any pitch, tar, or other matter on your poles, to increase their durability—and if so, what and how applied?

4. Please state what kind of insulators you use on your poles, and if possible, please give a drawing of them or samples of each, with your opinion as to their fitness or faults—also their cost?

5. Please state the expense of your poles, and what is the cost for digging holes, raising the poles, the putting on of insulators, and placing the wires on the poles?

6. What kind of wire do you use, and where mostly manufactured—and what is the price for the same, per pound?

7. Do you use galvanized wire, and what are its advantages or disadvantages?

8. Do you solder the joints of your wire—if not, do you find any difficulties arising from oxidation at joints?

9. Do you realise much difficulty in the use of either galvanized wire or other wire, on poles, from atmospheric electricity—on which the most, and at what seasons of the year?

10. Where you have wire on poles, do you find any difficulty arising from cross currents at the poles; that is, the current passing from one wire to another at the poles?

11. Are your instruments ever affected by induced currents; that is, the passage of the galvanic or magnetic electricity from one wire to another, by or through elements of nature other than material substances; and if so, to what extent?

12. Do you ever suffer from what may be denominated "heat lightning;" and if so, to what extent?

13. Do you suffer from atmospheric electricity, either accompanied or not accompanied with thunder, and to what extent? Also, how do you protect your iustruments from harm?

14. Do you know of the burning of any property through the agency of the electric wires; and if so, to what extent?

15. Are the telegraph poles ever struck and damaged by lightning; and if so, how often in a year, averaging for a scale of one hundred miles?

16. How high are your poles, and how many do you use per mile?

17. How many wires can you place upon one set of poles?

18. Do you find any difference in the working of the wires on the poles; that is, the upper, middle, or lower wires? If so, what is that difference in fair weather, warm or cold, wet or dry seasons, and in time of storm?

19. Do you fasten the wire at each pole; and if so, how?

20. Do your wires often break; and if so, what causes them to break?

21. How do you mend your breaks? How many persons are required, and what is the mode you adopt to make the joint?

22. Do your operators usually go on the line to repair breaks, or other damages to the line?

23. Do you have a police to repair the line; and what is the plan, or system, and the expense?

24. Does the snow in winter disturb the working of your lines on poles; and if so, what are the remedies?

25. Does much ice form on your wires; and do the wires break, caused by the weight of the ice?

26. Please state your mode of laying under-ground lines, and furnish drawings, or samples, if convenient?

27. Do you find any difference in the use of wires covered once or twice with gutta percha?

28. What are the difficulties presenting in laying wires covered only with hemp, over the gutta percha? and please state the different modes, with their respective costs.

29. What are the causes of breaks, and their frequency, with underground lines?

30. How do you discover the place of break in a subterranean line? Please give a drawing of the plan, and state the time usually required to make the repair. Please specify fully on the subject.

31. What is the cost of laying one, two, or more wires?—giving the cost of labor, depth of ditch, and the plan in detail.

32. In case of much rock on the surface, do you blast; and how do you lay the wires?

33. Where there are marshes, how do you lay the wires?

34. Do you suffer from the upheaving of the earth, in case of frost in winter, and to what extent; and what are the remedies to avoid it?

35. What seasons of the year do your wires suffer the least?

36. What are your plans for crossing small streams?

37. Do you suffer from cross or induced currents from one wire to another in underground lines?

38. Did you find any difference whatever in the working of the wires, by their increased number in any combination from one to ten or more underground? If so, what is that difference?

39. What is the relative quantity of battery you use on underground lines compared with lines on poles?

40. What battery do you believe the best, and what quantity required for a distance of one hundred miles? Please give the cost of the materials in items. Can you work more than one independent wire forming an independent circuit from the same battery? If so, how many—and by what arrangement and principle?

41. How often do you repair the battery; what is that repair, and its expense?

42. What are your plans for protecting your line and instruments from lightning?

43. What do you consider return currents; and to what extent do you find the existence of the same on both overground and underground lines? Please state all the points fully.

44. Have you discovered any difference in the time required in the transmission of a current on the overground or underground lines, or in submarine lines; and what are the facts respectively?

45. Have you found any advantages in the use of any given size wire for electric conductors, either over or underground; and what are they?

46. What is the difference in the practical use of a line of iron wire and one of copper, as far as you are able to judge?

47. Do your underground wires ever suffer from lightning?

48. Do you allow the Government any advantages in sending messages; and what are those advantages?

49. Has the Government given any grants, appropriations, or other advantages or benefits to the telegraphs, either in law or in its use?

50. Please give the mode of receiving messages from the public, and the various checks placed upon the message, and the time thus employed, commencing at the reception at the counter, and ending with its delivery at the destination.

51. Do you ever send messages not signed; or when written on any other paper than your printed forms?

52. Why do you require persons to use your printed forms, and has that been the practice from the commencement of the telegraph? Please give two blanks, thus used, one filled to illustrate the plan you follow, with all the explanations needed, to enable a stranger to understand the same?

53. Please give a form of your register books, upon which you enter the messages you send and receive, with explanations of their use. Also copies of your rules and regulations as to the company, and of working the line.

54. Please state the average salaries you pay for the respective officers required in your city and country offices.

55. Do you clothe your messengers?

56. Do you place any of your officers under oath or bonds, and is there any advantages to the public or company by so doing, and do the Government laws require it?

57. Are you often called upon to give copies of messages to persons, and do you retain copies in your office?

58. What is the cost of your printed forms respectively? And please furnish copies of every kind you use.

59. What rents do you average in the city and in the country?

60. How many hours per day do your clerks or operators work?

61. Do you employ female laborers, and if so, how and at what expense?

62. Have you ever paid damages by errors in messages? and has the responsibility ever been tried at law? and if so, please give the case.

63. Are you in the habit of sending free messages; and if so, to what extent? Also cypher messages, and what are your rules upon the subject?

64. Do you send news for the press at reduced rates?

65. Do you ever lose or mislay messages in their transmission; and if so, does it occur often?

66. Do you ever pay back money on account of delayed messages.

67. Do you ever give any class of messages preference in any manner?

68. Do you require pre-payment; and if not, on what kind of messages?

69. Are the operators allowed to answer messages, giving information to a patron, at a distant office?

70. How many clerks are required to attend one instrument in a city or country office?

71. What system of telegraph do you use, and the cost of the apparatus? and if possible, please give me the early history of its invention, and by whom? Please refer to any printed authorities, if any; and also to persons who are acquainted with any facts pertaining to its early history. Please give extracts, if you have any, from newspapers, magazines, or letters in your possession, pertaining to the above points, their date, and where they can be procured or examined.

72. Do you often make mistakes in messages; and if so, what causes the same?

73. Do you usually repeat back messages? and what are your rules respecting the sending or receiving of business on the line?

74. How many messages are you in the habit of sending,

before being answered of their proper reception from the office receiving?

75. How long has the plan of insurance been in use on your line, if at all; and is it any advantage to the Company or public? and if so, what is that benefit?

76. Do you insure on messages going beyond your line, and upon what plan? Please state the details, and give the forms adopted fully, whether going on your line or beyond, or from other lines.

77. Please give your opinions as to the use of magneto-electricity for telegraphing, and the expense of its application. How is it applied, and upon what length of circuit can it be employed?

78. Have you any mode of generating a continuous current of magneto-electricity; and do you think it could be continuously generated, giving an even or equal current, suitable for telegraphic purposes?

79. Do you work your wires charged continuously with electricity?

80. Are there any disadvantages arising from a continuous current, other than unfitness for your particular system; and if so, what are they?

81. What kind of submarine crossings do you consider the best, and how made, their cost, and by whom manufactured?

82. Do you consider there is any advantage in galvanizing the wires for cables, and to what extent?

83. Have you any facts relative to the extent of the action of the sea-water on the exterior wires? if so, please state them.

84. Do you know to what extent the sea-water acts upon the gutta percha? If any, please state the facts.

85. Do you consider there is any necessity for galvanizing the exterior wires for cables intended for fresh water crossings?

86. Please give me all the information you can as to the early history of submarine crossings, with plans and principles?

87. Supposing you needed ten conducting wires, how would you advise a cable or cables to be made?

88. Do you consider a cable of more than six conducting wires practicable; and if so, how constructed?

89. What is the weight of the cables of one, two, three, four and six wires, and the cost of each made of copper wire covered with one, two, or three coatings of gutta percha, being of Nos. 1, 2, 3, 4 and 5, as marked at the gutta percha factory, embracing the price of the respective materials?

90. Have you any information relative to the effect of lightning upon the submarine cables?

91. How do you protect cables from the dangers of lightning?

92. At what speed can a cable be manufactured?

93. Do you know of the use of gutta percha on lines overground, and how does it answer?

94. Supposing your line formed a circuit of two hundred miles, and there were fifty offices on that circuit, could you communicate with all the offices at one and the same time, and could they answer back respectively? And further, supposing one or more branch lines diverged from the main line at any one or more places, on which might be ten or more offices, can any one office on the main or branch lines communicate with all or any one of the offices on the main or branch line at the same time and at will, and be answered back at will? If so, by what arrangement?

95. Please state what were the first batteries used on the telegraphs in your country?

96. Please state what were the first telegraph lines erected in your country, how built, how long, when put up, when and how worked, by whom, and with what success? Also, what instruments were used on them?

97. Do you know any improvements in the art of telegraphing, either as to the lines or working, or as to the science not herein embraced, which would be beneficial to the enterprise if adopted?

98. Can you suggest any plan by which the telegraph can be made to serve the interest of the government of the country relative to army, police or other departments; and do you ever aid the police in the arrest of fugitives from justice?

99. Do bankers pay out money on messages from a distance, or delay protest; and are your messages recognized as evidence in court between parties as to contracts; and are your operators compelled, by law, to reveal in court the business of the line in any manner?

100. Can you give me any information relative to the early history and final invention of the different telegraphs? Please be particular, and give dates and the different stages of success, extracts from newspapers, magazines, books, etc., in which references are made to any or all of the inventions in question.

ART. IX.—ELECTRIC TELEGRAPHS IN GREAT BRITAIN.

FACTS PERTAINING TO THE SYSTEMS OF WORK AND GENERAL MANAGEMENT OF TELEGRAPHS IN ENGLAND, IRELAND, AND SCOTLAND.

BY CHARLES T. BRIGHT, ELECTRIC TELEGRAPH ENGINEER.

(*Answers to Mr. Shaffner's Questions.*)

Answer 1*st.*—Both. In its most important districts, from London to Birmingham, Manchester, Liverpool, Glasgow, Belfast and Dublin, the wires are laid underground. In some lengths there are duplicate lines, one above the other, underground. The following will show the extent of each description of telegraph in this company's system:—

UNDERGROUND WIRES.—From London to Liverpool, by Birmingham, Manchester, Bolton and Wigan, 250 miles, 10 wires. From Liverpool to Carlisle, 130 miles, 6 wires. Carlisle to Portpatrick, by Dumfries, 125 miles, 6 wires. Submarine cable from Portpatrick to Donaghadee, (22 miles,) 27 miles of cable used, 6 wires. From Donaghadee to Belfast, by Newtonards, 32 miles, 6 wires. From Belfast to Dublin, 105 miles, 6 wires. From Dumfries to Glasgow, and thence to Greenock, 115 miles, 6 wires. From Cork to Queenstown, 16 miles, 6 wires. Street-work in London, Liverpool, Glasgow, Dublin, and other towns, 13 miles, 12 wires, (average.) On Scottish Central, Great Northern Railway, and Haigh Colliery Lines, 8 miles, 4 wires. Total, 821 miles of line,—6,348 miles of wire.

Overground.—Chiefly 6 wires.

On the Great Southern and Western Railway,.........	170	miles.
Midland Great Western Railway,......................	150	"
Dublin, Drogheda, and Belfast Junction and Ulster Railway Companies,............................	160	"
Belfast and County Down Railway,...................	40	"
Belfast and Ballymena Railway,......................	40	"
Ballymena and Coleraine Railway....................	30	"
Londonderry and Coleraine Railway,..................	50	"
" " Enniskillen Railway,.................	60	"
Kilkenny Railway Co,..............................	30	"
Waterford and Limerick Railway,.....................	80	"

Caledonian Railway,	200 miles.
East Lancashire Railway,	100 "
Killarney Junction Railway,	50 "
Portarlington and Tullamore,	30 "
Miles,	1,190
Wire,	7,200

The total mileage of the company is therefore a little above 2,000 miles, and the length of wire about 13,000. The works in progress will bring the mileage to nearly 2,500 miles, and the length of wire to above 15,000 miles.

Answer 2nd.—TELEGRAPH POLES.—All the magnetic companies' poles are larch. During the first seven years of pole telegraphs, (Cook's patent for his mode of fixing wires on poles, the precursor of all other systems of poles in England, was dated September 8th, 1842, and specified in March, 1843,) the timber used was, without any exception that I know of, Memel *squared* timber, chamfered down the sides. A table of the dimensions of these posts is given in Highton's book. Since the end of 1850, larch has been altogether used. All the companies have adopted the round wood in preference to the Baltic cut timber, from its being cheaper and more readily obtained, and if straight and well selected, stronger than the old wood.

We have no proof of the respective durability of the two woods, save from comparison of gate-posts, &c., where the woods have been exposed, as in telegraph poles, to *wet and dry*, and we are led to consider that the larch poles will last much longer. None of the larch poles fixed have given way as yet, of course; but most of the square poles fixed up to the beginning of '47, have become so much decayed immediately above and about the ground, as to make it necessary to lower them, which the height of the pole above the ground (14 feet) has generally allowed. The 4 feet buried in the ground being cut away, the pole is lowered to near the same depth. It must be borne in mind, when thinking of the safety of such short poles, that in England all the pole system is by the side of railways, and within their fence, and that persons who might injure the wires if fixed so low on the high-road, have a wholesome dread of trespassing on a railway.

On a few lines where the poles have not been high enough to admit of their being thus lowered, they have been cut off at the ground, and fixed in a cast-iron screw socket—similar to the dwarf-screw piles used for breakwater fastenings, &c., patented by Mitchell.

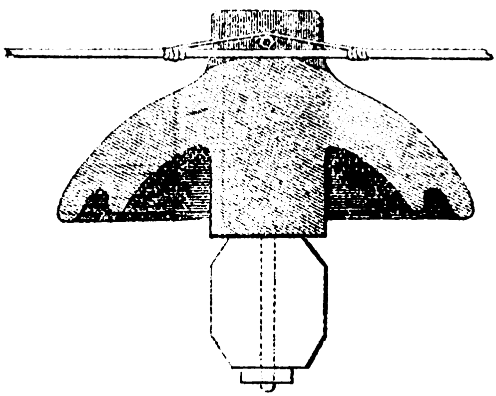
I do not stipulate for any particlar *age* of timber in purchasing larch poles, but only as regards the quality and dimensions. The age of the poles we use depends very much on the district

we are passing through. In some parts the tops, and seven or eight feet of thick butt ends of poles, are used for sleepers, and for props in coal pits, and in others larch is only used for fencing; and here we use the entire tree, from the butt to such part of the top as suits us, for size, while in the former case one pole would be the middle of much finer and older wood.

The size I fix is 18 feet in length, by 9 inches diameter, at the lower end, and 5½ to 6 at the top, measured after being barked. Crossing poles vary from 20 to 28 feet, according to the height of the railway cutting.

Answer 3d.—I have the poles well charred, from the lower end to about a foot above the depth they will be fixed in the ground, and the charred part soaked in *gas tar* for about twelve hours, the poles standing in tanks of tar within a timber framing.

SECTIONAL VIEW OF BRIGHT'S INSULATOR.

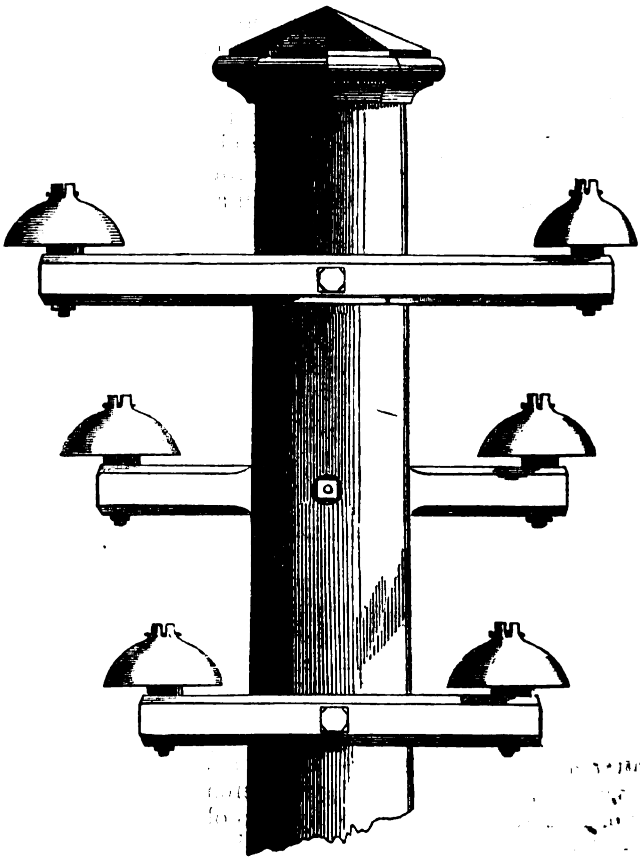


Answer 4th.—INSULATIONS.—The insulators first used by the Magnetic Company were of gutta percha, of the *surface* character of insulations, being simply two oblong pieces of gutta percha, about five inches in length, laid together while warm over the wire at the point of support, and fastened to the post by a small cast-iron chain, or shoe, screwed into the post.

These have been abandoned as not suitable to the long circuits the company works, and a glazed earthenware insulation, of the roof character, substituted and adopted in all the company's recent works.

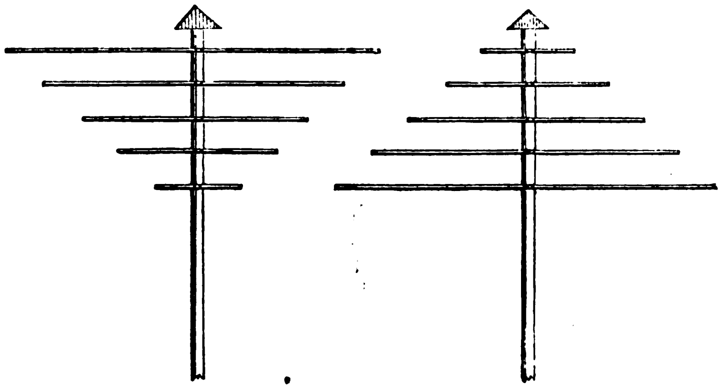
I give a drawing to illustrate the insulations. You will see that the wires are so arranged upon the arms that any wire breaking will not fall upon the others.

BRIGHT & BRIGHT'S PATENT, 1852.



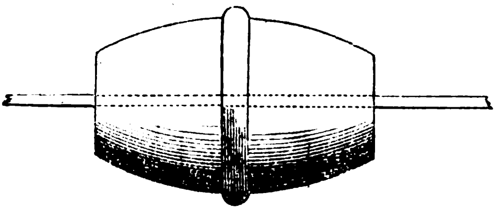
This system of pole telegraph was patented by my brother and myself, in October, 1852. The cost of each insulator, with bolt leaded in, nut and washer, is sixpence, delivered within two hundred miles. Of course, the apex of the cone in arranging the wires can be either above or below; but I pre-

fer its being below, as the wires, in falling, keep clear of any insulators below.



I find the insulators practically the best I have ever tried, though their size makes it necessary to have the poles well rammed.

COOK'S INSULATOR.



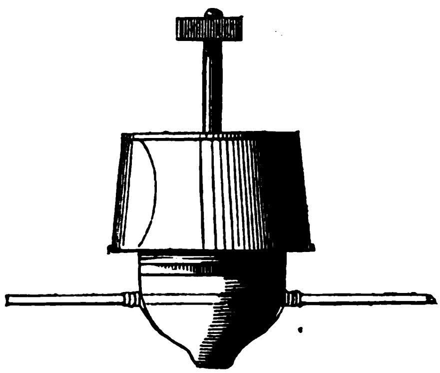
It may be interesting to describe the various methods of insulation used in England in the order of their adoption.

The first, known as Cook's Poll System, was by passing the wire through earthenware insulators of the size and form of an egg, slightly flattened at each end; but the system, though simple itself, was hampered with a method of winding of the wires at each quarter mile, by means of ratchet wheels. The system is described in Walker's Telegraph Manipulation.

Cook's insulators were extensively used until 1848; but it was found that the surface was not sufficient, and an insulator, patented by Mr. Ricardo, but generally known as Physick's Insulator, was brought into use. It is described in the Mechanics' Magazine for 1850. The wire is supported by a hook, the upper part of which passes through

a shed of earthenware, and is fastened by a nut at the top; above this, mastic was laid to insulate the hook from the post. This was found a very faulty insulator, the vibration of the wires, and other causes, breaking off the mastic.

CLARKE'S EARTHERN INSULATOR.



The next insulator is that known as Clarke's Insulator, having been patented by Mr. Edwin Clarke, the engineer of the Electric Telegraph Company, in 1850. It is described in one of the numbers of the Repertory of Patent Inventions, 1851; but as you may not have the work for reference, I have sketched it.

FIG. 2.

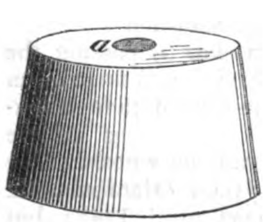
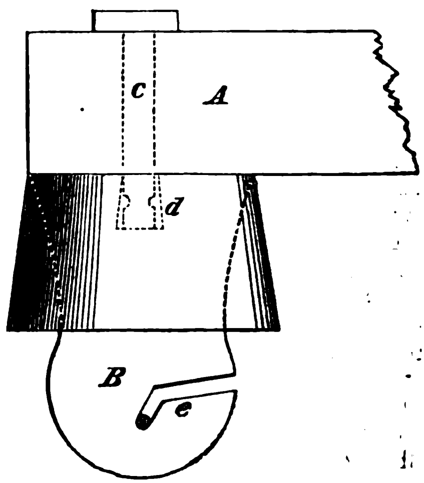


FIG. 1.

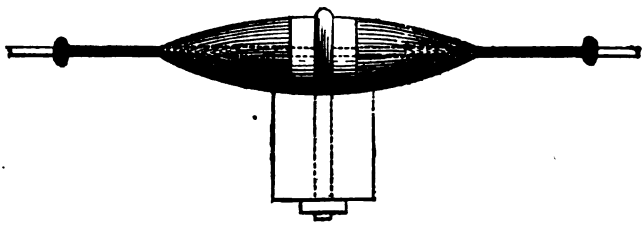


A is the arm to which the insulator is bolted by means of the bolt *c*, let into the earthenware at *d*—block *B* supports the wire by the slot *e* in the lower end of it. Between the arm and the earthenware is fixed, by passing over the bolt at the hole *a* in fig. 2 *a*, a zinc cap, of the shape sketched at 2. The size of the insulator is about twice that of the sketch. (Fig, 1.)

This insulator is now being discarded for one of the same form, and hanging down from an arm, but made of glass throughout, without any metal cap.

The object of the metal cap was, that the moisture might rather condense on it than on the earthenware; but it always seemed to me very hazardous to have a band of metal of such surface so near to the earthenware, and the result shows that the principle is faulty in practice; for the pent-house formed between the metal and the earthenware becomes so clammy with dew, or fog—without rain, which, of course, adds to it—that the insulator is a very defective one.

HIGHTON'S INSULATOR.



The British Company simply adopted a plan of lapping the wire with silk ribbon, for about six inches on either side of the point of support, and covering about five inches in the centre of the foot of ribbon with a piece of gutta percha, shaped like an elongated sphere; the whole is then varnished with brown, hard varnish. I believe this is very fair insulation for a few months, but the varnish soon comes off, unless frequently renewed, which is very expensive, and the silk decays and holds the moisture.

With Clark's and Physick's roof insulators the closeness of the sides was objectionable, on account of the clamminess thereby engendered, and the difficulty of cleaning.

In our roof insulator (page 183) we have spread the sides out, so as to widen the dry surface, and, by making more surface for the air to dry the insulator, the damp and dew is sooner dispelled. There is less lodgment for insects, and the insulator is readily cleaned. The double channel round the wire is to pre-

vent the rain being blown up the insulator in high ground. I have adopted the method of fixing the insulator from below instead of from above, as I find it firmer, and there is no strain on the fixing of the bolt.

Other insulators besides those I mention have been invented; indeed nearly every patentee has had an insulator among his claims, but none of them have ever been used, except Brett and Little's, Nott's and Bain's, all of which were removed very shortly after their establishment on short lines.

One of the most extraordinary ideas on the subject of insulation is that of Highton, who, in his patent, dated January, 1852, proposes to run a wire down each post to the earth, from the central point between each pair of wires, so that any of the "electricity transmitted, as it escapes from the wire, may be intercepted by this communication with the earth, and so transmitted direct to the earth without the possibility of its entering an adjacent wire!" I have no doubt, a wet day would satisfactorily prove, that more than he wished would be intercepted. It has not been adopted.

Answer 5th—STRUCTURE.—Poles of the dimensions above mentioned, cost 3s. 6d. or 4s. each, barked, the knots planed off smooth, and the lower ends charred and tarred.

Twenty-five are generally fixed per mile (unless there are other supports, as walls, buildings, bridges, or viaducts;) the number used to be 30, and frequently 32, but it is now preferred to strengthen the poles, and sink them deeper, and by fixing only 25, to reduce the number of points of suspension for the wire, and thereby improve the insulation.

The expense of erecting the line in labor varies very much according to the price of wages in the district, the nature of the soil, the fitness of the weather, and the length of the days at the time, &c.; but it may be taken from £3 to £5 per mile. I am estimating for six wires.

Answers 6th & 7th—ON WIRES.—Galvanized iron-wire, number eight (Birmingham wire guage,) of the quality known as 'best annealed.' Cost, at present time, £23 10s. per ton, delivered within 200 miles, less 3 per cent. discount, for cash. Weight, 3 cwt., 1 qr., 18 lbs. per mile. Manufactured chiefly at Birmingham, London, and Liverpool.

I think the difficulty and cost of keeping ungalvanized wire, properly coated with paint, to prevent oxidation, renders it unsuitable for telegraphic purposes, otherwise it would be stronger, especially at the welds, than galvanized wire. Near large towns there are disadvantages in galvanized wire.

No. 8 has been universally erected in England, except on the length from London to Southampton, one of the earliest lines built, when No. 7 was adopted. It did not appear so much less broken by frost, &c., as to influence its being selected afterwards.

In very important circuits, I use stronger and more expensive wire, known as "best charcoal annealed," which is sold at the present time at £29 per ton.

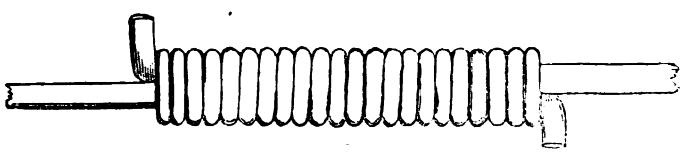
The cost of wire has been gradually rising for a long time. In 1851, best annealed was quoted at £16, in 1852 it had reached £18 10s. and it has advanced steadily since that time. The wire is generally delivered in ¼ mile bundles.

GUAGE OF WIRE.—I do not know if your numbers of guage are the same as ours; perhaps the following table of our *lengths* of *one pound* may be a guide to you if they differ, in understanding the size—I mean by any number of guage I speak of.

	Ft.	In.		Ft.	In.
No. 1	4	0	No. 13	41	0
4	6	8	14	55	0
6	7	3	15	66	0
8	13	6	17	113	0
10	21	6	18	150	0
11	28	0	19	206	0
12	33	4	20	250	0

These figures are from personal weighing and measuring.

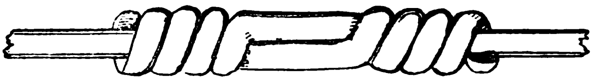
Answer 8th—MODE OF JOINTING.—I have all our joints soldered. Those made on the line are as in sketch below.



The ends of the wire to be joined are bent about ½ an inch; being laid together, they are lapped or bound with galvanized iron-binding wire (No. 20. B. W. G.) and soldered. I do not know any telegraph wires breaking at the *joints*, made after this fashion.

The wire used to be welded at the manufactory, and the weld more frequently gave way than any other part of the wire. Latterly, within the last two years, we have adopted a

different plan—similar, I believe, to that used on many of the American lines. The two ends are laid side by side for about 5 inches, and each lapped four or five times round the other, with a space between each helix of about $\frac{3}{4}$ of an inch.



Answer 9th—ATMOSPHERIC ELECTRICITY, &c.—I have had no opportunity of observing any difference between galvanized and ungalvanized iron wire in their electrical statics during atmospheric variations; but I have no reason to suppose that there would be any difference—at all events, not so as to be perceptible on ordinary telegraphic apparatus.

We suffer most from atmospheric deflections in April, and the end of October and November. We have not arrived at any laws, nor does it seem, from the irregularity of the occurrence of these magnetic variations, that any definite laws can be established for their appearance or extent.

Some interesting experiments, carried on for some time on a pair of spare wires, between Derby and Birmingham, in 1848, are given in a paper read by Mr. Peter Barlow before the Royal Society in 1848, where the variations are tabulated for many days.

The term "deflection," which we use in speaking of the varying currents induced by magnetic storms, arises from Cooke and Wheatstone's needle telegraph, being at first so generally used in England, and the needle being *deflected* for awhile to one side or the other by the temporary continuousness of the atmospheric currents. The effects appear to be the same in this country and on the Continent as in America—at least I have not heard of any more violent or frequent deflections in America than in England.

[The facts above given, will inform the reader of the great difference in the atmospheric electrical hindrances in America and England. It must be remembered that in England the needle system is the telegraph employed. We are firm in the belief that in the Western, South Western and Southern States of America, the needle telegraph would ever be able to send a message of one hundred words successfully and uninterruptedly—compared with the American system. The atmosphere of England is never so highly charged with *adverse currents* of electricity, like we have experienced in the summer months, when the armature of our magnets are continually affected, though regulated with the most careful adjustments. We purpose referring to these questions in future numbers of the Companion.]—EDITOR.

Answer 10*th*.—In wet weather or long circuits we sometimes experience difficulty from currents passing from wire to wire at the poles, depending of course in extent on the degree of good or bad insulation of the line.

Answer 11*th*.—No.

Answer 12*th*, 13*th*, 14*th* and 15*th*.—Yes; the coils and other parts of our apparatus are sometimes fused and broken, and the needle demagnetized, but I have never heard of any property being burnt or injured through the agency of telegraph wires. I should expect that they have rather been the means of saving considerable damage by carrying off a great deal of electrical matter. I have occasionally had poles injured by lightning, but cannot supply any certain scale of average, not having kept record of each case.

I have had only two cases since the commencement of this year, in above a thousand miles of pole line. One of them was the most violent that has occurred in this country, 24 poles being more or less injured near Newry, on the Dublin and Belfast line, eight being split open and splintered to their bases, so as to be totally useless again.

A wire conductor, terminating in a spike, used to be let into all the squared poles; but since larch round poles have been introduced, it has been abolished.

We have violent electrical discharges, as often with as without thunder—of course more on long circuits.

We use lighting protectors with our instruments on pole lines. We have hitherto used two plates with sawteeth screwed into a mahogany base, the points being so close as nearly to touch—one is connected to earth and the other to line, and a small spiral, all of very fine copper wire (No. 40) forms part of the line circuit. The whole is covered with a glass cover. It is a very simple arrangement, and effective, but it is found objectionable on account of the wood sometimes warping and bringing the earth in contact with the line.

I am about introducing a protector, included in Bright and Bright's patent of 1852, formed of two wire brushes, (about the size of a nail brush, the wires being about $\frac{1}{8}$ of an inch in length,) mounted on plates of brass $\frac{1}{2}$ an inch thick—the top plate being capable of ready adjustment by a screw.

I have lately seen in Turnbull's work on the telegraph in America, that something after the same plan is in use there, and known as Carey's Protector, and I am curious to know the date of its introduction. I can easily understand the difficulty in adjustment, if the points are mounted in leather, as Carey's protectors are thus described.

I am under the impression that in your country lightning is far more frequent and injurious, and more violent than here. Perhaps this may partly arise from the wires passing through districts less populated, where there are not the same number of conductors in works, chimneys, towns, railways, &c.,—and I should like to know if you find the same average of discharges in your thickly populated districts, as in those where the towns are distant from each other. Say from Boston, to New-York and Baltimore and Washington, compared with some long line in a thin district.

[We have no doubt of the correctness of this opinion. We have not the opportunities of judging as to effects on the route mentioned above, as there is much the same state of settlement. We can mention some incidents quite curious and to the point. In the West we have large prairies, ranging in size from one to ten and fifty miles, without a tree. These prairies are sometimes separated by a skirt of woods, a mile (more or less) in width. These large open prairies may be considered as large open fields, with but few houses—say one every two or three miles—and but few trees. In sections of country thus situated, the atmospheric electricity is so troublesome to the telegraphs, that for many hours, during many days of the year, it is impossible to work. A few years ago, while acting as president of a telegraph line, (sole manager or engineer, as known in England,) we noticed the following facts:—

The line ran nearly north and south. The country, one hundred and twenty miles south of the northern station, was mostly of the barren growth—a small post oak. This timber is of slow growth, and contains a small quantity of sap, so little, in fact, that enough cannot be diffused to all the branches, and many die for want of nourishment. During the last twenty years we have noticed, with much care, the growth of this tree. In alluvial soil the trees, in a few years, grow twenty and more feet high. In the barrens the trees do not attain that number of inches in the same time. The barren section of 120 miles contains much of this slow growth timber. In the summer seasons the difficulties experienced on lines crossing prairie fields were witnessed on this section of the line; and, during the afternoons of July, August and September, many times it was not possible to work, owing to the superior influence of the atmospheric electricity over the most carefully arranged galvanic force.

In connection with this consideration, there are many circumstances which would enter into the formation of a correct judgment. These we have not the room to give at present.

On the southern section of the line aforesaid, for 160 miles, the country is not so open, and the timber is large, and of a kind which retains a great quantity of sap. This section is not so hilly, nor is the wire so exposed to the sun, running many miles through the thick woodlands. We never experienced the difficulties on this end of the line, as mentioned, relative to the northern part of the same line. While it was not possible to work on the northern end, we could successfully work on the southern. The two countries are widely different in natural formation and in product. The most southern section worked at times when the northern could not, on account of atmospheric electricity, or some unknown power. The winds and the storms are great enemies to the American lines. We have all our telegraphs built on poles. Trees are blown across our wires, and the line is either broken or buried in the earth. Notwithstand-the daily troubles occurring from the storms, yet the atmospheric difficulties are the most powerful and annoying. With our practical and money-making ideas, we have not properly studied this difficult problem. If they had the same difficulties to encounter in Europe we have no doubt some remedy would have long since been discovered. In America the dollar controls everything. Success in making money makes the man. It is thus that many men become great, while others of merit are passed unnoticed. Our people look for the dividends immediately, and unless they are large and often, dissatisfaction is manifested. Success in money-making elevates in estimation of the public a fool to the honors of the university. It makes kings, princes and potentates. A lottery ticket can make a nobleman in an hour. When the money is gone, the nobleman's blood cannot retain him in rank.

In making these remarks we may add, that while the American people do not apply the necessary theory and scientific talent in the conducting of our telegraphs, we think the European lines do not have the appliances of practical facilities equal to the American. They are in advance of us in theory. We are before them in practicabilities for the time being. Theirs are substantial and made for years, while many of ours are built and rotted within a year. Upon this subject we purpose speaking to our American people in the language of figures, ere long. Daily observation tells us that we must change our mode of construction.]—EDITOR.

Answer 16*th*.—Answered under questions 2 and 5.

Answer 17*th*.—The size of poles I have described is intended for not more than 8 wires. *We* have no greater number any

where on poles, except at a few junctions where different lines meet and pursue the same course for a short distance. They would probably bear 10, but I should not like to have so many in an exposed country without increasing the size. The greatest number of wires that I am acquainted with on one set of poles for any distance, is on the Eastern Counties Railway, where 18 wires are carried from London to Stratford. The London and North Western line has 13 wires, the greater part of the distance on one set of poles, and in many places for short distances many more.

Answer 18*th*.—I have not observed any marked difference arising simply from position of the wires. I should suppose the lower wires would be more affected by earth contact, and the middle wires with wire contact, while the top ones would be the best; but to ascertain this it would be necessary to have all the wires exactly on a par as regards their insulation, and a delicate galvanometer would scarcely then show much difference. I should imagine ordinary instruments would indicate no appreciable difference in their working, if the wires were otherwise equally insulated.

Answer 19*th*.—In our old method of insulation, the gutta percha held the wire at each pole. In our present plan, you will observe the pin, which passes over the wire across the slot in which the wire lays, has a piece of binding wire laid over it, and lapped and soldered around the wire, on both sides, so that while the wire has a little play at the point of support, it is held in case of breakage. If a wire is held by anything biting fast to the wire, the continual oscillation at that point injures the fibre and makes it very liable to give way there.

Answer 20*th*.—Not often after the first winter, which of course tries them more severely than any time after. Contraction by frost, weight of ice and snow, and accidental or malicious injury, are the general causes. I have known galvanized wires near manufacturing towns, broken by becoming so attenuated in some places in consequence of the destruction of the zinc by gradual deposit and decay, as to break by their own weight.

Answer 21*st*.—By line men kept on the line for the purpose, and for general maintenance of the poles and wires. The number employed varies on different lengths, according to the importance of the line as a commercial circuit, and consequent necessity or otherwise for immediate repair of any fault, and according to the convenience for speedily getting to any place in the length. On a straight line of railway, for instance, any point of a man's district may be much more readily arrived at than at one composed of many short branches, where the junc-

tions and changes of trains make it difficult to travel so quickly. The average on my lines, is one to 70 miles of pole line.

Answer 22*d.*—No.

Answer 23*d.*—Answered under 21. The men's wages are from 18s. to 24s. per week. The latter for men of intelligence, capable also of repairing the instruments, or undertaking charge of works to small extent.

Answers 24*th* & 25*th.*—Our winters are not so severe, and our frosts so long in duration as to give us very much inconvenience in this way. Sometimes the wires break from the weight of the snow, when it collects to a great extent between the poles, but it is a rare cause of interruption. The greatest injury I remember being done by snow, was on the South Eastern line, where a considerable distance, above two miles I think, of poles and wires, were thrown down.

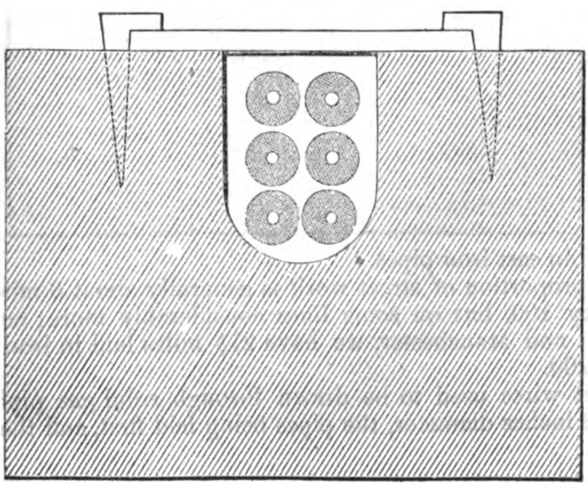
[In 1849-50, about two hundred miles of lines in the South Western States of America were broken in one day by sleet; many times a section of ten miles between every pole, the wire was found broken.]—Editor.

Answer 26*th*—Subterranean Lines.—We have 820 miles of underground line; 670 of which, from London to Dublin, by Manchester, Liverpool, Carlisle and Belfast, is in a continuous line, the longest underground line by far in the world.

The chief part of this is laid in a trough of kreosoted Baltic timber, with a lid of galvanized roof iron, overlapping the groove by ½ an inch on each side, of the guage No. 14 in thickness.

It is drawn with six wires, but in some places 10 are laid.

SUBTERRANEAN TELEGRAPH—NO. 1.

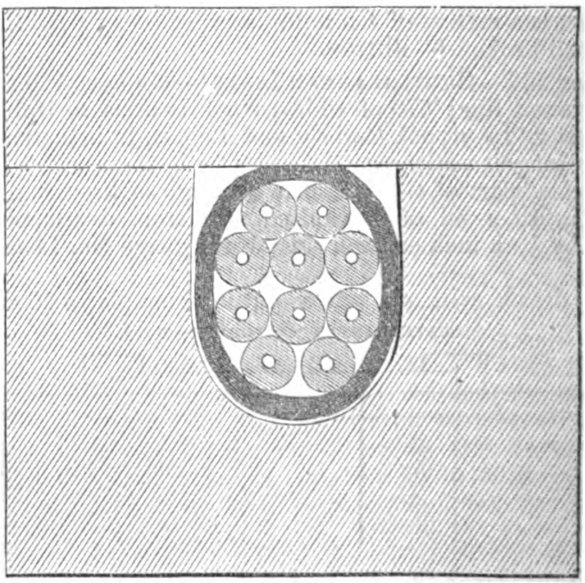


The line from Manchester to London, the first laid, has a wooden lid instead of the iron lid afterwards introduced. The district is easy of access by railway the entire distance, and the roads well attended to by the road; surveyors, (county, not *telegraph* officers) who inform us of any works, &c., to be done on the line of our wires.

The wires on this line, 10 in number, are covered with a serving of tarred jute as an additional protection, especially while laying, the expense being nearly covered by the saving in labor and carriage, in having the wires altogether in a rope, and wound on the same drum.

A full size section is given at fig. 2. The two plans are under the ordinary high road; but through the paved streets of towns, where the roads are often opened for laying gas and water pipes, drains, &c., and where, from the nature of the ground, the full depth of the trench cannot be made, the wires

SUBTERRANEAN TELEGRAPH—NO. 2.



are laid in cast iron pipes.

The proportion of street work is generally about 3 miles out of every 100, but on some lines considerably more; between London and Manchester, we have 21½ miles laid in iron pipes out of 200.

Street wires used to be drawn through solid gas piping of about 3 inches diameter, the pipes being laid first, and the insu-

lated wires drawn through afterwards. In doing this the insulating material was frequently injured; sometimes the wires were broken inside the gutta percha, or other insulating material, by the force necessary to pull them through, and occasionally they were drawn so tight that on the slight settlement of the ground, usual after the line has been laid a short time, some of the wires broke inside the insulating material, occasioning great difficulty and expense in detecting the fault.

The great proportion of the faults, however, were only abrasions of the insulating material; and though at the time the wires passed with all appearance of perfection through the ordeal of testing, and the streets were closed, and the pavement reinstated, before long the defects became so manifest as to interfere with the working of the apparatus, and the streets had to be re-opened, and the wires tested through length by length for the fault.

The wires required jointing at every other drawing point, and these points frequently proved defective, particularly in the old varnished cotton method of insulation and others, prior to the use of gutta percha.

In the beginning of 1852, having considerable lengths of street work to lay, I gave a good deal of attention to the subject, and determined on having the pipes cast longitudinally in two pieces, so that the wires could be *laid in* the under lengths, and the upper lengths then attached, instead of drawing, or threading them through solid pipes. I was the better able to carry this out, through the introduction of gutta percha, rendering the exclusion of moisture for the interior of the pipes of less moment. I tried various forms, rectangular, half-rectangular, with an arched lid, semi-cylindrical, with a flat sole, &c., but the form I found most generally useful and convenient, was that having the upper and under half exactly similar, making together a round pipe. I have the pipes cast in six foot lengths, and about 2 inches internal diameter, the substance being ⅜ of an inch,—the sides fitting clean together, without any flange, but fixed by small bolt and nut fastenings through semi-circular lugs projecting about 1½ inches from the side; one pair of lugs being about 9 inches from the faucet, and another pair two feet from the spigot end.

A pipe of these dimensions is much cheaper than the old 3 inch solid pipe, and more generally useful,—the halves being convenient for fixing to walls, viaducts, &c., over wires needing good protection in such places; and, from its circular form and smallness, it is very difficult to break, as a pick-axe, or other tool, cannot easily strike it full.

The process of laying in the wires is rendered much more expeditious and economical by the use of half pipes. I select a chronicle of some speedy operations in the middle of 1852, from the "Times" newspaper:—

"There is no greater annoyance in large towns than that which Parliament has granted to private Companies of ripping up their pavements at all times and places where it may be necessary for their interests. The authorities of a town pave their streets at great expense, and then comes a Gas Company, and then a Water Company, and then a Telegraph Company, to open deep trenches in some of the leading thoroughfares, interrupting the traffic, and creating great inconvenience. We have seen these trenches open in some cases six or eight days; but in the present instances we are glad to perceive that a great improvement has been introduced. The method adopted by the old Company has been to lay down a line of round cast metal pipes, through which the insulated wires are passed. This is necessarily a long and tedious operation, because considerable time is occupied, as each length of pipe is laid down, in passing the wire through it; but Mr. Charles Bright's plan is to use pipes split longitudinally into two halves. The under halves of the pipes are laid down in the trench, and then a large drum, on which the insulated wires are wrapped, is rolled along over the trench, and the wire is payed off easily and rapidly into its place—the upper parts of the pipes put on afterwards, and secured in their places by means of screws through small flanges, left outside for the purpose.

"So well has this mode succeeded, that in Liverpool the whole lengths of the streets, from Tithebarn Railway Station to the office in Exchange Street East, were laid down in a single night, (11 hours,) and in Manchester, the line of streets from the Railway Station in Salford to Ducie street, by the Manchester Exchange, in 22 hours. This was the whole time occupied in opening the trenches, laying down the telegraph wires, and re-laying the pavement; and while great credit is due to the Company on the ground of the little public inconvenience occasioned, no doubt they would find the benefit of it in economy of time and money."

Mr. Reid has invented an ingenious modification of the half pipe, of the rectangular form, which he has patented in company with Mr. Brett, and which we have used. I refer you for this to his patent, published in "The Repertory of Patent Inventions." Mr. Henley also has improved on the circular half pipe where it is intended only for subterranean work, which he has also patented; but both of them have top and under lengths differently shaped, and I find my original plan preferable for general purposes. All the telegraph companies have adopted the two piece pipe in place of the solid round pipe, except the old company. The depth of our trench is not less than 2 feet, but all obstacles, as drains, culverts, gas or water pipes, &c., are always passed *under*.

Answer 27th.—I have had no experience in laying underground wires with single covered gutta percha, having in common with

all telegraphic engineers in this country considered the occasional small flaws and air bubbles which occur in single wire, and which are covered and made good by the second coating, a bar to its use, except about stations, &c., where it is not in close contact with the earth, and may be readily examined.

Answer 28*th*.—I do not think wire, covered with hemp only, could ever be laid so as to preserve good insulation, equally with that coated properly with gutta percha.

The wires through the streets of towns used, prior to the introduction of gutta percha, to be coated with a double serving of cotton, varnished, tarred, and enclosed in a leaden tube, which was passed through cast iron 3 inch piping. The wires were continually getting defective after being laid some little time, and we have only been able to have underground wires of any length in a good state of insulation, since the adoption of gutta percha; and that only within the last 5 years. Before that, the art of coating wires had not reached its present high state of practice, (which may be attributed to the perseverance, energy and science of Mr. Statham, the able Manager of the Gutta Percha Company;) and in one of its first trials in the most important lengths of street wires in London, it proved in a few months to be an utter failure.

Answer 31*st*.—Answered partly under 26. The cost of laying varies very much according to the hardness of the roads, the price of labour, the season at which the work is done, &c.; for six wires, according to the plan shown in sketch appended to question 26, a line along the old mail-roads varies from £180 to £200. The price of gutta percha has changed so much as to make estimates very little to be depended on for a long time. Last year No. 4 rose two pounds per mile in three months, and other guages in proportion. For ten wires, according to the plan with wooded lid shown above, and covered with hemp, the cost may be set down at about £230 per mile—this is on hard Macadamised roads.

I should never lay less than four wires under ground; the proportionate expense of cutting the trench, and for troughing, &c., being about the same for one as for ten, unless the scarcity of timber be much reduced, the expediency of which I doubt.

Wires laid without some protection, cannot be depended on very long, unless in a very favourable country. In Prussia, they appear to have formed the same opinion. We have had to re-lay a line from Manchester to Liverpool, which was originally laid without protection, though sunk to a good depth. A line of two wires laid from Dumfries to Stranrae, in Wigtonshire, by

a now defunct company, called the Channel Submarine Company, has never been worked, and never will be.

The depth of our trench is two feet. In towns, and where gas and water pipes, &c., are laid, more according to the level of the mains and service pipes, which we keep under in all cases.

The only other company which have a line under ground of any length (the European and Submarine, from London to Manchester), have laid their wires less deep—from one foot to eighteen inches.

Answer 32*d.*—Where the road is rocky, we blast out about a foot deep, and lay the wires in iron pipes, packing up the trench with the shale and earth. We have had a great deal of rock crossing Shap Fell; on the road from Liverpool to Carlisle, we had a considerable length of solid rock; on the London line about Stoney Stratford, on that from Dumfries to Glasgow, near Abington, and through the Deloin Pass, and a good deal in Ireland.

Answer 33*d.*—Our wires are in every case, as yet, laid along the old mail-roads, which have been so carefully made and kept in repair throughout the kingdom for years past; we do not therefore ever pass through *marshes*, as the road would always pass over anything of the sort with a bridge or viaduct. We have no telegraphs in England "across country" without regard to roads. For the same reason, we have no upheaving of the roads from frost; they are all too old and firmly set for any such disturbance. The only danger at all of the sort that I apprehend, is the *settling* of the roads in some places in the colliery districts, from seams of coal mines passing under the roads.

Answer 34*th.*—If you mean underground wires, at present, I cannot say which. I should imagine that seasons do not affect underground wires, save in induced currents, at all; with pole lines, spring, autumn and winter, are the worst times. I think about in the above order, summer is of course the best season for exposed wires.

Answer 36*th.*—See reply to 33—Our mail-roads always cross by bridges, and our wires are laid over them, frequently close under the parapet, about 6 inches deep, (as the crown of the bridge is generally shallow, to avoid much raise of the level of the road,) enclosed in wrought iron solid pipes, about an inch in diameter, by three-sixteenth in substance, which are threaded over the wires, for the short distance required.

Answer 37*th.*—CROSS, INDUCED, AND RETURN CURRENTS.—Under question 10, you have referred to *cross currents* as what

we term "wire contact," that is, communicated by moisture, or otherwise from wire to wire.

Under 11, you speak of an *induced* current from wire to wire.

I suppose, therefore, that by the latter you mean something that we have not yet experienced; at least not so as to be visible on our ordinary instruments, but which perhaps your continual current, or some peculiarity of your atmosphere, in some districts may have engendered.

[The American telegrapher will please observe the answers to Question 37. It is one of the greatest importance. It strikes at a question in philosophy about which our people have made more discussion than any other—their arguments being based upon theory. The answer given is full upon the subject. The author of the answer thoroughly understands the science and art of telegraphing; and when he speaks thus, we can depend upon the non-existence of that which American telegraph philosophers have mostly dreaded.]—EDITOR.

We have had no case of wire contact in underground wires; I should doubt our having any, unless in some case of a nail, or a portion of an iron cover, or of a tool being forced in between two wires, as the communication with the earth (or to use our term, the "earth contact") would be paramount.

We have had no experience of any induced currents from wire to wire in underground, any more than on pole lines.

Answer 38*th.*—I have not observed any difference; certainly our instruments are not in the least affected. You must bear in mind, that our wires have been laid only a short time. That from London to Liverpool has been completed 9 months—the North and Irish lines only six; and having been very much occupied with extensions, and opening out our present system, I have had little time for experiments with delicate galvanometers and other apparatus, but I speak here, and before, of my results as shown on working telegraph instruments.

Answer 39*th.*—I cannot speak for certain, as I have not had time to try. I have in reserve this, with a number of other experiments, when I have more leisure, and will acquaint you with the result.

You are aware that we use magnets only, and their induced currents, for our motive-power; and as my experience of batteries has, of late, been only for purposes of testing, etc., this and the two following questions will probably be much better answered by your other friends here.

Answer 42*d.*—Answered under 12, &c.

Answer 43*d.*—On overground lines they are very trifling, indeed, compared with underground; the conditions on which the wires are suspended and insulated, passing also through a medium, capable, to a certain extent, of absorbing any electricity developed in surplus, prevents the occurence of any effects appreciable by ordinary needle telegraphic instruments.

I look upon an underground wire as being exactly similar, on a large scale, to a Leyden jar, and I am borne out in this by the experiments of my brother and myself, and by those instituted by Faraday on the underground wires more recently laid by the Electric Telegraph Company. The magneto-electricity, as well as the galvanic (or chemical) electricity, evinces these phenomena, hitherto supposed to belong to properties appertaining peculiarly to frictional electricity.

The copper may be compared to the inner metallic coatings of a Leyden battery, the gutta percha to the glass, and the earth and moisture surrounding to the outer covering.

I was much interested in one of our experiments to observe, that the larger the size of the wire experimented upon, with the same battery power, the greater the amount of return current: a strong support of our opinion; as, had it arisen from an *elastic* return, owing to the wire being unable to receive as much electricity as was forced into it, as some supposed, of course a *smaller* wire (with the same power as that employed with the larger size) should have given out a *greater* amount of return current. If you experimentalize on No. 18 and No. 16, you will see this very clearly.

Answer 44*th.*—My brother tried some experiments, by connecting our underground wires together, which he will be better able to describe than myself. I am about to try, on a very extended scale (over all our wires joined together, and various lengths), the distance to which we *can get a current*, and will acquaint you with the result.

Answer 46*th.*—Practically, the difference is, that an underground line of copper requires considerably more power than a suspended line of iron. If we assume the difference of conducting power of the two metals to be in the proportion stated by Becquerel and others, then the vast resistance engendered by the (so to speak) Leyden jar condition of a well-insulated underground wire, is manifest.

Answer 45*th.*—No. 8 has been the only size of wire used overground. No. 7 has been tried on one line, but No. 8 was found to be sufficiently strong. No doubt, a much smaller wire would

have sufficed (in the absence of any appreciable return current, as in subterranean lines,) for all ordinary conducting powers.

I have tried, with Mr. Statham, the Manager of the Gutta Percha Company, some important experiments on the conducting ratio of different sizes of gutta percha coated-wire, which show a considerable difference in conducting power of copper wire, leading me to the decision that, for any line of a length above one hundred miles, it is not expedient to use a size less than No. 16 copper wire (Birmingham wire guage).

I extract a few notes of our experiments on Nos. 18 and 16, as clearly showing the difference.

Fifty miles of No. 16, and fifty miles of No. 18, tested for continuity with a Galvanometer.

1st	Fifty miles of No. 18.	Fifty miles of No. 16.
With 3 pr. of plates,	45°	53°
6 " "	62½	Full, so as not to be reckoned in degrees.
2nd	One hundred miles of No. 18.	Fifty miles of No. 16.
With 3 pr. of plates	29°	39°
6 " "	50	59°

With needle of Galvanometer weighted.

3d	One hundred miles of No. 16.	Sixty-five miles of No. 18.
With 36 pr. plates,	17½°	17½°
18 " "	10½	10½

The loss of conducting power appears, therefore, to be more than proportionate to the different area of metal.

Mr. Statham, who went to considerable pains in investigating the ratio of conductibility, and insulated many miles of various sizes, practically to demonstrate the differences, has made a very good wire for short distances, by which a saving may be effected in such lengths of underground lines, which he calls No. 7 Gutta Percha Covered Wire, the copper wire being 18—the gutta percha being *double* covering, but not so thick.

Answer 77th —MAGNETO-ELECTRICITY.—I am naturally strongly in favor of the use of magneto-electricity. Its economy is undoubtedly the most prominent feature. A pair of magnets costing at Sheffield 30s. and perhaps 40s. to 45s. (according to the finish bestowed on the instrument,) by the time they are fixed and ready for use, will send a strong current on a well insulated suspended line for above 200 miles, and on an underground wire above a hundred. (I have had signals, but only weak ones, through 250 miles of underground wires with the class of instruments I am speaking of) while the six twelve-cell trough battery used in this country, which would be necessary to

perform the same work, would cost £7 10s., besides the constant expense of renewal, &c.

A magnet, if the keepers are put on when the instrument is not in use, will retain its magnetizm for an indefinite time. I have not as yet had to re-magnetize any of our sending magnets, though we have instruments that have been in use since our incorporation in 1852, and some since the exhibition in 1851, where our apparatus carried off the highest medal the jury could allot.

I cannot speak as to what length of circuit magneto-electricity can be used, as I have not as yet tried with magnets of great power, beyond those we use daily.

We work the longest circuit that is daily worked in England—from Liverpool to Belfast and Dublin, an underground line, which, with a pole line would be equal, at least, to 800 miles, though I doubt if we could put a current of such power into any pole line, unless in very dry weather. The magnets here used, are the large horse-shoe compound magnets you have seen in our offices, about 15 inches from the poles to the back, about 5 inches in height, made of 12 plates, in breadth about 1½ inches. I have spoken with these for experiment through 530 miles of underground wire; but for our arrangement of circuits it would be unnecessary, and inconvenient, as we should have to lay more wires so as to connect up long direct circuits, which would be very little used.

These magnets cost nearly £7 each.

Answer 78th.—We have no mode in use, because it is not adapted to our system, the magnetic current we send being sufficiently long for our purposes.

I do not see much difficulty in keeping up a continuous current. Wheatstone patented one some years since, but it was complicated and comprised six compound magnets for each wire.

A simple reverser, which should change exactly as the coils changed their polarity, similar to that used by Billant, and a close arrangement of the poles of the permanent magnet, are the chief points.

By rotating a disc or plate, with coils on its axis between the poles, perhaps an equal current might be maintained.

I have not given much attention to the subject, as we do not use continuous currents here, and can obtain sufficient duration of the effects of the movement of a pair of coils for about 30 degress in the face of a permanent magnet, by having the receiving coils and their cores so arranged as to retain the residual magnetism until another current is sent.

Answer 79th.—We do not use our wires continuously charged with electricity.

Answer 80th.—I do not know of any practically, from having had no experience at all in the use of continuous currents. Glancing at the subject, I should think there must be some inconvenience wherever an iron core is used in the receiving coils by the residual magnetism retaining the keeper or magnet. This would be increased in an underground line, where the return current would follow so quickly on any break of current, as to make any rapid sending impossible. Is not the expense of maintaining battery much increased by their more frequent operation?

Answer 81st—SUBMARINE TELEGRAPHS.—I like the plan most generally adopted the best—that of covering the gutta percha wires first with tarred hemp, and afterwards with strong iron wires wound spirally round the rope. They have been made in England chiefly by Newall, of Gateshead. The cost varies very much of course, according to the size of wires used, &c.

Answer 82d.—I do not think there is. It weakens the rope, and in manufacturing is liable to injure the gutta percha wires by scaling, &c. We lost a galvanized rope between Portpatrick and Donaghadee in October, 1852, which was entirely recovered afterwards. A new one, ungalvanized, was laid in May, 1853—the first successful attempt to connect England to Ireland after three failures by other companies and ourselves.

Answers 83d to 92d.—I have either been unable to give reliable information on the subjects, or cannot just now go into them fully, and collect estimates. I shall be happy to do so hereafter, if you have not obtained full particulars from others.

Answer 93d—INSULATED WIRES ON POLES.—Gutta Percha wire has not been used in England upon poles. For my own part, I consider it would have all the disadvantages of both the overground and underground systems, with few of the merits of either. I speak of our abandoning gutta percha pole insulators under No. 4.

Answer 94th—COMBINING CIRCUITS.—We have no circuit with anything like that number of stations, so I cannot speak by experience; but I have no doubt if our present instruments could not overcome so great a resistance as that number of receiving coils in a long circuit would present, that apparatus could, without difficulty, be made that would be sufficient. We have no arrangement exactly such as you mention; but, at all our junctions we have switches for turning the branches into direct communication with the main lines.

Answer 95th—Galvanic Batteries.—Trough batteries after Wollaston and Cruikshank's plans. Mr. Cooke modified them, and introduced the use of sand in the cells, which equalized the action, and made the batteries more convenient for carriage and use in offices. I speak of the first working telegraph—not experiments.

Answers 96th and *97th*—First English Telegraph.—Cooke and Wheatstone's Needle Telegraph. That with 5 needles, used on one or two lines at first—(the Norwich and Slough lines the only ones I remember at present)—but were shortly afterwards changed for the double needle as more convenient and economical. The first line—the Great Western to Slough—was fixed in 1839. It was erected on short standards, the wires being laid in a trough carried on them. It was worked a long time, but has since been changed for the suspended wire system. Its chief use was for the railway company's affairs, and partly for commercial business. Other lines followed rapidly after this—among the foremost, the Southwestern to Southampton, Gosport, Portsmouth, &c., with wires for government use in the Admiralty Department.

DIRECTIONS FOR INSULATING JOINTS IN GUTTA PERCHA COVERED ELECTRIC TELEGRAPH WIRE.

Have in readiness a few strips about [illegible] inch broad, of very thin Gutta Percha Sheet, also a little *warm* Gutta Percha about [illegible] inch thick, one or two hot tools, and a spirit lamp.

Remove the Gutta Percha covering from along the wire no further than may be necessary for making the joint in the wire. Having joined the wire, warm gently with the spirit lamp the bare wire and joint, and the Gutta Percha near to it; taper the Gutta Percha over the bare wire until the ends meet; warm this, and immediately apply one of the strips of thin sheet in a spiral direction over it. Press this covering well on until cool; then, with the spirit lamp, carefully warm the *surface*, and proceed as before to put on a second strip of the thin sheet, observing to wrap it in a direction reverse from the first strip, always making the commencement and termination of these coverings to overwrap the previous one. *It is safer to perform this operation a third time.*

Next, take a piece of the warm [illegible] inch sheet, and cover over the coats of thin sheet, again overwrapping the original covering of Gutta Percha, which should be heated so as to ensure perfect adhesion. Press it well on as it cools, and when cold, or nearly so, finish off the joint with a warm tool, working well together the old and new material at each end.

Lastly, and in general, avoid moisture, grease, or dirt, and be careful not to burn the Gutta Percha, which would prevent proper adhesion.

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MORSE AMERICAN TELEGRAPH.

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ART I.—ELECTRIC TELEGRAPHS IN GREAT BRITAIN.—NO II.

THE SCIENCE OF TELEGRAPHING—MAGNETO-ELECTRICITY—RETURN CURRENTS —ROYAL PROTECTION TO TELEGRAPHS—BUSINESS DEPARTMENTS AND OFFICE ARRANGEMENTS.

BY EDWARD B. BRIGHT,

Secretary of the English and Irish Magnetic-Telegraph Company, Liverpool, England.

(Answer to Mr. Shaffner's Questions.)

Answer 44th.—RETURN CURRENTS ON SUBTERRANEAN LINES. —In the course of a long series of experiments carried on last year by my brother and myself, inquiries were instituted with reference to the speed with which the galvanic or magnetic sensation is communicated through underground wires.

The result of the inquiry shows decidedly that the communication of the electric impulse through a length of 50 miles of underground gutta percha covered copper wire (1 6 guage) does not exceed 900 to 1000 miles per second—a speed far below that usually assigned.

Reasoning upon the issue of these experiments, and those previously tried in America, I have no doubt that the speed of any description of electricity varies greatly with the peculiar conditions and nature of the conductor used, and also with the length of the conductor interposed; and that a wire suspended in the open air, especially if insulated only at points of its support, (such as in a pole line) would offer far less resistance (cœteris paribus) than a wire undergound.

Submarine cables are similar, as regards electrical conditions, to subterranean lines, and the speed with which the electric impulse is communicated would be the same.

I have no doubt, however, that, as Professor Wheatstone's

experiments showed, the speed of electricity developed by friction (or machine electricity) is of *far* greater velocity, whatevre be the medium of communication interposed, than the species (voltaic or magnetic) used in telegraphic manipulation.

Answer 48*th*—Preferred Messages.—It is provided in the royal charter granted to the company, that any communications handed to the company by government for transmission, are to be forwarded prior to any other messages, and at all times when the offices of the company are open. The government make considerable use of the magnetic telegraph, and their messages always take precedence, and are paid for according to the usual tariff for private messages.

Answer 49*th*—Rights of Way for Telegraphs.—Government has made no grant, as regards concession of property to telegraph companies; but gives to them power to open roads, and to pass their wires through or over any public way or public property without compensation, and subject only to certain formal notices to the local road surveyors, and to their approval of the subsequent re-instation of the surface of the road opened.

The various telegraph companies have availed themselves more or less of the power so conferred: the electric telegraph company by laying their wires through the streets of towns from the termini or stations of railways: this Company for some years past have extended the use of the clause to the construction of main lines along the high-road, in addition to street work; and recently the "European" Company have adopted a like plan. Finally the British Telegraph Company in several instances have carried pole lines for short distances (a few miles) over the highway, where they could not obtain permission to use the railways. There are many difficulties, however, in carrying wires along the turnpike roads overground, as the landlords of adjacent property have particular objection to the lopping of any branches that project, as is often the case for miles on both sides; and wires so placed are peculiarly open to malicious injury, which could not well be guarded against.

Royal Protection of Telegraphs.—Accidental or malicious injury is provided against in the Company's Act of Parliament, dated 1st August, 1851, 14, 15, Vict., Cap. cxviii. I cite the clauses that particularly refer to this point:—

"LIV.—That if any person shall wilfully remove, destroy, or damage any electric telegraph, which shall or may have

been lawfully erected, or any wire, standard, apparatus, or other part of such telegraph, or any works connected therewith, he shall be guilty of a misdemeanor.

LV.—That with respect to the offenders whose names or residences are not known, any officer, agent, or servant of the company, or any constable, police officer, or servant of any railway company, along or near to whose railway any electric telegraph, or any of the apparatus thereof, or any part thereof respectively, shall or may be erected or placed, or any constable or police officer, and all persons called by any such officer, agent, servant or constable as aforesaid, to his assistance, shall or may seize or detain any person who shall or may have broken, injured, or obstructed the working of any electric telegraph of or belonging to the company; or any of the wires, standards, instruments, apparatus, or other parts of any such electric telegraph, or who shall have committed any other offence against the provisions of this Act, and whose name or residence shall be unknown to such officer, agent, servant or constable, and shall or may convey such offender with all convenient speed before some justice, without any warrant or authority other than this Act; and such justice shall proceed with all convenient speed to the hearing and determining of the complaint against such offender."

I may instance, that, in November last, the wires of this (the magnetic) company were cut during the riots at Wigan. Having obtained information, I caused three men, Peter Moorfield, Peter Fairhurst and Thomas Bradshaw, to be apprehended, and obtained their committal to gaol to await trial.

We proved the charge against them at the Wirtedale Sessions, in January, 1854, and a verdict sentenced them to six months' imprisonment, with hard labor.

Answer 50*th*.—RECEPTION OF BUSINESS FROM THE PUBLIC.—All messages are handed to the company, written upon printed forms provided for the purpose. To all good customers small books of forms are issued. Larger books lie at the places of general resort (such as the exchanges, reading-rooms, &c., &c.); and any casual customers find forms ready at the company's offices upon counters of a height suited for writing, when standing, and subdivided into spaces, with fluted glass screens between each, to prevent any person seeing another's message.

The company's cashier quickly counts the words in the body of the message (the address not being included, but passing free), endorses the message and writes a receipt of the amount;

the customer is handed the *receipt*, upon the money being paid. Parties sending messages are advised to write them distinctly; and the cashier reads the message, in order to see that the writing is legible, before handing it through to the instrument room.

The cashier enters upon a list, opposite to the consecutive number of the message, the amount received; and, on being passed through to the instrument room, the lad receiving the message marks the number upon a similar list, and sends the message to the instrument for which it is intended. The clerk at the instrument then dispatches it to, or towards its destination, receiving an affirmative or negative signal after each word; if the latter, the word is repeated, not having been rightly understood by the receiving clerk at the distant station. So commencing the message, the *sending* clerk signals the number of words the message contains (previously inscribed on the paper by the cashier), and, as soon as completed, the *receiving* clerk's writer counts the number of words received, to see that the message is correct as to length; and, as will have been seen, the "understand" or "not understand" signals after each word, check the words themselves—admitting, when the system is carefully carried out, of little possibility of mistake.

In the foregoing I have embodied the routine observed in our *chief* stations. In small stations, where there is no great influx of messages, the checking is not carried out to such an extent.

As soon as the message has been sent, it is returned to the checking lad, who files it, and draws his pen through its consecutive number, to intimate that, as far as the due forwarding is concerned, the company have performed their duty, and it is his business to see that the signal clerk has endorsed upon the document the time at which he sent it, the station to which he signalled it, and his initials. By such an arrangement all chance of a message being mislaid is avoided; as, if the communication is not returned in a quarter of an hour, to have its number marked off the list, it is the duty of the checking clerk to enquire after it, and to ascertain why it has not been dispatched.

Very little time is lost in such an arrangement, and the chance of error of any nature greatly diminished.

CELERITY OF TELEGRAPHING.—Messages are forwarded upon a pair of wires by needle telegraph, at an average rate of 27½ words, of five letters each, per minute; and the more expert operators can pass 35 words in a minute; or as fast as the writer can possibly take them down.

The time occupied in forwarding messages, on an average of a thousand between Liverpool and London, averages 4½ to 5 minutes each (including any occasional delays that arise) counting from the time when handed to the company, by the customer, to the completion of their reception in the London office.

I cannot give any average for delivery, as that depends entirely upon the distance from the office to the address. Messengers are always in waiting, and one is immediately sent off with the communication in a sealed envelope upon arrival.

The order of precedence is determined by priority of handing the message ready written over the company's counter to the cashier.

Instances, well authenticated by the customers themselves, have occurred where the whole process from the handing of a message to the company, to its delivery to the party to whom addressed, has been accomplished in a minute and a half.

But this can only happen when the receiver's office is close at hand, and an instrument entirely disengaged at the moment the message was handed to the company.

Answer 51*st.*—Official Blanks for Messages Required to be used by the Public.—No. If messages are brought in to our offices on plain paper, the person bringing such is requested to copy the communication upon the printed forms provided. Otherwise the message would be refused by the company; though this is a contingency that does not arise, owing to the requirement being made without exception by each company.

If the customer cannot write, one of the company's clerks copies the message, reads it to the customer, keeps the original, and obtains the signature or mark of the person, at the foot of the company's paper. The message is then sent, the company being freed from onus.

Answer 52*d.*—Printed forms have been used from the establishment of the telegraph.

It has been found requisite for many reasons. In the first place, the difference of cost between plain and printed paper is of small consideration, as compared with the necessity that would devolve upon the company, to explain to customers the mode of arranging a message upon paper, to customers.

The defined position of the address from and to, and of the body of the message, materially aids the instrument clerk in forwarding the communication.

Moreover, for the security of the company as a trading concern, we consider it necessary to embody certain conditions and stipulations upon which alone we receive messages.

We also caution customers against indistinct writing, and

disclaim all responsibility for the same, and require, finally, the *signature* of the customer in authentication of his message, and as *subscribing to the company's conditions.*

INSURANCE FOR CORRECTNESS OF MESSAGES.—In the stipulations subscribed to, we mention, that in order to ensure accuracy, it is necessary that communications should be repeated from the station to which sent; and that an extra charge of half a rate is made for such repetition, the company holding themselves responsible to the extent of £5 upon such repeated messages. Further, another clause provides for the insurance of valuable messages to any amount upon payment of one per cent. upon the amount insured.

This latter regulation is *never acted upon;* and that of repetition seldom. No error has occurred in repeated messages.

When parties, as is frequently the case, hand us messages in French, German, Italian, or other foreign languages, we take them at the risk of the sender as to accurate transmission of the words.

Code signals for various descriptions of messages, and cyphers for short words of frequent occurrence, such as "the," "from," "and," "to," "in," "on," "you," "yes," &c., and for terminations, such as "tion," "ing," "ment," are much used by the staff to facilitate transmission.

The company's customers (especially the stock and other brokers and banks) use cypher to a great extent, one message out of four, on an average, being so written, the regulation being, that code words shall not exceed two syllables in length in order to prevent an abuse of the system by the introduction of words of a nature or length likely to delay the company's operators.

Of course the correspondents arrange their codes between themselves, each having a key, so that on arrival of the message at either end, it is translated.

Answer 57th.—WHEN COPIES OF MESSAGES ARE GIVEN.—We are very seldom called upon to furnish copies of messages. The company in all instances refuses to do so, unless upon the application of the person to whom the message is addressed; and in all cases requires a satisfactory reason.

MESSAGES RECEIVED AS EVIDENCE IN COURT.—We produce messages in courts of law upon an order of the sitting judge or magistrate; they are received as evidence in a court of law when recorded upon oath from the company's servants, connected with the reception of any communication so referred to.

FILING OF DUPLICATES OF MESSAGES.—We keep a duplicate of each message, (taken by means of carbon paper, in manifold,) each duplicate being numbered and put by with the others at the end of each day—the parcels being deposited in hampers sealed, and in a cupboard under lock and key. At the end of two years the messages are damped and mashed, until all trace of writing is lost.

Answer 58*th*—COST OF STATIONERY.—Our forms were much larger, and on a finer description of paper than at present used. But after a conversation with Mr. Shaffner, I have thought it best to change the size of the forms, and also the paper used; obtaining the present stationery at a geatly reduced rate.

Cost of Forms as under:—

Forms on which messages are written by customers, printed on both sides, with particulars, regulations, &c.	Five shillings and three pence per thousand, or $1 26.
Received message forms upon which communications are written for delivery,	Same price as above.
Envelopes, printed with the words "Immediate," "By Magnetic Telegraph," and adhesive,	Five shillings per thousand, or $1 20.

Answer 59*th*.—Cannot give average—so much variation as to size, locality, &c.

Answer 60*th*—TIME OF CLERK LABOR.—Duty of clerks and messengers averages nine hours during day, and eight hours when on evening or night duty at the principal stations.

The older clerks take night duty in rotation. The younger clerks are always kept to day or evening work.

Answer 61*st*.—No.

Answer 62*d*—RESPONSIBILITY FOR ERRORS IN LAW.—We have never lost damages in any court—the question of responsibility has been occasionally tried. The most recent case is one in which the British Telegraph Company were implicated—the plaintiff being beaten.

I subjoin a copy of a press report from the Glasgow Chronicle, dated June 28th, 1854, of a suit instituted by Messrs. Dick and Martin, shawl manufacturers, Paisley, against the British Telegraph Company. Subjoined verbatim:—

"A manufacturing firm in Paisley, having lately sent a message by telegragh to their London agent, 'return all printed squares above five shillings,' and the message having been delivered with the word 'scarfs' substituted for 'squares,' which led to two days delay in the squares arriving in Paisley, the

manufacturers brought a small debt action against the telegraph company, and their agent, Mr. William M'Intyre, jr., for £12 damages, as loss sustained by them in consequence.

"The defendant denied liability, pleading the message order as a special contract, which contained a condition, declaring that they would not be liable for mistakes. The sheriff took the case to avisandum for a week, and on Thursday last pronounced his decision, sustaining the defence."

The Chronicle remarks, that the decision must be regarded as of great importance, considering the continual risk of small mistakes occurring in the transmission of messages over long distances with several "repeats," and the ruinous amount of damages in which telegraph companies if liable might be involved. The agent for pursuers in this case was Mr. John Guy—for defendants, Mr. Thomas Campbell.

In this instance, the message had to travel over several companies' lines. The British company's wire not extending beyond Manchester.

Legal advisers, as a rule, do not like bringing forward such cases in the face of the conditions subscribed to by their clients upon the company's paper.

I consider that a claim cannot be well established except in a case of a repeated or insured message, as a claimant would be met with "Why did you not insure, if your message was of such consequence? Seeing that the company has a special provision for such cases! And in the case of any mistake or non-delivery of an insured message, the company would be willing to pay, upon proof, without going to law.

Answer 63*d*.—Free Messages.—No free messages, except those purely on the business of the company, and sent by the officers of the company, are allowed.

When directors or shareholders wish to send messages, they pay the ordinary tariff like any other customer, handing the message in over the counter in the usual form.

Answer 64*th*.—Tariff for Press News.—Our rates to the press are far less than to the public. There are two district systems in operation as regards the transmission of intelligence for the news rooms and papers. Either they can supply themselves from their own agents, or contract for a supply from the company. In the former case, an universal tariff of sixpence per line of nine words is charged, whether between London and Liverpool, London and Glasgow, or London and Cork, &c., and by this system, of course, *special* news can be forwarded.

In the latter, the company having established agents and re

porters in the various towns with which we communicate, the press are furnished daily with a column and a half to two columns of the latest political, foreign, commercial, and market news, in return for a payment amounting on the average to a little over a farthing a line. But of course in this case the news forwarded is perhaps distributed in duplicate among the three or four news rooms and dozen papers of the town.

Answer 65*th*—REGULARITY OF BUSINESS.—This company, since the commencement of *working*, in February, 1852, lost four messages. In each case the amount paid was returned; none were insured. In one case, an action was brought but could not be sustained.

Answer 66*th.*—If, under any circumstances, a message is not sent in half an hour after being handed to the company, the superintendants are instructed to send word to the customers, giving the reason why the message has been delayed; it is then at the option of the party to withdraw his message and receive back the amount paid; or to allow the company further time to transmit it.

Answer 67*th.*—As previously mentioned, government communications take precedence.

Private (paid) messages come next in order, constituting the bulk of the company's business. Next to these rank news messages, whether forwarded by the agents of the company or of the press. In any great emergency, however, where a prompt order is necessary, a business message (usually *last* in order of precedence) is sent by an officer of the company before anything else, with a peculiar code or cypher prefixed to denote the extreme urgency of the message; and if any communication should be sent with such prefix without necessity, the officer sending it would be subjected to dismissal.

I may mention that the company's news messages are usually passed at hours in the day when the commercial business is slack.

Answer 68*th*—PRE-PAYMENT REQUIRED ON MESSAGES.—Pre-payment is required upon all messages forwarded by the public; but good customers—sending many messages in the course of a day—are not usually called upon to pay at the time of sending each message; but an account is made up in the afternoon and sent round by a clerk, whose duty it is to collect in money for the cashier.

In cases of great exigency or emergency, persons are sometimes allowed to send messages "to be paid for by the receiver;" and *answers* are frequently pre-paid by those sending the messages requiring answers.

Answer 69*th*.—No. Answered in 63.

Answer 70*th*—OPERATING DEPARTMENT.—Three clerks to every two instruments, *i. e.*, an instrument while *sending* requires *one* clerk; and when *receiving*, two, one to read off, and the other to write down from dictation.

Answer 71*st*.—The apparatus belonging to, and used by, this company, is the magnetic telegraph, (the practical application of magneto-electricity to telegraphic apparatus,) and of course consists in principle of a needle telegraph, worked by the inductive influence exercised by magnets upon electro-magnetic coils, when placed in propinquity to the poles of the permanent magnets.

The electro-magnetic coils are so arranged that their cores of soft iron serve as a keeper (in facto) to the permanent magnet.

Professor Faraday is accounted the discoverer of the *principle*; and after many unsuccessful attempts to apply it to practical purposes, Steinheil, of Munich, (I believe,) was able to construct a magneto-electric machine to work between Munich and Bogenhausen.

Subsequently Professor Wheatstone endeavored to apply it, but failed, except as far as relates to ringing bells by an apparatus familiarly known as a "thunder-pump," from the pumping action of the machine, which consisted of a lever-handle, at the end of which two large electro-magnetic coils were fixed,—the axis allowing the coils to be attracted against a magnet; this apparatus engendered a strong current of electricity for ringing bells, but no indicating apparatus was contrived.

Mr. Henley afterwards managed by arranging a magnet-needle between a pair of horns of soft iron, projecting from the poles of a pair of small electro-magnetic coils—to obtain with the motion of the lever a backward and forward movement of the needles.

Since that time, various improvements have been introduced by my brother Charles and myself. The apparatus is found to answer every purpose as far as speed, certainty, invariability of action, and small cost of maintenance is concerned. The improved apparatus is moreover the only telegraph that I am acquainted with that works satisfactorily in connection with underground wires, as in its present form it is not at all affected by the induced currents that affect other apparatus. Cost varies, from £15 for small, to £36 for large.

Answer 72*d*.—Mistakes are of very unfrequent occurrence with us—averaging about 1 in 2,400 messages sent by this company,

and two out of three are occasioned by the indistinct writing of customers. Others are caused by the similarity of sound between certain words, such as "hour," "our"—"one," done," &c. The immediate movement of our needles and their *dead-beat*, (*i. e.*, the absence of all vibration and oscillation,) greatly tend to prevent mistakes. In the ordinary galvanic telegraphs of Cooke, Highton, and others, the needle sways to and fro after each beat, occasioning confusion between letters, which are formed by combinations of "*beats*." We also employ clerks in charge to check over all messages received or transmitted, to see that the context is correctly rendered, and the words rightly spelt.

Answer 73*d.*—At first we repeated all paid messages, but I found it led to more frequent error, as the clerks relied so much upon the repetition to correct any error, that they signalled in the first instance carelessly; and in any pressure of business the repetition being made still more hastily, they more frequently committed blunders.

I do not quite understand the latter part of the question, but suppose that answers 56–7; 66–7–8–9, will also apply to this.

Answer 74*th.*—As mentioned in answer 50, each word, on being forwarded through the instrument, is succeeded by an affirmative or negative signal from the receiving station. If the former, the word next in order is sent; if the latter, the word just sent is repeated.

Answer 75*th.*—The plan of insurance has been prescribed by this company for two years and a half, but, as mentioned in "52," the principle has not been adopted by customers.

Answer 76*th.*—If called upon to insure, the company would refuse to take such responsibility beyond their own lines, having no mutual arrangement with other companies on the subject. And in any case, it would be highly dangerous for one company to undertake responsibility for the working of another company; especially if the slightest ill-feeling existed on the part of either, as one might take advantage of such a system of insurance to ruin the other.

Answer 83*d*—PRESERVATION OF WIRE CABLES.—In reference to this question, I may observe, that tar is found to act as a great preservative in connection with iron, when immersed in salt water; hence, in making a cable, it is advisable to saturate the hemp surrounding the conducting wires with Stockholm tar, prior to laying on the outer casing of protecting wires. With a cable so constructed, it is advisable to select as *sandy* a bottom

as possible; for the cable we laid between Donaghadee and Portpatrick, made on this plan, is found to have surrounded itself, when passing through sand, with a hard concrete, impervious to moisture, composed of sand and the tar that had oozed from the cable. There is an objection to galvanized wire, owing to its brittleness, interfering with the process of manufacture, and with the laying, by continual snapping; the galvanizing appears to make the wire in parts assume the crystalline condition in lieu of the fibrous.

Answer 91*st*—CABLES NOT LIABLE TO INJURY BY LIGHTNING.—A submarine cable, in connection with the underground system, is not, I apprehend, liable to injury from lightning, as such a cable would offer no more inducement, but at the same time far greater resistance to the exit of electricity through the insulating medium, from its wires, than the underground wires would evince. In the first place, the gutta percha coating of the submarine wires is considerably thicker than that around the land wires, and besides this, each wire in the cable is surrounded in addition by a thick non-conducting layer of closely packed tarred yarn.

The electricity, if ever it managed to get into the underground wires in any dangerous quantity, would naturally seek an equalization by the easiest path, and would make its way through the insulating coating of the subterranean wires to the moisture surrounding them, in preference to the cable.

It would, however, be extremely difficult for the electricity to pass into the wires, which are never brought above ground, save in the offices, when in connection with an instrument; and lightning would be opposed on entry by the thin coil-wire of the apparatus.

If submarine cables are used in connection with *overground* wires, it would be advisable to use every means of arresting, or rendering nugatory, a discharge of atmospheric electricity.

I should think several short coils of thin wire, consecutively interposed in the circuit on either side, would produce the required effect, especially when placed in an *earth* box; for any electricity that could pass without facing the coils and escaping to earth in transitu, would be comparatively harmless in the cable.

As it may be of some interest, I subjoin an extract from the London Times, May 26, 1853, relating to the submersion of our submarine cable between Donaghadee and Portpatrick.

"THE SUBMARINE TELEGRAPH BETWEEN GREAT BRITAIN AND IRELAND.

"This important line of communication has at length been successfully effected (as briefly announced in the Times yesterday), by a submarine cable, manufactured by the well-known masters, Messrs. Newell & Co.,

of Gateshead, and laid down, on Monday, between Donaghadee and Portpatrick.

"The cable consists of six communicating wires insulated in gutta percha, and protected, in the usual manner, by an outer covering of iron wire.

"It could not be laid, as was intended, during the previous week, owing to the gales from the east preventing the opening of the dock gates at Sunderland to let the vessel containing it pass out. As several previous attempts to lay a submarine telegraph across the Irish Channel had failed, every care was taken to ensure the successful termination of the present attempt; and the expedition, consisting of the screw steamer William Hull, (with the cable and apparatus on board) the Conqueror and the Wizard, left the Irish coast, having landed the end of the cable at a point about two miles to the south of Donaghadee harbor, and commenced the submersion of the cable, under the guidance of Captain Hawes, R. N., specially appointed by the Admiralty, who rendered great assistance in determining and directing the exact course to be pursued, without which, in all probability, the squadron could not have successfully overcome the swift tides and adverse currents prevalent throughout that part of the Channel.

"The party who accompanied the laying of the cable included Messrs. Newel, Mr. Statham, of the Gutta Percha Works, Mr. Bright, the Secretary, Mr. Charles Bright, the Engineer of the English and Irish Magnetic Telegraph Company, Mr. Reid, the well-known telegraph engineer, and Mr. Mosely. The cable was landed on Wednesday morning in a sandy bay (called Mora Bay), a little to the north of Portpatrick, which belongs to Mr. Blair, of Dunskey, who kindly accorded permission for the laying of the land wires through his estate; and as soon as the end had been taken up to the position assigned, the magnetic instruments were put in operation, and the following message was despatched:—

"'Mora Bay, Portpatrick, Monday, May 23.

"'The Directors of the English and Irish Magnetic Telegraph Company beg to acquaint His Excellency the Lord Lieutenant, that they have, this morning, successfully effected communication between the shores of Great Britain and Ireland, by means of a submarine cable from Portpatrick to Donaghadee.'

"The cable at each side was then buried in the trenches prepared for its reception, and instruments connected to serve as a means of communication for a short time, until the subterranean line of six wires, now being carried from the Company's station at Carlisle, through Dumfries, to meet the cable at Portpatrick, is completed to that spot; and an underground line is about to be extended from the Irish end of the cable at Donaghadee to Newtonards, the terminal station of the County Down Railway, along which the wires of the English and Irish Magnetic Telegraph Company are nearly completed to Belfast. At Belfast, the wires meet the Company's line of telegraph already completed over the Ulster Railway, and will be carried *via* the Belfast Junction and Dublin and Drogheda Railways, into the Company's offices, on College Green, Dublin, where their line from Galway (already working) and their Southern lineof telegraph, now in forward course of construction from Cork, will concentrate.

"The lines of the English and Irish Magnetic Telegraph Company, now working between Liverpool, Manchester, Blackburn, Bolton and Preston, and between Carlisle, Glasgow, Greenock and Edinburgh; and those now in forward progress between London and Manchester (consisting of ten

subterranean wires), and between Preston and Carlisle, will join on at Carlisle; and the three capitals and chief towns of England, Scotland and Ireland will be thus brought into instantaneous communication with one another."

Answer 94th—ELECTRIC CIRCUITS FOR SUCCESSFUL WORKING.—I observe, in my brother's answer to this question, that he has merely referred to our existing arrangements with regard to circuits, and I would therefore add a few remarks.

It has been found in England that none but large towns yield any profit upon the working expenses of a telegraph; we therefore determined, in the outset, not to extend our wires to any points where a profit could not be obtained; hence our station list is small, and does not require more than five or six, or, at the utmost, eight stations in a circuit.

It is not, I consider, advisable to have too many stations in a circuit, continual interruption arising, combined with difficulty in obtaining that prompt attention to calls requisite.

Moreover, from the many connections, a circuit with a number of stations at all approaching that mentioned, would be much more likely to get out of order, from its integrity being disturbed.

In addition to this, an operator, in case the wires were occupied when he wished to forward a message, could not tell how long he might have to wait before the other stations would be sufficiently disengaged to allow him time to obtain the attention of the station he required, and to send his message; and the *calls* become very complicated when more than eight stations are in a circuit.

Many towns in this country have no demand for speedy communication by telegraph, although the charge for messages is low—about a shilling for twenty words (address not being counted, and porterage within a mile of station free) per hundred miles. This want of a demand is chiefly due to the facilities afforded by the postal arrangements, which are speedy and excellent, and partly to the steadiness of business and non-existence in many towns of any speculative trade.

We possess arrangements of a simple nature, ready for use whenever needed by the company, by which, even with a badly insulated line, any number of stations can be linked together, in immediate correspondence to and fro with one another, whether on the main line or branches.

Answer 98th—GOVERNMENTAL LINES IN ENGLAND.—The use of the telegraph in connection with the government and the police might be much more *systematized*, but at present great

desultory use is made of the various telegraphs in this country by government, relating to the army, navy, and commissariat. In the southern districts government has had several lines constructed between the head-quarters of government and the chief naval depôts and arsenals, and have their wires worked by their own staff.

ARREST OF FUGITIVES FROM JUSTICE.—In many instances we have aided the police in arresting fugitives from justice. Sometimes telegraphing the exact dress, height, and personal appearance, with any special marks for identification of the party sought after.

In each case the company is merely the *carriers* of orders and instructions between the police of one city and another.

In the shipment of troops to the East, and prior to the departure of the naval squadrons, government made continual use of our wires, orders, countermands and directions following one another.

Answer 99*th*—BANKING BY TELEGRAPH.—The banks generally pass though certain codes known only to themselves and their correspondents—varying with each day. Such code-signals precede the *body* of the message. By this check on frauds, banks daily transact a large amount of business—chiefly relating to returning bills or stopping local notes. Sometimes remittances of twenty and even thirty thousand pounds ($140,000) are made by means of advice by telegraph from one bank to another. They frequently also inquire as to respectability of parties—managers holding applicants in conversation till the answer arrives.

MESSAGES RECEIVED AS EVIDENCE IN COURT.—Messages are received as evidence in court. The signature of the party sending the message being sworn to, and also that of the party receiving, (entered on the messenger's ticket.)

There is no law compelling evidence on the part of a telegraph company; but in all cases where necessary, that I am aware of, evidence has been given freely.

THE MERMAID'S LAST NEW SONG.

ON THE SUBMARINE TELEGRAPH, CONNECTING ENGLAND AND FRANCE.

BY DOUGLASS JERROLD.

THE mariners brave tidings bring
That they through Dover's Strait who steer,
If, of an understanding ear,
Thus ofttimes hear the mermaid sing,
When the blue deep is calm and clear:

A wonder have I seen below,
A marvel new and strange to me,
Who dwell beneath the rolling sea,
Amid the wrecks sunk long ago;
The wealth of Ocean's treasury.

There runneth an enchanted wire
O'er the sea-bed, from shore to shore,
Of nations that were foes of yore;
The conduit of a magic fire,
Lightning beneath the water's roar.

The skulls of ancient enemies
Around it lying, grimly frown;
There, where the slain of old went down,
Through wars of hoary centuries,
In many an action of renown.

The flash, amid those forms of death,
Flits quick as thought from land to land;
No hostile bolt, no deadly brand,
Nay: but a soft electric breath,
Warm like the grasp of friendly hand.

A kindly spirit guides its aim,
Benignant science bids it fly,
Conveying question and reply;
There's language in that social flame,
And France and England talk thereby.

'Mid antique arms, old gun, and sword,
Which insects of the sea o'erlay,
Of those long fall'n in savage fray,
The bony fingers with the chord,
That links the nations, gently play.

And sea-sprites, as they sport along
That nerve of wire, by human skill
Between two peoples made to thrill,
Sing joyously the Mermaid's Song,
To England, peace!—to France, goodwill!

ART. II.—BUSINESS FORMS IN THE ENGLISH TELEGRAPHS.

We annex a series of blank forms used by the respective telegraph companies in Great Britain. They are herein presented in their adopted form, and about the same size, as those in use by the lines in England. We also give the blank receipts and account forms. We give a brief explanation of the forms respectively.

On pages 224–5, Document A, will be found a blank form, which is used by the public in the presentation of a message, to be transmitted by the telegraph company. The two pages represent the face of the blank form in which the message is written, and the heading is to be filled by the company's clerk. The patron signs the message. Document B, page 226, is printed on the back of the sheet on which the message is written, represented by Document A, on pages 224–5.

Document C, pages 228–9, is the form used by another company. Documents D, on page 227 and E, page 230, are forms printed on the back of the sheet, marked Document C, pages 228–9. These forms present the tariff of insurance and assumed responsibility. Pages 228–9, are on one side of the sheet, and pages 227—230, are on the other side of the official form. Document F, page 231, is the head or caption of a message as sent to the public. The face of the sheet is about the size of the usual letter paper, only half of the blank being represented by Document F, page 231.

Document I, page 232, is a blank used by the companies for messages received from a distant office, and which is to be transmitted further by another line. The size of this blank is the same as Documents A and C, only half of the sheet being represented. The forms at the bottom of the page are to be filled, and then sent to the next line. In order to prevent confusion, the blanks are printed in different coloured inks.

Document G, page 233, is the form of an account sent out with the messenger, accompanying a message for collection.

Document H, page 234, is the form of a receipt given the customer on the reception of his message for transmission at the counter of the company by the cashier.

Doc. A.

ENGLISH AND IRISH MAGNETIC TELEGRAPH COMPANY.

LIVERPOOL STATION, 2 EXCHANGE BUILDINGS.

No.................. Date..1854.

Received.......................... } Code.............................. No. of Words } ....

Sent.............................. }

Message, " "

Porterage, " "

Paid out, " "

Total " "

To Station. } ....By me..Clerk.

Please to send the following Messages according to the conditions printed hereon.

From | *To*

....

....

....

....

....

The Company will in every case guard as much as possible against mistakes, but cannot hold themselves responsible for any that may occur.

Signed ....

PLEASE TO WRITE DISTINCTLY.

Doc. B.

THE ENGLISH AND IRISH MAGNETIC TELEGRAPH COMPANY.

CONDITIONS AS TO UNINSURED MESSAGES.

The Public are informed that, in order to provide against mistakes in the transmission of MESSAGES by the MAGNETIC TELEGRAPH, every Message of consequence ought to be REPEATED by being sent back from the Station at which it is to be received, to the Station from which it is originally sent. Half the usual price for transmission will be charged for repeating the Message. The Company will not be responsible for mistakes in the transmission of unrepeated Messages, from whatever cause they may arise. Nor will the Company be responsible for mistakes in the transmission of a repeated Message, nor for delay in the transmission or delivery, nor for non-transmission or non-delivery of any Message, whether repeated or unrepeated, to any extent above £5, unless it be insured at the rate of £1 per cent.

Doc. D.

THE ELECTRIC TELEGRAPH COMPANY.

CONDITIONS AS TO UNINSURED MESSAGES.

The Public are informed that, in order to provide against mistakes in the transmission of MESSAGES by the ELECTRIC TELEGRAPH, every Message of consequence ought to be REPEATED by being sent back from the Station at which it is to be received, to the Station from which it is originally sent. Half the usual price for transmission will be charged for repeating the Message. The Company will not be responsible for Mistakes in the transmission of unrepeated Messages, from whatever cause they may arise. Nor will the Company be responsible for Mistakes in the transmission of a repeated Message, nor for delay in the transmission or delivery, nor for non-transmission or non-delivery of any Message, whether repeated or unrepeated, to any extent above £5, unless it be insured.

Correctness in the transmission of Messages can be Insured at the following rates in addition to the usual charge for repetition :—

	£ s. d.		£ s. d.		£ s. d.
For any Sum up to £100	1 0 0	Above £400 to £500	5 0 0	Above £700 to £ 800	8 0 0
Above £100 to £200	2 0 0	£500 to £600	6 0 0	£800 to £ 900	9 0 0
£200 to £300	3 0 0	£600 to £700	7 0 0	£900 to £1000	10 0 0
£300 to £400	4 0 0				

and 20*s*. for every £100, or fraction of £100 above that sum; and the Company will not be responsible for any amount beyond the sum for which the Message is insured and the rates paid.—The Company will not be responsible in any case for delays arising from interruptions in the working of their Telegraphs.

J. L. RICARDO, *Chairman*.

Doc. C.

THE ELECTRIC TELEGRAPH COMPANY. STATION.

Prefix........................ Code Time........................ No........................

Received........................m } Date........................185

Finished........................m } Sent to........................*Station.*

by me........................*Clerk.*

Message........	"	"
Repeating.......	"	"
Reply...........	"	"
Porterage	"	"
To be paid out ..	"	"
Total......	"	"

(All numbers must be written at length in words.)

PLEASE TO SEND THE FOLLOWING UNINSURED MESSAGE ACCORDING TO THE CONDITIONS ENDORSED HEREON.

FROM

Name and Address of the Sender of the Message. ....

TO

Name and full Address of the Person to whom the Message is to be delivered. ....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

Before Signing, please to see that the amount to be charged for the message is correctly entered above, & on the receipt, and read the endorsed Conditions.

Signature and Address of Sender. ....

....

The Company will not be answerable for Errors caused by indistinct writing.

Doc. E.

NOTICE.—Messages to be sent to any places beyond the extent of the Company's Lines or Stations, will be delivered by the Company's officers at their terminal Station mentioned in the subjoined request, to such parties as may have charge of the further means of conveyance; but it is expressly provided that the Company are in no case to be held responsible for the transmission or delivery of the Message beyond the terminal Station in such request mentioned.

(*REQUEST.*)

I request that this Message may be forwarded from the Company's Office at ....

(being the Terminal Station of the Company) by ....

to the address mentioned therein, subject to the above conditions, and have deposited ....

to be applied for that purpose.

Signed ....

Doc. F.

ENGLISH AND IRISH MAGNETIC TELEGRAPH COMPANY.

Code }
Time } ....

LIVERPOOL STATION,

2 EXCHANGE BUILDINGS.

No. of }
Words } ....

Received the following Message } At .... h .... m the .... day of .... 1854.

Signed .... Clerk.

From	*To*
Name	*Name* ....
Address	*Address* ....

☞ No inquiry respecting this Message can be attended to without the production of this paper.

Doc. I.

ENGLISH AND IRISH MAGNETIC TELEGRAPH COMPANY.

From..............................*Station.*	*Code Time*..............................	..............................*Station.*
To..............................*Station.*	*No. of Words*..............................	..............................1854.

FROM	TO
....	....
....	....

[The Form contains full space between these lines for a Message of fifty or more words in length. We omit the space.]

RECEIVED.	SENT.
Com :......*h*......*m*. *Fin* :......*h*......*m*. | *Sd*..............................	*Com* :......*h*......*m*. *Fin* :......*h*......*m*. } *Sd*..............................

Doc. G.

THE ENGLISH AND IRISH MAGNETIC TELEGRAPH COMPANY. **No.**

....1854.

Messenger's Name..

For..

	H.	M.	
Sent out....	....	....	............M.
Received at	....	....	............M.
Returned at	....	....	............M.

Signature of Receiver..

Charges to Pay..

Clerk's Initials..

N. B.—You are requested to give no fee or gratuity to the Messenger, and pay no charges beyond those entered in this sheet.

Doc. H.

ENGLISH AND IRISH MAGNETIC TELEGRAPH COMPANY.

LIVERPOOL STATION. Date .... 1854.

No. .... Time received, ... No. of Words } ....

From ....

....

....

To ....

....

....

Message	"	"
Porterage	"	"
Paid out	"	"
Total	"	"

Signed .... *Clerk.*

ART. III.—COMPARATIVE CONDUCTIBILITY OF WIRE.

EXPERIMENTS ON THE CONDUCTIBILITY OF WIRE—IMPORTANT DISCOVERY IN TELEGRAPHY—GUTTA PERCHA WORKS IN THE WORLD—STATHAM'S FACTORY.

WE give below some experiments made by Mr. Statham, proprietor of the London Gutta Percha Works. There are four gutta percha manufactories now in existence:—one in London, one in Berlin, one in St. Petersburgh, and one in New-York; and of the four, the London works are far superior in every respect. Mr. Statham, who has labored so faithfully for many years in the production of the best means or mode of using gutta percha for electric telegraph purposes, has won for himself the admiration of the entire telegraphic community.

He has labored faithfully to devise the useful implements and auxiliaries required in the telegraphic art, and his success has been perfect. No one has done more for the art than Mr. S., and as a member of the profession, we feel grateful to him for the production of so much in the advancement of the telegraph enterprise. The London Gutta Percha Works manufacture gutta percha wares of all kinds, and his mode of insulating telegraphic wire is complete. Any company requiring wire for submarine, subterranean, or for office purposes, can safely depend upon Mr. Statham in forwarding the best article desired at an honest cost. He understands the subject much better than we who are more actively engaged in telegraphing; he has had facilities and experience superior to those which we have enjoyed, and his energies have impelled him to the consummation of the most useful andpractical developments. We then, in view of these facts, recommend to all telegraph people, throughout the world, to procure gutta percha insulated wire from Mr. Statham. Inform him of the purposes of your wire, and he can best judge of the quality you need. What we here say, is wholly unsolicited by any one, and is the free and voluntary utterance of an opinion, produced by evidences enforcing conviction.

We refer to the following schedule, viz.,

EXPERIMENTS—*Showing relative resistance of No.* 18 *and No.* 16 *copper wire, insulated by double covering of gutta percha, and submerged in the Regent's Canal.*

Gutta Percha Works, 27th May, 1854.

No. 18.—Guage copper wire, covered with gutta percha to guage No. 7.

No. 16.—Guage copper wire, covered with gutta percha to guage No. 4,

An ordinary single needle instrument was employed—connected to earth, as usual in practice.

100 miles.	No. 18.	No. 16.	
With 3 pair plates	29°	39°	deflection of needle
6 " do.	50°	59°	do.

The same instrument employed, but the needle slightly weighted.

Battery of 72 pairs plates.	No. 18.	No. 16.
100 miles	23°	30°
90 "	25°	
80 "	26½°	
70 "	28½°	
65 "	30°	

Battery of 144 pairs plates.	No. 18.	No. 16.
100 miles	35°	41°
90 "	37°	
80 "	38½°	
70 "	40°	
65 "	41°	

Battery of plates.	No. 18.	No. 16.
100 miles, 72 pr. plates	23°	30°
100 " 84	26°	
100 " 96	28½°	
100 " 102	30°	

ART. IV.—FRENCH NOTICES OF MORSE'S TELEGRAPH IN 1838.

PROOF OF THE EARLY INVENTION OF MORSE'S TELEGRAPH—NOTICES OF MORSE'S INVENTION BY THE PARIS PRESS—THE TELEGRAPH CONSIDERED BY THE ACADEMY.

In looking over the files of French papers, at the date of the presentation of *Morse's Telegraph* to the Academy of Sciences in Paris, September, 1888, we collected a few of the numerous notices of it, from which our readers can judge for themselves whether the Electro-Magnetic Telegraph was then considered an invention *well known*, or something *entirely new*.

From the Constitutionnel, Sept. 13, 1838.

"A foreign philosopher, M. Morse, of New-York, (who unhappily does not speak the French language, for we requested of him some explanations of his beautiful invention,) exhibited an *Electric Telegraph*. This instrument attracted the notice,

and excited the curiosity of the whole Academy. M. Arago explained its mechanism, but in a manner too brief to enable us sufficiently to comprehend it.

Before speaking of it, we would see this telegraph in operation. We await elsewhere the future explanations which M. Arago has promised."

From the Courrier Francais, Sept. 13, 1838.

ACADEMY OF SCIENCES—SESSION OF 10th SEPTEMBER.

"Even before the opening of the session, an intricate apparatus, placed upon the table of the Academy, attracted all eyes. There was there seen a large magnet surrounded with electric conductors, some cylinders of brass, upon which paper was rolled up, and above all a cord, much intertwined, of galvanometer wire. It is the electric telegraph, established for sometime in the United States by Professor Morse, and which its author comes to submit for the approval of the Academy, and of France. Notwithstanding the exterior complication of this instrument, the general plan of it is very simple. A magnet, furnished with wires wound in a helix, which greatly increases its power; a wire conductor of indefinite length, which receives and transmits the current; some points of a pencil furnished with ink, which inscribes the dispatch in conventional black marks, and in which change of place forms an alphabet; such are the principles which lie at the basis of the electric telegraph. It appears that the system of Professor Morse unites the qualities of economy and certainty. It further offers this advantage, that it is not absolutelynecessary to have the persons employed permanently present at the place where the news is received, since the despatch inscribes itself. The strongest argument which presents itself in favour of this invention of Professor Morse, is that it has already operated with complete success in the United States, through ten miles of conductors, or about four leagues.

Although we have seen the apparatus of Professor Morse, as well as many plans of German electric telegraphs, we by no means undertake to give here a description which would be superfluous to those who have examined these machines, and necessarily unintelligible to those who have not had this opportunity. We learn elsewhere that soon will be seen in action, in Paris, one of these telegraphs, upon a line of some extent. But while waiting for the realization of these promises, and even before the possibility of establishing long lines has been well established, the question of priority is contested with some warmth between the two worlds.

It is by no means easy to take positive ground in this contest.

There has been given to us even the first suggestions of some philosophers on this subject, as if in experimental science ideal machines were of the least value. It has been said that Franklin, and our celebrated musical composer Berton, had had *the idea* very strongly of electric correspondence at great distances. It appears that in the year 1794, a German philosopher, Reiser, gave a plan of an electric telegraph, by means of the ordinary machine, a plan which had been realized in Spain about 1798, by a Doctor Salva.

It is easily conceived that the invention of the galvanic battery, which dates in 1800, has given a new aspect to all these attempts. But ten years passed away ere any one attempted to take advantage of the immortal discovery of Volta. It was not till 1811, that Soëmmerring proposed an electric telegraph based upon the voltaic current, by means of thirty-five conductors, insulated from each other, which were to represent all the letters and cyphers possible. Its complication, even the inextricable intricacy of this apparatus consigned it to the region of impossibilities.

Ten years later, that is to say, about the year 1820, our countryman, the philosopher Ampère, attempted to find an electric telegraph in the discoveries of Oersted, as Soëmmerring had attempted to find it in those of Volta. Ampère gave the plan in a few words, which has been much better carried out since his time, in proposing as many magnet needles as there are letters of the alphabet, put in action by conductors, which are made successively to communicate with the battery by the touches of a key, which is depressed at pleasure.

Ampère thus saw that his process furnished the means of overcoming all distances.

Therefore, after the historical researches of M. Amyot, it must be admitted that the ideas of all those who have occupied themselves in England, in Germany, and even in Russia, in constructing the electric telegraph, have rested on the process of M. Ampère. The instrument of Professor Morse, shown to us, comes evidently within this category.* But can one award the title of inventor to an idea, very happy, it is true, but which the

*This is a mistake. Ampère's suggestion was the use of the *magnetic needle*. and this indeed is the basis of all the English, German, and even Russian telegraph systems. Morse's suggestion is entirely original with him. It is the use of the electro-magnet; it is a new basis of an electric telegraph, first suggested by him, and which he has successfully carried out. He is indebted to Ampère for nothing except the fact that an *intensity current overcomes all distances*. This is the fact discovered by Ampère, but which had been erroneously given, until recently, to Professor Henry.—EDITOR.

illustrious Ampère has only casually thrown out in his first memoir upon electro-magnetism.

We see then that in truth there does not yet exist the inventor of the electric telegraph.

The inventor will be the first *constructor*, (constructeur,) who will operate the machine upon a line of considerable extent.

Under this aspect of the matter, the palm might perhaps be given to the Baron Schilling, an amateur philosopher, who constructed at St. Petersburgh, in 1832-33, an electric telegraph which operated in a very satisfactory manner, for a considerable distance, and under the eyes of the Emperor. Schilling died a little after his first attempts, and the Russian government had abandoned an object which for it, above all, is of the greatest importance. The importance of sure electric telegraphs is readily comprehended for an empire which extends in Europe from Finland to the Black Sea.

After these experiments a multitude of attempts were simultaneously made, at many points. During the labors of Professor Morse in the United States, Professor Wheatstone disposed a telegraph to wire with electric relays in the vast cellars of the University of London; and Professor Steinheil, of Munich, corresponded regularly from his house with the botanic garden, by means of a telegraph with a thousand ingenious details in its construction. It seems this last philosopher has followed out the suggestions of the celebrated geometrician, M. Gauss. In France, M. Amyot appears to have attempted a degree of simplicity still superior: a single current, a single needle, which writes of itself on paper the correspondence which gives at the other extremity a simple wheel upon which a person has written it by the aid of points differently spaced, as in the cylinder organ of Barbary; such are the bases of his process. In short, at Caen, M. Professor Masson has lately announced that he has established with success an electric telegraph, operating by means of magnetic needles at the two extremities, on a line of about 600 yards.

These brief remarks which the telegraph of Professor Morse have suggested to us, will suffice to show that the question of the electric telegraph occupies at this time the attention of eminent minds so largely, as to lead us to expect with confidence to see it resolved. As M. Arago has well remarked in describing the apparatus of Professor Morse, the great difficulty lies in the establishment and placing of the conducting wires. Suspension in the air appears nearly impossible, for this mode is liable to all sorts of attack from malevolence. On the other hand, interring them in the ground would seem to present a

greater inconvenience, which will arise in case they should become out of order among themselves, or broken in some part of the line. Nothing can point out the precise place where the evil exists. Would it be necessary to disinter the whole telegraphic line to repair a single point? Neither has one dreamt, at least in the apparatus where the wires are large and insulated, of the dangers which present themselves from the discharges of atmospheric electricity upon a line so extended. For example, from Paris to Bordeaux, one must admit, that many times in the year there is a storm more or less in the day upon the whole route, and can any one tell what effect will be produced at the termini, on the appearance of lightning at some of the intermediate points? This kind of despatch deserves serious consideration; at least it is a question as yet unresolved. But however this may be, the Academy appears to take a great interest in the system of Professor Morse. Unhappily, this philosopher does not possess our language sufficiently to describe himself his system, of which he expects such great results, and the introduction of which among us is at the same time a scientific and political event. The electric telegraph and its splendid promises, has diverted our attention from other subjects treated at this session," &c.

From the "National," September 13, 1838.

ACADEMY OF SCIENCES, SESSION OF 10th SEPTEMBER, 1838.—TELEGRAPHY.—ELECTRIC TELEGRAPHS.

"It is a long time since we have spoken of electric telegraphs. Still, until to-day, the different notes addressed to the Academy upon this subject, at the same time curious and important, have indifferently attracted the attention of the philosophers of France. But in the session of this day, M. Arago, in presenting a novel electric telegraph in the name of M. Morse of the United States, dwelt in a manner altogether peculiar on the mechanism of this new system, which was operated in presence of the public. It will be difficult for us to give a very clear idea of it without the aid of a diagram. But we can do no less than record here some details of it, as possessing much interest, since perhaps in half a century France and Europe will be furrowed (sillonnées) with these new lines, which are, for the transportation of thought, what the most rapid railroads are for the transportation of merchandize.

* * * * *

This system presents one question for solution. Will it be best to suspend the conducting wires inhe air, or to put them beneath the ground? In the air, we shall sooner see if they

are continuous, but at the same time, malevolence can cut them more easily. Beneath the ground, the advantages and disadvantages will be in an inverse ratio. The wires will be, it is true, protected from destruction, but when they shall have been broken, a great number of tubes must be broken open, before the place to be repaired can be found.

The apparatus of M. Morse is of the size of a small writing-desk; but it would have been not more than half the size, if the inventor had not wished to prevent the accidents by journeying, and the ravages of our amiable custom house officers."

From the "Journal des Debats," September 18, 1838.

ACADEMY OF SCIENCES.—SESSION OF 10*th* & 17*th* SEPTEMBER.

"The electric telegraph makes its way by degrees, and we do not despair very soon to see it take the place of the present machines with arms upon our buildings with as much advantage as steam has taken the place of the heavy horse-power of our factories. Professor Morse has submitted to the Academy a complete system of his invention, which has been in operation in the United States through a distance of many miles. The substantial difficulties which yet present themselves to the establishment of these admirable means of communication, as quick as lightning, cannot much longer resist the genius and skill of philosophers."

In an article published in the Journal des Debats of September 25, 1838, on the subject of lighting Paris, the author, M. Tournal, thus alludes to the exhibition of Professor Morse's telegraph to the Academy.

"Listen then; an example borrowed from some facts of another nature, will better illustrate my thought. Is it not true that when the invention of telegraphs, that marvellous invention which demonstrates to the most incredulous the possibility of a European union, men the most eminent believed in good faith that it was not possible in the nature of things to transmit thought with greater promptness, since in the most favorable circumstances, a half hour was sufficient to send a despatch from one end of France to the other, and a single signal could be sent from Paris to the Mediterranean in five minutes? Well, at this moment, numerous experiments, made with electric telegraphs, demonstrate irrevocably, that man can, by means of some copper plates and iron wire, send instantaneously a despatch over all parts of the European continent. These experiments have already been realized on a great scale at Munich and at New-York; and, can it be believed? an apparatus, very ingenious, adapted to one of the termini of the telegraph,

completely dispenses with the presence of the superintendent, the despatches imprint themselves upon a strip of paper which is wound on a cylindrical roller. All those persons who were present at the session of the Academy of Sciences on the 10th of September, will testify to the authenticity of this discovery."

We see by the above extracts, what was the state of knowledge, and what were the opinions of the scientific world, in regard to the telegraph generally, and Morse's system in particular, in the year 1838.

It was with them a visionary scheme unworthy of the attention of the scientific minds of the Academy, until Morse's system was exhibited to the Academy, and explained with peculiar force, and with approbation by the celebrated Arago. Doubts were still entertained, amidst sanguine hopes that the electric telegraph would soon be proved a practicable enterprize. How was it then in France some years later? Eight years had passed, and the doubts of its practicability were not dispelled, at least to the satisfaction of the legislative mind of France. We give the following from the Paris correspondent of the National Intelligencer, in the summer of 1846:

"Professor Morse had the goodness to send me an account of the recent achievements of the electrical telegraph, with a copy of the Baltimore Sun, containing the President's message in the Mexican war, as it was magically transmitted to that paper. I sent the communication to *Pouillet*, the Deputy, author of the report heretofore mentioned to you, and he placed them in the hands of ARAGO, who submitted their very interesting contents to the *Academy of Sciences* and the *Chamber of Deputies*. In the chamber, on the 18th instant, when the proposed appropriation for an electrical telegraph from this capital to the Belgian frontier came under consideration, BERRYER opposed it on the ground that the experiment of the new system was not complete; that it would be well to wait for the full trial of what was undertaken between Paris and Rouen.

"ARAGO answered. *The experiment is consummated.* In the United States *the matter is settled irresistibly.* I received, three days ago, the *Sun* of Baltimore, with a letter of MR. MORSE, one of the most honorable men of his country, and here is the President's message printed from the telegraph in two or three hours; the message would fill *four columns of the Moniteur;* it could not have been copied by the most rapid penman in a shorter time than it was transmitted. The galvanic fluid travels seventy thousand leagues per minute."

"THE APPROPRIATION, OF NEARLY HALF A MILLION OF FRANCS, WAS PASSED *with only a few dissenting voices. The bill has been reported to the Chamber of Peers*, with a circumstantial and able recommendation from the pen of GABRIEL DELESSERT, chairman of the Committee of Peers."

It will be thus perceived that the electric telegraph had not been established in France, in 1846, while it was in full and active operation in this country, and, moreover, that it was the result of its success here that operated to its establishment in France. Morse's system is, at this date, established throughout the Continent of Europe thousands of miles, and is still in process of extension, and is fast superseding the needle and signal systems. Even in England, where the Morse telegraph has never been practically tried, it is about being introduced. We expect, in the future, to discuss the relative modes of telegraphing with a consideration to financial economy.

ART. V.—MEDITERRANEAN ELECTRIC TELEGRAPH,

UNITING EUROPE WITH AFRICA, EAST INDIES AND AUSTRALIA, VIA FRANCE, PIEDMONT, CORSICA, SARDINIA, ALGERIA AND EGYPT.

JOHN WATKINS BRETT, ESQ., GERANT.

WE append the substance of a circular, issued by the International Telegraph Company, relative to the extension of the line across the Mediterranean Sea. The whole management is under the direction of that wonderful and energetic telegrapher, John W. Brett, Esq., who has been the foremost man of the world in the extension of submarine lines and the general advancement of electric telegraphs.

In the advancement and promotion of this grand undertaking, connecting Europe with Africa, the French government has exhibited a degree of energy and character not surpassed by any other government. The Emperor of the French has had opportunities of witnessing the advantages to be derived from the extension of the electric telegraph, and with a spirit of enterprise that does honor to his power and country, he elevates the art in every way possible, for the general good of his people. Had the present emperor been on the throne in 1838, Professor Morse would not have met the sad fate he did when in France. After much expense in exhibiting his wonderful achievement in the invention of the electric telegraph,—producing the first available system known to man, he procured

a patent from the French government. One of the conditions of the patent was, a requirement to put his invention into actual operation within two years. After much effort, Professor Morse effected an arrangement to fulfil this provision of the patent by the aid of one of the railways.

The fact becoming known to the government, Prof. Morse was served with information, prohibiting the erection of the line. This order continued in existence until after the expiration of his patent, and was then rescinded. These are the facts as near as we can give them. The king of the French ought to have abdicated long before he did. But he is gone! It would have been better to have informed Morse before he went to much expense, that his telegraph could not have been allowed in that country. We do not refer to this with a view to cast any unreasonable reflections upon the memory of the ex-king; but we refer to it, to show what difficulties Professor Morse had to contend with in the establishment of his telegraph, and also to illustrate the difference between the power of France in 1838, and that of 1855. The former was indifferent to the wants of the age, and the latter carefully studies and exerts himself to advance his country and promote the happiness of his people.

We will not say more at present upon this subject, and therefore refer the reader to the following, for further information relative to the extension of the electric telegraph, and the liberal consideration given to it by the French and Sardinian governments.

REPORT OF JOHN W. BRETT, GERANT.

GENTLEMEN:—We shall assemble on the 14th instant, to inaugurate the completion of the first portion of the submarine cable for the great Mediterranean and Indian line of telegraph, and it may be interesting to you, first, to recapitulate the various heads of the concessions, and, secondly, to inform you of the state of the works at the present moment.

The concessions were confirmed to me by the French and Sardinian governments, with the guarantees and privileges as above, on the 1st of June, 1853, allowing two years for the completion of the works, and an open communication for telegraphic correspondence in all languages, without restriction.

1ST.—THE CONCESSIONS

Give to the company the power to construct any number of telegraph lines (h e junction of the telegraph lines of

Italy, France, and England, at Spezzia,) across the Mediterranean, *en route* to India, with exclusive privileges for fifty years, dating from June, 1855.

STATE OF THE WORKS.

The first portions of the submarine cable intended to unite Spezzia with Corsica, and Corsica with Sardinia, is now completed (110 miles), allowing some 20 miles more than the actual distance, and it is confidently expected that these two portions will be laid down and in operation by the middle of July next, by which time the whole of the land lines (about 800 kilometers) in the islands of Corsica and Sardinia, will be finished.

About fifty miles of the second portion (150 miles) of the submarine cable is aleady completed, and it is confidently expected that this will be also laid down about the middle of August next, uniting the Island of Sardinia with the telegraph lines of the French Government at Bone, in Algiers, when the present undertaking of this company will be accomplished.

The company are at present under treaty with the English government for an extension of the telegraph to Malta; but as this extension would be purely a government line, it cannot be undertaken without some similar support from the British government to that already granted to this company by the French and Sardinian governments for the extensions to Algiers and the island of Sardinia; and they also confidently look forward to a fair support from the East India Company to enable them to extend the lines to Alexandria and India.

It must be borne in mind that, in addition to the difficulties attending the introduction of a system of telegraphs—in countries where all the necessary materials and labor had to be imported—other adverse circumstances have occured, not the least of which have been the enormous increase in the price of the materials and labor, and the extraordinary demands for freight (namely 90*s.* per ton,) owing to the demand of vessels for the government service. Notwithstanding these disadvantages, the works have been carried on energetically, both in the islands of Corsica and Sardinia, aided by the able superintendence of some of the most experienced and practical telegraphic engineers in Europe.

We must be allowed to add, that the thanks of the shareholders are due to Mr. Tupper, of the firm of Tupper and Carr, contractors for the cable, &c., and to Mr. Glass, of the firm of Kuper and Co., the manufacturers; also to Mr. Statham, of the

gutta percha company, from whom, as from others, we feel indebted for the very able assistance received in forwarding the above works.

In conclusion, gentlemen, we must express to you the gratification we feel at the success attending our operations as far as they have gone, and we beg to assure you of our constant and unremitting efforts to carry out the undertaking, so as successfully to insure the interests of the shareholders and the advantages of an European telegraphic communication with the East.

I have the honor to be, Gentlemen,

Your most obedient and humble servant,

JOHN W. BRETT.

Since the issuing of the above circular, we had the pleasure of witnessing the shipping of the 110 miles of cable on the steam ship Persia, June 15th, 1854, at Greenwich, near London, designed for the section between Spezzia and Corsica. The rigging of the vessel was very beautifully dressed, with the flags of nearly every nation upon the face of the earth, and on referring to our notes, we find the United States flag was not there!

We attended the celebration, through the kindness of Mr. Brett, and we were much pleased to meet so many gentlemen interested in the extension of the electric telegraph. The cable was 110 miles, containing six wires. These electric wires were connected, making 660 miles, and through which the needle instruments were worked very successfully. During the day, we had only one desire, and that was to have there two of the Morse instruments with two expert operators, to convince the assembled gentlemen, that America was far in advance of them in the art of telegraphing.

The war in Europe is unfortunate for the extension of the telegraph. It has been a great hindrance to the success of Mr. Brett. Notwithstanding his promptness in making his cables, he cannot get vessels to lay them down. How *cheering will be the dawn of peace.*

ART. VI.—THE WORLD GIRDLE TELEGRAPH.

PRACTICABILITY OF A TELEGRAPH AROUND THE WORLD CONSIDERED—THE ROUTE GIVEN—THE COUNTRY PEOPLE AND CLIMATE.

TAL. P. SHAFFNER, PROJECTOR.

An electric telegraph line or lines surrounding the globe, is now an enterprise of serious consideration, and, in our opinion, will, at an early day, be realized. When we say, that it is under serious consideration, we wish to be distinctly understood, that active arrangements are now being made to consummate that grand and stupendous undertaking. When we say that it will, at an early day, be realized, we desire to be understood as saying that, within a few years, probably not exceeding ten revolutions of the earth around the sun, we will see the earth girdled with an unbroken chain of electric flashes, controllable by man, and diffusing light and knowledge—cultivating peace and good-will to the nations of the globe. It may be deemed by some gentlemen as visionary—as a scheme for a few days' talk, or the wild and rattling fancy of an ill-arranged brain. The impossibilities, doubtless, arise in the minds of some, towering over the reach of human ingenuity. Natural formations of the earth's surface are supposed to contain formidable barriers, and even too much so to be overcome. Scientific difficulties are supposed to exist, preventing the consummation of the undertaking. No one doubts for a moment the advantages to be derived from the telegraph, if constructed to connect the continents across the Atlantic. No one doubts the benefits to the world that would flow from the construction of a telegraph, connecting the two hemispheres by lines, as proposed in the plan of the world's girdle telegraph. We do not deem it necessary to discuss the financial arrangement necessary to execute this great and magnificent undertaking. That must be a question resting upon a distinct basis. The advantages to the people of the earth are, of course, admitted by every person; and, therefore, any discussion upon that point we deem superfluous at the present time.

We propose to notice the two and only remaining difficulties, namely—the *scientific* and *natural* difficulties necessary to be over come in the construction of a telegraph around the world; and, first, the

Scientific Questions.—It has been demonstrated, by several years' practical experiments, that a galvanic current can be sent on circuits varying in length from 100 to 1000 miles,

on overground lines, and from one to six hundred, and, perhaps, a thousand miles, on subterranean or submarine lines. We can safely calculate on the successful working of a line six hundred miles, as a fact; and, therefore, we need not base a single argument upon a supposed theory, but wholly depend upon practical and unquestionably demonstrated history, in telegraphy.

If there should be formidable difficulties preventing the working of a line on a longer range than six hundred miles, we will have the chances of the efforts of science to overcome that difficulty, and its after realization. We have the knowledge of the working of a line six hundred miles; and, of course, nothing can dispel that practical law. As we can work successfully the distance mentioned, there is nothing to prevent the working of a line around the globe by the combining of circuits. The operator in London, St. Petersburg, or other cities, can work his circuit, and that will open and close his next, and that will repeat the same to the next; and, in this manner, circuits can be contrived to communicate, at will, any desired distance. In business messages, generally, the circuits can be worked separately, and dispatches can be repeated from point to point, as circumstances of economy may dictate. These are views not original now, but actually the daily operation of every telegraph line on the face of the earth. Why cannot the same practice be applied to a world girdle telegraph?

With the existence of these facts, well known to the scientific telegrapher, being the daily practice of nearly all telegraph lines, we do not see that, so far as the question of science pertains, there can be any doubt whether a line around the world can be successfully worked, for all purposes of trade between the people of all nations.

NATURAL OBSTRUCTIONS require more consideration than we have deemed proper to give the former proposition. We think it is eminently feasible, and, when attempted to be executed, must certainly be crowned with success. We are not sanguine upon the point, without being sustained, as we think, by evidence beyond question. We have devoted much energy and attention to the subject; we have carefully studied the natural and artificial difficulties in the way of its execution; the climate and the population of the countries through which the line must pass, have not escaped the calm reflection of the most earnest solicitude. The practicability of the enterprise may, perhaps, be better considered under the following questions, namely:—topography of the country, the climate, and the character of the population. These we will consider briefly.

We place the eastern coast of America as a starting point. The section connecting America with Europe, we believe, is a solved problem. The ocean section will be found discussed in the present number, under the head of the Transatlantic Telegraph; and we would refer to that article for further particulars as to what appertains to the section connecting the eastern and western hemispheres across the Atlantic Ocean.

It is not material, as to location, where the cable lands in Europe, whether in Ireland or on the western coast of Norway. If in Ireland, there is a telegraph the entire distance to St Petersburg, through England, Belgium and Prussia. If the cable lands on the west coast of Norway, then the line can be constructed to Stockholm, and from that city to the Alland Islands, and from thence along the coast of the Gulf of Finland to the city of St. Petersburg. We know very well that in Finland, north of the City of St. Petersburg, as far as the line will extend, the people are healthy, and cultivate their lands, as in other populous countries. The latitude is 61° north. Thus far, then, we have a country inhabited by people, and there can be no hindrance to the successful working of a telegraph. The face of the country is level, and well adapted to the easy construction of a line. From St. Petersburgh to Moscow the country is level, and government lines already exist. The line is composed of two wires, and runs with the railroad. From Moscow we propose to run to Vladimir, and to Nijhni Novgorod, on the Volga, a city of much importance in Russia. This is lati tude 56° north.

NIJHNI NOVGOROD.—This is a large and very important city, containing about 20,000 inhabitants, and in the summer months, during the fair, the population proximates 300,000. To this city traders from Europe and Asia assemble, and, in fact, people from all sections of the world are here to be seen engaged in merchandize. The city is well built, and contains a fortress and many public buildings. It is on the great highway to Asia, and is the centre of mercantile trade for a large section of the globe. We give a description of one of these fairs from an eye observer.

"The celebrated fair which is now held at Nijhni Novgorod, dates its proper institution from the year 1648, at which epoch it was established at Makarief, about fifty miles lower down the Volga than the site upon which it is at present held. In the year 1816, however, upon the occasion of the destruction of its buildings by fire, it was removed to its present site, where it is less exposed to the annual inundations of the great river, which had continually threatened its destruction while it was held at

Makarief. Since this time, the encouragement of the government, and its admirable position in the very centre of the vast inland navigation of the empire, have raised it to be, probably, the greatest place of exchange of merchandize actually exhibited upon the face of the globe.

But before we mingle with the busy throngs at this great gathering of the commercial world, it will be as well to make a few concise remarks concerning the races which compose the Russian people.

The Russian empire is inhabited by a number of nations and tribes of different origin and language, and of various degrees of civilization, from that of the refinement attained by a portion of the Slavonic race, differing in nothing from that of the most advanced people of Europe, down to the condition of the half wild man still roaming over the Siberian deserts, and subsisting by the use of the bow and arrow. Nevertheless, all the seemingly distinct races, which we find settled, or following still their pastoral or nomadic lives, between the Ural Mountains and the western districts of the empire, appear to derive their origin from two sources—from the great Caucasian family, and from the Mongolian tribes. From causes, however, the details of which belong to the history of barbarian conquests, to that of constrained and voluntary emigration, and to the effects of manners, morals and customs, upon the increase and decrease of numbers among particular races, the proportion of the population of Mongol origin, which was once considerable, is not now supposed to exceed a hundredth part of that of the entire empire.

The portion of the population belonging to the Caucasian family, inhabiting Russia Proper, has been divided, and, probly, very justly, into three branches, the Sclavonic, the Thule or Finn, and the Tatar. And it is, with tolerable exactness, ascertained, that the first of these, the Sclavonic, compose about nine-tenths of the whole of the population of Caucasian origin in the empire. The people of this race are, however, subdivided into Russians, properly so called, Lithuanians, Poles, Lettes, Wallachians, and Servians, the Russians of all these being so greatly predominant as to compose about two-thirds of the population of the empire, or amounting to about forty millions of souls. Those, indeed, of this branch of the grand Caucasian family may be considered to compose the more solid portion of the entire population.

In a word, the true Russian nationalit is formed, like our own, from the amalgamation of a variety of races, of which one chiefly stamps the character and shadows the destiny. Just in

the same manner that all the races that successively settled in America, have mingled the elements of their character only to modify that of the Saxon; it is evident, that all the blood of all the races that have settled in this empire, will finally be confounded with, and only modify that of the predominant branch of the Sclavonic race of the grand Caucasian family which has given its name to the country and its inhabitants."

From Nijhni Novgorod, we propose to run the linė to Kazan, passing over a fine country, and well cultivated, producing wheat, flax, hay, and other commodities. From Kazan the route extends over a country somewhat more undulating, until we arrive at Moukikaksinskaia, and then continuing through a country not quite so thickly settled until we come near Klanovskaia. The hills are few and very moderate in size. The woods are mostly the tall pine, and, to a considerable extent along the road, the birch is planted as ornaments, and in fact the whole country is beautiful and unequalled in its extent of scenery, pertaining to productive effects. It is not characterized with stupendous mountains, dashing streams over cataracts and of romantic vales; but, the rich waving fields of wheat, barley, flax, and the various products of the empire, can be seen for many miles in extent as one common plain. Crossing the river Ochausk, the largest of all the rivers rising in the Ural Mountains, we soon arrive at the

City of Perm.—A very fine place of modern architecture. The result of the richest mines of the world has done much for this country. The roads are most substantially and beautifully constructed. We have no such roads in America. We have boasted of our national paved highway across the mountains, as one of the best in the world; but our national road cannot be compared to the Russian roads. A comparison between an ordinary stream, and the great father of waters, the Mississippi river, would be as proper.

The city of Perm contains about 5,000 inhabitants; who are mostly engaged in the smelting of iron, copper, and other mineral productions of the country. It is a commercial city, and ranks as one of great importance. From Perm we propose to extend this line to the Ural Mountains, passing many villages. Part of the route will pass over immense and solid fields of alabaster. The undulating hills are of a more variegated form, abounding in the fir tree and the cranberry, equalling the richest of the Newfoundland or American berries. We have omitted to speak about the large factories to be found in this country, one particularly, which has been the property of the Countess of Strogonoff, who, we have been informed, has held

no less than 80,000 serfs. Vessels of various sizes are constructed on the streams, and being loaded with iron, copper, and products of different kinds, find their way to all parts of the world.

THE URAL MOUNTAINS.—The ascent to the Ural Mountains is very gradual. The highest peak is about 6,400 feet, the passes for the roads are about 2,100 feet above the level of the sea, and so gradual, that a railway can be easily constructed across the range of mountains in many places, with much less expense than has been incurred in crossing many of our ordinary ranges of hills. The pine, fir, larch, and silver-birch, are the common forest trees abounding on the mountains. The cedar is often found, and also the oak, in the direction of the route we propose for the telegraph, being about 56 degrees north latitude.

The Ural Mountains have a range of about twelve hundred miles, running from the Arctic Ocean to the Caspian Sea. They have great inequality of breadth, sometimes reaching seventy-five miles, and at other parts five to seven miles. Where they are broad, they abound in lakes, marshes and mineral springs. Thus far, there are no disadvantages to overcome, in the extension of either a telegraph line or a rail-road, at a less expense than over an equal extent of territory in the most favoured part of the United States.

Leaving the Ural Mountains, we proceed to Schadrinsk, Yalontorovsk, Ishim, Orlova, Tiokalinsk, Krasnoyarskaia, and to Omsk.

From the Ural Mountains to the city of Omsk, a distance of about five hundred miles, the country is much the same as Russia in Europe has been represented. The descent is very gradual, and the plains large, proximating much in appearance the American prairies, being occasionally skirted with woodlands. The roads, as throughout Russia in Europe, are well marked out by large guide-posts, painted white and black, and planted about every two-thirds of a mile, so that in winter, there is no probability of getting lost. Cultivation, throughout Russia in Asia, is not so extensive as in Europe, but there is much of the country under a high state of improvement. Although the country is in the same parallel of latitude as Moscow, the snow lies upon the ground, and the earth remains frozen for some five to six months in the year; and, as a writer says—

"Yet is this disadvantage in climate in a wonderful degree compensated, and its effects modified, by the earth's extreme fertility. The soil is here composed of a fine black mould, and very probably, as subsequent observation of similar soils, the

origin of which could not be questioned, has induced me to think, of decomposed volcanic matter. Such, indeed, are the fertilizing qualities of this soil and their durability, that the composts, or the use in any way of stable or any other manure, is here unknown, although rye, barley, and oats, are cultivated in more than sufficient quantities for the consumption of the inhabitants. In the meantime, the surface of the ground is covered with a wild, coarse, long grass, which affords ample provision for herds of cattle during the year. In the summer they graze upon it at large, and fatten; and during the winter, they subsist upon the fallen grass of the past summer, which they rake from beneath the snow, where it lies withered in great abundance throughout the plains."

A writer on Siberia thus speaks of a night's dream and a day's observation, which leads the mind to contemplate the vastness of the Asian plains of Russia, and to the American it will forcibly remind him of the immense plains of the Far West of his own country.

"During the proper hours of the night, I seemed, as I slept, to float upon another Irtysch, whose silent banks and pine forests appeared converted into the seats of music and song, which resounded through such groves as might be formed by the olive and the sycamore, and the palm and the pomegranate, and wanted only exemption from the change, that we cannot but remember must come, to equal one of those blissful regions which poets write of, but which travellers never find. Gradually, however, the soft and harmonious sounds that had prevailed, grew confused and harsh, and the fresh groves became so full of light, that the eye could not without pain regard them, until, with the effort to recover the placid state of body and mind which the light seemed to have disturbed, I awoke.

Upon now opening my eyes, I found a scene before them, which, with the recollection of the state of the light before we fell asleep, confirmed the causes both of the agreeable and clear visions of the early portion of the night, and of the indistinct and confused scenes which succeeded them. The dim light of the moon and stars, which had shone through the first hours of our slumber, had passed away, and the full glare of day, as our faces were turned towards the east, was directly before us.

This morning was also among the more remarkable of those of our journey, on account of the magnificence of the spectacle which it presented to us. There was not a tree nor a shrub to be seen above the wastes of grass that appeared on all sides around, to make the least break in the uniformity of the plain. A hoar-frost covered the whole surface of the ground; and al-

though the sun, when we opened our eyes, had not yet appeared above the horizon, the sparkling element, which sat upon every blade of grass, reflected the rays of the beautiful Aurora from the silvery bed of the wide plain. But as the sun approached the horizon, the face of the grassy steppe yet increased in splendour, and the scene in interest. As we cast our eyes around, without encountering a single object to obstruct the vision, it seemed as if we were gliding across an illuminated crystal plain. But as the bright orb began to appear above the line of the horizon, the chaste silvery scene gradually changed into golden hues, until the full reflection of his beams presented us with a spectacle too bright to behold.

Long after the bright orb "had ta'en his last leave of the weeping morn," and the spangled carpet of the plain had disappeared, and the ground recovered its wonted green, the same unbroken horizon appeared around. The first object that we saw above the level of the plain, looked like a distant vessel, wending her way across the waste of waters within Neptune's domain. It was a single tree, that braved the solitude of the steppe, and, bent by the winter tempests, appeared to the eye of the travellers like a ship under canvass in a stiff gale. * * *

There was nothing in the prospect around, that varied from that which constantly presented itself to us at the same hour. Nothing was to be seen but the silvery plain, and the red, grey, and blue of the different quarters of the heavens, all blending their colours insensibly with one another, without a cloud or fleeting rack to break the harmony of the view, or a breath of air to disturb the silence that reigned. A mariner would have been reminded of the scene which the ocean sometimes displays, when not the smallest ripple appears upon the surface of the water to arrest the reflection of the sun's brilliant rays, and not a cloud is seen in the sky. It reminded me of a calm I once experienced within the tropics, when all on board our bark watched anxiously for days for the first "cat's paw," to give us hopes of a breeze.

In both these positions, almost equally, the isolation to which we are exposed seems to leave the mind free to contemplate calmly the two greatest wonders that the creation displays, with more advantage than when we are surrounded by many objects that distract our thoughts or engage our attention—the great globe upon which we tread, and the far greater by which it is enlightened and fertilized. As we walk over the plain, or as we float upon the ocean, when no object breaks the evenness of the curve line of the horizon, the magnitude, the form, and the solidity of the globe which we inhabit, by the less familiar aspect

in which they are now seen, than that in which we are accustomed to behold them, doubly impress us with their reality. Nay, often when the sun is rising or setting, whether the horizon which he is approaching or leaving be formed by the ocean or the plain, if we will forget for a moment the ideas we attach to our familiar expression of the rising and setting sun, and think only of our true relation to the bright orb, and of our rotatory motion, now bringing and now closing the day, we shall seem to observe more plainly the real character of our movement, and almost perceive the onward motion of the waters upon which we float, or of the firm ground upon which we tread.

With such scenes as these before our eyes, the coldest must feel what the poet alone can express. But nothing, perhaps, in a similiar position, is more striking than the contrast we are insensibly led to draw, between the durability of the grander objects of nature before our eyes, and the limited existence of the sentient being that is permitted to contemplate them.

Later in the day, we passed through a country abounding in morass land, and producing coarse high grass in greater quantities than usual. In several places we saw large herds of cattle and flocks of fat-tailed sheep, under the watch of Kirgeeze shepherds. The villages were, however, from twenty to five and twenty versts apart, and the way was unrelieved by any variety in the scene, and more wearisome than ordinary."

The route for the proposed telegraph will pass through Kainsk, Kolivan, Tomsk, Ashinsk, Krasnoyarsk, Kansk, Polavinotchezemhosskayah, Nij Oudinsk, Iamsk to Irkoutsk; latitude 51½° north. The city of Irkoutsk is about two thousand five hundred miles from St. Petersburgh, and about nine degrees south of that city; and the reader will please to remember, that we have kept south of north parallel 60° since leaving St. Petersburg. The country is much the same from the Ural Mountains to Irkoutsk; a hundred villages are passed, and cultivated fields are generally to be seen throughout the route, except occasionally in the more extended plains. Some of the villages are well constructed.

City of Tomsk, having a population of, at least, 10,000, ranks as a place of importance, and is rapidly growing.

"The departmental town of Tomsk is the capital of the district of the same name, in the great western government of Siberia. It is situated upon the right bank of the River Tom, which is one of the numerous tributaries of the Ob, and at about twenty or twenty-five versts from the point of junction of the tributary with the main stream of the grand river. It

lies in the direct line between the Ural Mountains and the capital of Eastern Siberia—from each of which points it is about equally distant, and in the vicinity of some of the more productive mineral districts of the country. It is the residence of the governor of the department of which it is the capital, who is usually an officer of engineers, and superintends, in an especial manner, all the mining operations of the imperial government within the district.

Favored by these advantages, Tomsk has become, in point of wealth and population, superior to all the towns in Siberia, except the capital of the grand eastern government. Its population is about 10,000; and its wealth is probably greater than that of any town of an equal number of inhabitants in Russia Proper.

The town is built partly upon two hills, separated by a narrow vale, and partly upon low and even ground, and is divided into nearly two equal parts by a torrent which runs down the vale, and continues its course through the town along the bottom of a deep fissure in the ground, until it falls into the Tom. * * * * * *

In several shops of a superior class, were exposed the more valuable articles of merchandize, such as cloths, furs, cotton and linen goods, among which we found in one that we entered, which was kept by a Tatar merchant, articles of English, French, and German manufacture, as well as others of the coarser description of Russian goods. The prices, however, of every thing were from three to four times higher than we usually pay for the same articles in the west of Europe. Some were even valued as much as six times higher than the prices of London and Paris.

At the distance of a few hundred yards further, continuing the same street, we mounted the hill upon which stands the portion of the upper town, which is upon this side the ravine or fissure above mentioned. This brought us to the quarter occupied by the more wealthy portion of the inhabitants. The houses here also stand apart from one another. Some are of brick, and several are built after the model of those which are placed in the open parts of Moscow, and were painted with as much taste as is commonly displayed in the exterior decoration of houses in the towns in Russia. Some have walls painted straw-color, or a faint yellow, and others a pure white, and all have green roofs. They have all, also, their ends fronting the street, and their doors at the side in a spacious court, and several have gardens behind them. * * * *

The inhabitants of Tomsk may be divided into three orders,

in every one of which are found two or more classes. But that we may, in this account of the town, properly distinguish the voluntary colonist of every grade from the constrained inhabitants of a penal colony, who are not, in a civil sense, a part of the population, we shall have to regard the exiles of all orders and grades apart, though we shall find them mingled with all classes of the free population, under regulations which properly distinguish the political from the criminal exiles, and also the degrees of crime which the latter were sent into Siberia to expiate.

The first, then, of the three orders into which we must divide the population, may be considered to comprise all the civil and military authorities, from the governor down to the lowest *chinovnik*, or under civil official.

In the second order, we may place the principals and agents of the mining companies, and the merchants of the several grades, including, of course, the Tatars, and those of all religious faiths, with all who are employed in their service.

The third order will then consist of all the artizans and the inferior tradesmen and peasants, composed, for the most part, of the descendants of exiles, and the voluntary colonists for some generations back.

We will now divide the first of the above orders of the population—that is, all the *chinovnik*—into two distinct classes, in the same manner that conventual usages, with but slight variations, divide the same order of the people in all countries.

The first of these consist of the governor, and the general in command of the troops within the department, whose appointments are usually for a limited term, the *gorodnichii*, or chief of the police, the *ispravnik*, or judge, the post-master, the agents and engineers in the mining service, the chief architect, and several others whose appointments are permanent, or usually endure for a long period.

The second class of the same order of the people may be considered to be composed of all the under *chinovnik* in all the departments superintended by the above-mentioned superior officers. These are generally sent from Russia, after having been selected from among the classes whose attainments do not commonly exceed the acquirements of reading, writing, and the first elements of arithmetic.

In the second order of the people, the sole distinction is, between those engaged in the proper occupations that belong to mining, and those engaged in commerce.

In the third order, the varieties are yet less manifest. Here the artizan, inferior tradesman, and peasant or laborer, are,

with but few exceptions, confounded with one another, by similarity of manners and conduct.

We come now to that important class which form so considerable a portion of the population of the country. But in order to introduce them in their proper character in this and other towns in Siberia, it is necessary to recur to the circumstances which attended their settlement in the country.

From the time of Peter the Great, exiles have been continually sent from Russia Proper into Siberia. The number which have been sent since that period up to the present time is uncertain; but the number that now annually pass the Ural Mountains is about 10,000, including many of the wives of the exiles, who voluntarily follow the fortunes of their husbands. But owing to the distance, which, save in the case of some who remain in the nearer governments, is not performed in less than two years, many of these never reach their destination; and thus the effective augmentation of the population by this means does not probably exceed 8,000 souls a-year.

The exiles are formed into five distinct classes; and every one receives the treatment in the country which is proportionate to the offence to be expiated.

The first class consists of those who are condemned for the highest crimes and offences against the laws of Russia.

The second class comprises all those who are found in a state of vagrancy throughout the country.

The third class consists of those condemned for minor offences against the laws.

The fourth consists of those condemned by the courts estabtablished in the villages, and, for the most part, for petty offences.

The fifth class is composed of serfs condemned by the order of the government, upon application from the proprietors of the estates to which they belong.

The exiles, generally, after the passage of the mountains, are distributed through the country, at various distances from the boundary of the colony, depending upon the character of their offences. Those who are condemned for the highest offences, are usually sent to the eastern provinces, but those who suffer for the lighter, remain in the western.

They now submit to a division into three classes only. Those of the first class are called *katorschniki*. They consist of such as are condemned for life, or for a long period, to work in the mines. They are considered as civilly defunct. Some of the most criminal of these are sent to the silver mines at Nertchinsk, in the government of Irkoutsk. Before

the reign of Alexander criminals of this class labored for the rest of their lives beneath the ground, where they were at their decease interred; but at the present day their treatment is very different.

Those of the second class are called *loslannyje na raboto.* They consist of such as are condemned for a shorter period, and designed for colonists upon the expiration of their term of forced labor. These are employed in the service of the government in mere ordinary labor.

Those of the third class are called *loslannyje na poselenye.* They consist of such as are condemned for the lightest offences which incur the penalty of exile. They are considered upon their arrival in the country to have in effect already expiated their faults, and they are at once established by the government as proper colonists. Sometimes they are settled in villages already existing in the vicinity of the towns, and at other times they are placed in villages laid out and built expressly for their reception. They receive, moreover, the government aid in everything proper for their establishment, even to such a sum of money as is deemed necessary to accomplish that object; and for three years they are free from the taxes levied upon the older colonists. Almost the only inconveniences, indeed, which these exiles suffer, consist in their confinement to the villages in which they are settled, beyond the limits of which they are not permitted to pass the night, and in an interdiction from changing their avocation. They are, in effect, peasants *glebæ adscripti*, without the conditions of service to which the serfs of Russia Proper are subjected.

But the most remarkable feature in all that regards the settlement of the exiles, is the organization of the civil affairs of these new villages. At the head of every village is placed a simple soldier, ordinarily a Cossack, who administers justice and punishes all petty offenders, by thrashing them soundly with a stick. Nevertheless, in case of the commission of grave crimes, the administration of the law rests with the court of the nearest town, or is intrusted to the *zasidytelle*, who is here a sort of itinerent magistrate. This state of society, however, does not endure beyond the generation which succeeds that in which it is established. After this, a *starosta* is appointed, by whom justice is administered as in Russia.

It now becomes necessary to mention the important moral distinction in the classification of the exiles, in all that regards their position in the proper society of the places they inhabit at the different periods of their exile. This consists simply in the different conventional treatment, as well by the government

as by the people, of those who have been exiled for state offences, and those who suffer the penalty of any other offences whatsoever. Thus, while the punishment of both is the same in regard to actual settlement, restraint, and civil dissabilities, and is proportionate alike to the gravity of the offence against the law; yet, as they become relieved from the first restrictions which follow their arrival, the difference of the position in which they severally stand in relation to the rest of the population, is very great. The criminal exiles remain for life under the moral ban, which neither pardon nor forgetfulness is able wholly to remove; while the political exiles, as soon as the first year or two of their exile removes the restraints which are first imposed in respect of the place of their abode and their confinement, enter, without any moral stain, into the society, wherever it is found, of the same rank as that to which they properly belonged when in their state of freedom in Russia.

Not any of either of these orders of exiles can engage in any trade or handicraft. Their proper avocation is the cultivation of the ground, which they may follow to any extent. * *

Everything within and without these houses, was upon a parallel scale, from the fitting up of the drawing-rooms, with their several articles of luxury imported from St. Petersburg, to that of the kitchen, and even to the stables in which the noble animal, so much abused by the peasant and *yemstchik*, has all the comforts that the most favored of his race enjoy in Western Europe. I entered but one of the kitchens, which was that of Gospodin Philomonoff. Eighty-two servants and dependents were sitting at the table to dinner; and I was told that sometimes there were about a hundred and twenty in the same house.

The provisions made by the three proprietors of these houses for the instruction of their children, was agreeable to the wants arising from the insulated position of their town, and commensurate with the arrangements throughout the different departments of their establishments. Gospodin Astaschaff, who had only a son, maintained an accomplished German gentleman in his house as tutor or *governor*, to apply the term equivalent to that in use here. Gospodin Philomonoff had daughters only for whom he had a governess of the same nation; and Gospodin Garrockhoff, who had both sons and daughters, had a German lady and gentleman as governor and governess. Thus, whatever the wants of the present generation, no fear can be entertained, that that which is to succeed will be full of all desirable knowledge, out of which, it is be hoped, will at least arise some reform in the present extravagant manner of living,

which cannot be favorable either to the interests or morals of the Siberians. * * * * *

The costume of the inhabitants is as various in winter as in summer, and is regulated by the rank, or fortune, or profession of the parties. The military officers never put off their plumed caps; but the civilians wear fur caps of all forms and at all costs. The rest of the dress of all classes that is seen, consists of a simple *schouba* or pelisse, of which the material that it is composed forms the distinction. All who aspire to the first rank must be dressed in sable when walking or driving in fine weather for pleasure, and in bearskin when it is colder or when they are travelling. But those whose ambition does not affect this rank, or whose means are more limited, are content to walk, drive and travel in the colder weather, in wolf-skins. The under *chinovnik* dress in black lamb-skins; and they suffer much when they travel, from not being able to obtain better clothing to protect them against the cold. In the meantime, the peasants, whose condition is usually much better, dress ordinarily in deer-skins, which are said to be the warmest of any skins whatsoever. And they certainly are so, in proportion to their weight and the space they occupy, though the fur of the bear and that also of the wolf are, without doubt, much warmer. The men of the lowest of all classes, the actual criminal exiles, and others who work during the summer in the mines, dress at this season in common sheep-skins.

The winter dress of the Siberians sits picturesquely upon the peasants, who draw their *schoubas* tight around the waist with a scarf, but not upon men or women of any other class, owing to an absolute decree of fashion, which proscribes the girdle, and is obeyed by all except the peasants, by which the appearance of the dress is spoiled. Indeed, the *schouba* usually worn by all classes above the peasants, in walking, is made as ugly as can be imagined, by being put on with the sleeves, which it never wants, left dangling at the sides.

The peasant women wear precisely the same dress as the men, when abroad, save that a hood of the girdled *schouba* covers the head instead of a fur cap.

The *schouba* of the ladies is a true cloak, in which, however, they very rarely walk. If a morning visit is to be made merely across the street, the *sani* conveys them. And when their acquaintance with those they visit is not familiar, or when the rank or fortune is disproportionate, the formalities and etiquette are as rigorous as at St. Petersburg or Moscow. The head-dress of the ladies without doors is the same as in the larger towns in Russia. The bonnet that is worn in summer is merely lined with fur for the winter."

We have examined a meteorological table of the weather for December, and other months, and we find the climate not as cold as was experienced in the northern states of America in December, 1854. The table was prepared at Tomsk, and is a fair exhibit of the climate of that portion of Siberia through which the proposed line should run.

CITY OF KRASNOYARSK has some 8,000 population, having many public edifices, one of which is a cathedral costing over $1,000,000, being 187 feet in length, 96 feet in breadth, height of tower, 198 feet, height of dome, 182 feet. The church was built by voluntary subscriptions.

CITY OF IRKOUSTK.—We come now to speak of Irkoutsk, the capital of Eastern Siberia. It contains a population of 25,000 souls. The buildings are erected in the modern style, with large yards. That the reader may judge of the nature of the people and the city properly, we will quote a few sentences as written by an eye-witness:

"Irkoutsk, the capital of Eastern Siberia, is seated at the immediate point of the confluence of the Angara, the most considerable of all the rivers that fall into the Yenessei, and the broad and rapid torrent of the Irkout. It contains a population composed of the same social grades as the population of the town of Tomsk. It is the seat of the government of Eastern Siberia, and the place of residence and head-quarters of the governor-general over all the departments which are comprised in the great eastern division of the country. It possesses a handsome cathedral, nine churches, a government-house, and all the ordinary public buildings of a Russian governmental town, and a *gostinnoi dvor*.

There are seven public establishments for education in Irkoutsk, five of which are for the instruction of boys and two for girls. And there is also an independent seminary for the daughters of parents who can afford and prefer to give their children a private education.

The schools for the boys are of three distinct kinds, with different objects. One of them is designed for the sons of exiles of every kind, who are, without distinction, obliged by the law to be raised for soldiers. The boys are here educated, but not maintained, at the public charge. Another receives the sons of the *chinovnik*, who are educated, fed and clothed, at the expense of the crown, in the service of which they are afterwards employed.

Two higher schools have a common object, one of them

being but an elementary school of three classes, in which the children are prepared for the gymnasium, or higher school, which has seven classes. In this establishment there are usually about 150 boys, forty of whom are by special privilege, under regulations bearing reference to the positions of their parents, maintained, as well as educated, at the public expense. The scholars are, for the most part, sons of officers, merchants, and proprietors of mines or their agents. They receive a liberal education, and usually afterwards follow the profession or business of their fathers. Besides the head master, there are fourteen professors; and the branches of knowledge which are taught are the Russian, Latin, German, French and English languages, geography, mathematics, rhetoric, logic, physics, and drawing. All the boys, even though they should be the sons of peasants (of which there are many among the rest), if they pass a prescribed examination, are equally eligible to advancement, and may enter one of the universities of Russia under certain regulations. Those, for instance, who attain this privilege, but who have been educated at the public charge, are only eligible for Kazan, and are liable to serve the crown for eight years; while those who are educated at the expense of their parents may enter any one of the universities in Russia, according to their objects, the constitution and design of the universities being different; and they are liable for only six years' service.

It must here be remarked, however, that although, strictly speaking, the sons of the political exiles have no higher privilege than those of the criminal, who are ineligible to the higher class schools, the iron letter of the law has yielded to the force of natural claims, and the greater part of these enter the elementary school, which gives equal right to all to pass to the gymnasium, where they wear uniform, and receive the fourteenth or lowest grade of nobility, and become, finally, eligible to enter one of the universities of Russia.

The remaining school for boys is exclusively for the sons of the clergy, who are designed for the priesthood. At this period it contained no less than 150 scholars. All must have attained the age of fifteen before commencing their theological studies. They remain in the institution for six years, at the expiration of which time they are subjected to an examination, and advanced in proportion to the degree of proficiency which they have attained. A few of those who appear to have made the greatest advances in their studies, at the expiration of the prescribed period, are transferred to one of the four higher colleges at St. Petersburg, Moscow, Kieff or Kazan.

After this, such as aspire to the rank of bishops, become monks. Those who are next in reputation for their progress at the termination of their studies at the college, become eligible for the ministry; and upon their taking to themselves wives, they are ordained deacons, priests, and ministers. But those scholars who do not acquire such a reputation as is thought sufficient to entititle them to any of these privileges, are employed in the meaner ranks of the clerical order, or as mere assistants in the performance of the ordinary offices of the church.

One of the two public institutions for girls is maintained at the expense of the crown, and admits fifty children free. The other was founded by a millionare of Irkoutsk, and admits thirty or forty free."

The city of Irkoutsk is of very great importance. The climate of the country is good, latitude north, 51½. It is situated near lake Baikal and within a few miles of Chinese Tartary, and borders one of the best tea districts of the world. Maimatchin, in Chinese Tartary, on the boundary, is the great tea mart. From this place thousands of caravans proceed to Pekin, and to Nijhni Novgorod in Russia. Many weeks are thus employed in the transportation of the tea to these far distant mercantile cities. Could they have a railroad upon which to transport the products of the lands and the arts, what a great achievement it would be for the country and the nation! There is nothing to prevent the construction of a railroad from Moscow to Irkoutsk, and we believe, the early erection of the telegraph will open the way for the steam car? What a blessing it would be to Russia!

KIACHTA is on the boundary between Russia and China. It is a Russian town of about 2,000 inhabitants. Maimatchin is the Chinese town of some 1,500 people. These towns are within a half mile of each other, and yet the people of one cannot speak the language of the other. The trading carried on between the people of these two cities is very great. From official information we learn, that in 1850, the whole of the Russian wares exchanged here was 27,630,480 roubles, or, $20,722,860. In 1840 it was 19,501,281 roubles, or $14,625,061. These wares embraced the variety of furs, woollens, cottons, linens, leather, and other implements of arts, needed by society, including manufactures of iron, tin, copper, brass, lead, &c. The Chinese products consist of black tea, silks, &c., amounting to 11,697,357 roubles, or $8,773,023.

This data throws considerable light on the economical condition of the two empires,—great fertility to the north of the line

and barrenness to the south; superior energy of the Russians over the slow and unprogressive Chinese. A traveler thus speaks of these places, and the grandeur of an Aurora Borealis, which he witnessed there.

"The two border towns of Russia and China, in every light they may be seen, are highly characteristic of the spirit of the people of the great empires to which they severally belong. North of the great line of demarcation, everything wears the appearance of youth, and rapid growth, and advancement towards the superior degrees of excellence which we trust that the people of the Russian empire are destined to attain. But we no sooner pass the threshold of the gate of the empire of the peculiar people whom we are now among, than the figure of age and social decrepitude stands before us; and were we not aware of the prevalence of a state of morals throughout the land that shocks every better principle that we have imbibed, the type now exhibited of Time's withering hand, might at least command our sympathy. * * *

The whole of the northern hemisphere first appeared tinged with a deep dull light, similar in color to red-hot iron shortly after it has been taken from the fire. This, however, soon spread in rays of brighter color, which seemed to dart like sunbeams across the zenith, until the entire heavens, from the horizon on one side to that on the other, was covered with these beams of light in rapid and continual motion, and change of shade and color, of which I know nothing in nature that might afford a simile to convey any just idea."

The face of the country surrounding Irkoutsk for many miles is slightly undulating, and the fertility of the soil is equal to that of any other part of Asia. Agricultural departments are extensively conducted, resulting in the filling of the graneries of the people. The products of the lands around Irkoutsk are very full, embracing wheat, barley, oats, hay, &c. The people never want for food. The cattle graze on the rich plains of grass, and hence, the living here is as good as can be found in any part of the world. Some travellers speak much against the dirt and filth of the pecple. We have read the like of Russia in Europe, and of America. There are travellers who expect to have the delicacies of London or Paris in every clime! We have heard much of the dirty huts of people living in camps and open shelters in the woods. We have seen all such in America, and yet, not occasion any especial

wonder! The people about Irkoutsk, and in nearly the whole of Russia in Asia, are well disposed, and we have no fears of trouble from them in the maintenance of the telegraph. The churches, convents, hospitals and public edifices are constructed upon the most magnificent scale. The glitter of the golden domes give special wonder to the great inland cities. It seems most "passing strange," that Russia should be heralded forth throughout the world as a barbarous country. Other countries could improve by following in the footsteps of such people as Russians. At Irkoutsk there are charitable institutions, schools intended for the maintenance and education of female orphans. They receive such a training as will be likely to render them useful in life. With such a state of moral society, who can doubt the propriety of associating Siberia with the modern world by telegraph?

We have said as much of this part of Siberia as we deem necessary, and we now propose to consider the route to Yakoutsk and thence to the sea of Ochotsk. From Irkoutsk to the sea, there are two routes, by which a telegraph can be constructed;—one through Yakoutsk, and the other route along the old boundary between Russia and China. This route will, beyond doubt, be of much public use in the future, particularly as it borders the Amour River country, over which Russian jurisdiction now extends. As the northern route through Yakoutsk is the most traveled, and now the main government thoroughfare to the Pacific Ocean, we propose to consider that as the best and most feasible at the present time.

Route to Yakoutsk.—Leaving Irkoutsk, we bear north ward until we reach Yakoutsk, passing many small towns on the road, some of which are quite extensive. The road follows the Lena River and passes over a very fertile country, aboundding in the richest products. The people between these two cities are descendants of a high rank of exiles, and they compare very favorably with the intelligent people of Russia in Europe. Of this country a traveler thus writes:—

"The country after this, during the day presented to us the same natural features, with intervals of arable land, which, as we perceived from the somewhat spare stubble of the preceding year, had borne crops of rye, barley, and oats.

Early on the day after that on which we commenced our journey, we arrived at a small village called Mansourskaia, where we breakfasted. After this, we found the country still improving in natural fertility and agreeable views. A long

range of hills appeared on our left hand, at further and nearer distances, as we proceeded; and sometimes, upon our right, the river upon which we were to embark, a little further from its source, was seen wending its course through a still more varied country than any I had seen anywhere on this side of the Ural Mountains; unless, indeed, the shores of the Selenga, which, at the season at which I visited them, exhibited everything to great disadvantage, might be an exception.

We found the country now chiefly inhabited by the Bouriats; and the effects of their sobriety, generally, with its accustomed attendant, steady industry, were here, as on the opposite side of the Baikal, seen to great advantage, compared with the progress of the Russo-Siberians.

As the day advanced, we found the country flatter and the scenery tamer. Early in the afternoon, after crossing an alluvial plain, we arrived at the place of embarkation upon the great river we were to descend. Here we found a marshy point of land, forming the inner side of an elbow of the river. By the bank of the stream stood a number of huts and temporary sheds; and on the river, moored to the shore, were lying ten or twelve roughly constructed flat-bottomed craft. This little settlement is called the port of Mansursk. Immediately opposite to it is the village of Katschougskaia, seated upon more elevated ground; though the side on which we arrived has been chosen as more convenient for loading the craft which are to descend the river, as all the cargoes they carry come direct from Irkoutsk. At this point of the Léna is embarked all the merchandise designed for exchanging for furs, which are procured from the various tribes of the native inhabitants throughout the entire north-eastern districts of Siberia.

This mighty river, even here, at the distance of more than 4,000 versts from the Arctic Sea, into which its waters fall, is a deep and clear stream, of about the breadth of the Thames at London; and it is, at this season, perhaps, more rapid than any part of any navigable river in the world, except some portions of the Saint Lawrence, properly called the Rapids. It presents, as well here as at many other points of its course, the same peculiarity which has been noticed as prevailing with other rivers, both in Russia Proper and in Siberia, of high banks on the right hand along the course through which it flows, and more frequently low and marshy land which is often subject to inundations, upon the opposite shores.

The village of Katschougskaia possesses a church, which is painted in gaudy yellow, and has some of the better sort of Siberian houses ranged along the high bank by the river,

which, together, give to the place rather a gay and agreeable aspect.

I visited this village during the time we were detained here. It is inhabited by Russo-Siberians and Bouriats, the latter being the most numerous. Its site has been well chosen; but it has nothing remarkable within it, and nothing differing from the ordinary Siberian villages inhabited by the same mixed races."

This same traveller passed down the river Lena, and of his voyage he writes the following:—

"As we lost sight of the village of Katschougskaia, we had steep hills on either side of our course, thinly covered with mixed woods, chiefly of the fir tribes; and there was here and there some small patches of cultivated land. During the second hour, we were driving through narrower passes of the river, between steep cliffs of red sandstone of considerable elevation. All that was here visible of the soil upon the banks of the river and upon the hills, was of the same color as the cliffs, and the woods were still of fir thinly sown.

Soon after we had swept through these narrow passages, we passed by the Russo-Siberian village of Korkinskaia, upon the right bank of the river. The position of this village seemed as isolated and desolated as could well be conceived.

Two hours after this, we passed the village of Ponomarefskaya upon the same side of the river. The country was now less hilly, and we observed a greater variety of vegetation in the natural forests; and there was also more cultivation to be seen at a distance from the banks of the river.

Before noon, we passed the village Yigolafskaya, upon our right hand; and three hours later, we brought up at Oustilguinskaya, a considerable village, with two churches, one of which was in a state of decay, and the other not quite finished.

The last-mentioned of these villages, the captain of our boat informed us, contained an industrious population and a manufactory of stockings and nightcaps, both of which articles were produced entirely by the hand. We stopped here for a short time to endeavor to obtain some milk for our supper, in which we were successful.

At a distance of twenty versts further, we passed the small village of Bolofskaya. Here the color of the soil along the inclined planes, more particularly upon the right bank of the river, indicated the existence of iron ore. During the afternoon we passed several of the smaller description of villages, and we found the country generally improving in aspect, with the firs in which it abounded of superior growth.

The face of the country, as we proceeded, continued to improve in appearance by the increase in the variety of the vegetation with which the hills were decked. The silver birch was now abundant, and there were more pines of a larger growth than we had before seen, distributed among the lesser species of the fir tribes. Before sunset we observed the first signs of the close of the winter sleep of the vegetable world, in the green tinge among the birches, where they were more thickly sown in the sheltered valleys. * * *

We had found the ice upon the shores as we proceeded every day in greater quantities. But it was lying in some of the coves, in fields undisturbed by the current that swept down the channel of the river; and in some places it was strewed in arge masses upon the shores on both sides. From this, it seemed evident that we were advancing more rapidly north wards than the genial summer heat. But if we were outstripping the effects of the sun in our progress, we had, however, the advantage of lengthening the day in a greater proportion, by the change of our latitude than by the advance of the sun. It was now the 15th, (our 27th) of May, and we were already north of the 55th degree, where the period that the sun at this season is below the horizon during the twenty-four hours little exceeds six hours; and when the sky was clear, the night was light enough to admit of our continuing our drift, without any necessity for mooring.

The next morning, we swept rapidly by the village of Urkutsk, upon the left bank of the river. Immediately after this, we passed the tributary river, Kuta, which here meets the parent stream. Salt, which is obtained from some low land near the sources of this river, is manufactured here, and sent through all the northern and eastern districts of Siberia.

The next day we had a return of the finest weather, with light and favorable winds. The thermometer at eight o'clock in the morning was at 11 degrees of heat, and at mid-day the rays of the sun were scorching, though we were still floating between banks of ice, or broken masses of the frozen element, which were lying along the shore upon either side. At twelve o'clock we passed the village of Markofskaya, with a church.

Throughout the greater part of our drift during to-day, the serpentine course of the stream, with the character of the hills, gave more than usual variety to the scenery around, and to the river very often the appearance of a lake. The hills were here steeper and higher than those we had before passed, and were covered with red pine forests, apparently of a "second growth;" but the woods were very open, and the trees were not large.

Nevertheless, the canoes that were to be seen at the villages, were made of single trunks of trees, rudely hollowed out, and were of large dimensions; and, as this attested the existence of very fine pine groves at some part or other of the river, we were led to inquire of the peasants where these groves were; but all the information we received was, that they did not go far to find them.

In the evening it became calm, and the scenery was greatly changed. We seemed now, from the distance which we were able to see before us, as if we were gliding into an open and champaign country; and the water was so still, that the hills and the forests that clothed them, were reflected upon its surface on either side, almost as distinctly as from an artificial mirror. In the meantime, our course was so gentle, though so rapid, that we were only sensible of being in motion, by the perpetual variations of the landscape.

The next day we were drifting in broader reaches of the river, and there appeared to be some slight diminution in the strength of the current. But the scenery presented the same features as during the last two or three days. * * *

Towards evening we approached a more mountainous country; and during the period of the dim light, in the short absence of the sun, we passed through a strait, which the navigators of the Léna have rightly named *Tchookhea*—the Magnificent. The natural objects here present the most striking of all the scenes which this mighty river exhibits. I saw them, unfortunately, but imperfectly; for I was not previously informed of our approach towards anything remarkable, and I was sound asleep when we passed through the grandest portion of the strait. Happily, however, I rose by accident, while we had yet a distant view of the remarkable objects by which it is formed. At the distance of ten or fifteen versts, by full daylight, it appeared like a vast rent in the range of mountains, which are here composed of granite rock. But this distance was too great to observe it from, to admit of the spectator speaking confidently of the breadth of the passage, or of anything further concerning it.

The whole country, indeed, at this part of the Léna, is magnificent in the extreme. It resembles some of the grander passes of the Rhine, near the sources of that river, with the advantage to the spectator, who may be navigating the Léna, of floating upon a far mightier stream. In some places, indeed, appear the boldest and most picturesque scenery that may, perhaps, be anywhere beheld, bordering any river in any land. The

most striking that I saw to advantage was at the mouth of the River Ora, which falls by a narrow channel, between high and precipitous rocks, upon the left bank into the parent stream. It was such as we think we could gaze upon for ever. But there was a novelty which formed a portion of it of a very rare kind among the natural objects that mountain lands exhibit. The mother of the arts was here seen rather as a copyist of the works of men's hands than as the model to guide them. Perhaps Nature has nowhere produced anything more nearly resembling the works of men, than the prodigious rocks with which she has here bordered and overhung this great river. I was for a minute or two deceived, and believed we were looking upon the remains of the architectural works of some race of our species that might have inhabited the land, when the great mammoth trod the firm earth of the country, at this time watered by the mighty Léna. The appearance, indeed, which is here presented of architectural ruins, has so near a resemblance to many remains of the productions of earlier ages of European history, that they will excite the wonder and interest of every traveller who beholds them. We seemed to look upon a vast fortress with several towers, one of which appeared even circular. The proper walls of the place, overhanging the water of the narrower stream, seemed to be supported by artificial stone work, resting upon jets or steps of the rock; and upon the side of the land, as far as the seeming walls were not hid from the view, was seen even the appearance of a lofty gate. Nay, even loopholes appeared to be pierced in several parts of the walls. If a race of genii were dwelling up this romantic river, and had been occupying themselves in constructing works in imitation of our ancient fortresses, they could not be said to have been unsuccessful. There is, indeed, a traditionary legend among all the native races in this part of Siberia, concerning this particular spot of the Léna, which relates that the bank of the Ora are inhabited by certain spiritual beings, whose will has great influence upon the destinies of men. Thus, all the navigators of the great river, who thread this pass when the season will permit, stay and bathe in the Ora, or at its mouth, which is thought to be complimentary and highly pleasing to the spiritual inhabitants of the vicinity.

"YAKOUTSK is the capital of the department of the same name, which is the largest of the provinces of Eastern Siberia. It lies in the latitude of 62 degrees north, and beneath the meridian of 129° 40 east of Greenwich. It is the most northern of the provincial capitals of Siberia, and is the place of residence of the

civil governor of the department, and of an *ispravnik* and a *gorodnichii*. It possesses a population estimated at 4000 souls, composed of the mingled race of Russo-Siberians and Yakoutes, with a few pure Russians, who are chiefly officials in the service of the government and of the Russian Fur Company. * * *

Yakoutsk is at present the centre of the fur trade of Siberia, and is annually the depository of furs to the amount of upwards of two millions of rubles. Salt and talc are here also exchanged for merchandise.

Notwithstanding the somewhat heterogeneous materials which compose the population of this provincial town, to the eye of a stranger, the inhabitants appear to be almost wholly Yakoutes, on account of the features of the face, in particular, of that race being more distinctly marked than those which distinguish the proper Russians. The proportion of Yakoutes, however, of unmingled blood, does not exceed a quarter of the population. The mixed race, in the light in which they are chiefly seen by strangers, seem quite conformists to all Russian usages, though this is not in all things in reality the case. At their homes, and in their domestic affairs, and in their language, they are Yakoutes; while in their religion, and in regard to the social rights which they have been admitted to enjoy, they are not now distinguished from their fellow subjects even of the pure Russian race. * * * * * *

But at the same time, while at Yakoutsk we find the best example of those happy consequences of this accommodating disposition of the Russians, it is here also, that in comparing the Russian conquest of the aboriginal inhabitants of the country with the conquests of other nations of which history affords us ample examples, we discover the more essential moral causes of the different results that the sequel of their several wars has produced. The Spaniards, whose conquests form the greatest contrasts with those of the Russians, carried before them the cross, for which they opened a passage by the sword, and by worse means, carrying on exterminating war against all who submitted not blindly to their authority, and embraced not the faith which was to them a religion of blood with no other moral than that which recognised the right of the strong to commit every kind of violence against the weak. The Russians, wiser, and better endowed with the true spirit of the religion they profess, have carried with them also the same emblem of peace and good-will from Heaven towards man. But the means by which they have opened the passage for the symbol of their faith, and by which they have planted it in new soils, has been justice and equal rights, for the firm establishment of which their tolerant

spirit has been the pledge. Thus, while the Spaniards lighted the flames of war and hatred which are far from being extinguished even at this day, and afterwards converted to Christianity only in name the feeble remains of the people whom they nearly destroyed, the Russians have by their humanity subdued and reclaimed whole nations of far more barbarous races than any which the Spaniards encountered, and added them to the number of which their empire consists, and to whom their laws and their protection extend. * *

As we landed at Yakoutsk, there were a dozen or two men and women gathered upon the shores of the little port. The costume of the men we observed differed very little from that of the Siberians generally, but that of the women was novel to us. The men wore skins, cut in imitation of the caftan, trousers, fur caps, and short boots of untanned leather; but the women were dressed in very short caftans, also of skins, with a border of the breadth of half the length of the skirt in scarlet cloth, and enormous bear-skin caps. They also had the short boots of untanned leather; but their legs were bare like those of Highland *men*. * * * * *

We found the streets of the town laid out with the same regularity as those of the greater part of the towns both in Russia and Siberia, and the town divided into two nearly equal parts by a brook of not very limpid water, for which space enough, however, has been left for a fine river to flow, with a public promenade on either side.

We counted during our walk, six churches, all of which had been painted in the usual yellow and green, but none of them had much remaining of this mark to distinguish them from the ordinary houses of the town. There is also a convent here, with a church belonging to it; and there are some remains of an old Cossack fortress, which is said to have been erected by the conquerors of Siberia so long ago as 1647. * * *

The weather had been extremely variable during the first days of our detention at Yakoutsk. Sometimes a scorching sunshine during the greater part of the day was succeeded by a cold wind and rain in the evening, and the thermometer did not, after our arrival, indicate more than 11 Reaumer degrees of heat, until the 7th of the month, when it rose to 13. On the ninth, it stood at 15 at eight o'clock in the morning, and at 16 at noon, and on the tenth at 16 in the morning, and 17 at noon, with every appearance of settled weather."

YAKOUTSK.—We have no correct data as to the temperature of the weather at Yakoutsk, there is every reason to believe

that the summers are short and the winters very long. We have seen statements which represent that there are years when the frost never leaves the earth where the sun cannot reach it. Of course, we regard this as not to be wondered at in that far northern region. We have seen snow in Virginia lying in bank as late as the middle of June. In 1832 we very well remember seeing large quantities of snow lying in the field as late as the first of May, and in cultivating the land the snow was in the way of the farmers' progress. The snows remaining as late as the middle of June was where the sun did not reach it. With these facts existing in this country, we certainly expect the frosts to remain to a very late date in Siberia, as far north as Yakoutsk. But it is not material; the frost may be perpetual, and the snow may remain upon the earth for a century, and still the success of the telegraph would be certain. The colder and the more frozen climates are the best for the electric telegraph!

We have shown, that as far as Yakoutsk, the country is settled, the lands fertile, the people civilized and really useful in the cultivation of products, that the lands produce the varieties of grains, and that the face of the country being mostly level and abounding with timber, a telegraph can be constructed and maintained without any difficulty.

We have omitted to mention that the entire distance from the Prussian boundary in Europe, through Russia, across the Ural Mountains, to Tomsk, Irkoutsk, Yakoutsk to the sea of Ochotsk, is a post route, and every few miles a change of horses can be made at post stations! A traveller says:

"The next day after breakfasting upon the same dish on which we had supped on the previous night, we set off with fresh horses; and finding the same description of country, with a continuation of the same chain of small lakes, bordering with meadows and grassy slopes, that were perfectly dry, we encountered no obstruction, and reached the station Tshishikeiska, at the distance of thirty-two versts from that at which we had slept, at an early hour.

As far as the next post, Porotowska, at the distance of thirty four versts, we passed over the same description of country, and had the same facility of travelling; and we found here a similar lodging to that in which we had passed the previous night.

Upon the third day of our journey, we set off at an early hour with fresh horses, and continued our way by the same chain of small lakes, which it was now quite evident were but

the deeper parts of the bed of an ancient grand river, through which the current had ceased to flow, by the drying up of its sources, or a change in the course of the stream, or, possibly, by some geological phenomenon, such as the raising of the land caused by imperceptible volcanic action. Early in the day we arrived at the post of Tshuraptshinska, at the distance of thirty-two versts from that at which we had passed the second night of our journey; and soon after mid-day we reached Arilatska, at a further distance of thirty-two versts from the post last named. * * * * * *

The weather, during our journey up to this time, had been exceedingly fine, with the thermometer oscillating during the day between 16 and 21 degrees of heat. But during this afternoon the sun was obscured; and, a little before our arrival at this post, a storm of thunder, lightning and wind commenced, which, before our horses were relieved of their burdens, was attended with such torrents of rain as to make us think ourselves fortunate in being under cover."

Between Yakoutsk and the sea of Ochotsk, the route is much varied in its formation and products. The distance is about seven hundred miles to the port of Aian. The country next to Yakoutsk is very flat and swampy, full of marshes and ponds. The government road is very well improved, and the swamps are crossed by pole bridges, in the same manner as the marshes are in the western United States. Part of the route is hilly, and not a very agreeable country for travelling. The following description is from a traveller, who passed over Siberia, some two hundred miles north of the route intended to be followed by the telegraph.

"Until now, the spruce in its ordinary varieties had been sometimes the only kind of tree or shrub that was to be seen; and at other times the larch, with more kindly growth, flourished side by side with the several species of the hardier fir. Here and there, indeed, we had observed the pine growing, but only to the size, and in the form, of a mere shrub. But now we had the two first mentioned of these species among the innumerable varieties of the fir, of more luxuriant growth and in nearly equal quantities, and, at the same time, pines much larger in size than those we had seen before, and so rare and curious in form as to be worthy of particular remark. Not in a few instances merely, but during nearly the whole of this day's journey, we observed these trees growing as nearly as possible in the form of a bell turned upside down, and set upon its handle, which was represented by the trunk of the tree. The particular

species appeared to be that of the common white pine, which, although I had seen it growing, both where scarce and where abundant, of all sizes, from the shrub up to the sovereign of the most magnificent forests, I never before observed it taking this form. Here, however, where it seemed to have robbed all the other species that appeared in its immediate vicinity of their fair share of the earth's foison and abundance—for none of any other kind which were near it exceeded in growth the smaller shrubs—its height did not exceed that of the spruce in favorable situations, or perhaps twenty feet, while the bowl of the bell that was formed must have been in many instances eighty or ninety, and in some cases above a hundred feet in circumference.

The weather had been fine since we reached the dry lands, and we enjoyed the first part of this day, as freer from the natural obstructions to travelling which the country offers, than any we had passed since the first days of our journey. We were continually ascending the hills in front of us; and, before midday, the streams had become mere brooks, though our way was now more precipitous, and more fatiguing for our horses.

Early in the afternoon we crossed the summit of the first ridge of hills of any considerable height forming the grand mountain range. Owing to the rugged character of the ground, and the winding of the ways through which we had passed, we had obtained but one view of the country around, and that had been at no great elevation. But here we were more fortunate; and we halted for a short time to refresh our wearied sense, so long fixed upon the same scenes immediately around us. We had now, indeed, an extensive view of the country through which we had passed, which presented to us an undulated and vast tract of land covered with its sombre groves, that seemed to want nothing but the variations in the color of the vegetation of more temperate climes to exhibit all the freshness and variety of the most luxuriant forests.

After this we passed over narrow plains or shallow valleys, in which the horses were sometimes up to their knees in snow, and at other times marching upon masses of ice, honeycombed upon the surface by the rays of the sun, though quite solid beneath. These are the glacial districts of these mountains, whence the streams of the lower country are supplied with water, when the sun has its full force in the height of summer. This source, however, of these streams is cut off with the earlier frosts, which usually occur towards the end of August; after which the lesser rivers are dried up. In some places we found rents in the ice like fissures in solid rocks; and through these the water was

running over the ground in winding courses just in the manner that the brooks generally flow; and to pass them was difficult, on account of the thickness of the ice, which was from ten to fifteen feet. But in some places these unsubstantial banks of the streams were so worn beneath by the passage of the water, that, upon the horses approaching the edge of them, large sheets upon which we were marching broke off, and let us easily down; while the noise they occasioned in falling, made the hills echo with the loud sound from one extremity of the vale to the other. But what was most remarkable to observe upon these glacial fields, was the heat of the sun's rays reflected from the ice, which was greater than any thing of the kind I remembered experiencing, except the reflection from the sand in the hottest climates. Here, too, and far from the dry ground or trees, the quantity of the mosquitoes which swarmed until five in the afternoon exceeded any thing we had met with in the swamps. Altogether, the scenes and all we experienced during this day were novel in our travels; and the noise at all times of the ice melting sensibly around us—the occasional deep sounds caused by the falling of masses of the frozen element by the side of the streams—the crackling of the horses' feet as they crushed the honeycombed ice beneath them—the murmur of the running waters—the clouds of mosquitoes, and the excessive heat,—left an impression as indelible as that of the more disagreeable portions of the journey already described."

The country above described, is on the route formerly the government highway to the sea; but, it has been of late changed; it now runs from Yakoutsk to Aian, and not to the port of Ochotsk. Here is a description more appropriate to the telegraph route.

"For the endless firs, sown over the whole surface of the ground in larger or smaller quantities, depending upon the character and quality of the soil, and the elevation of the country, and exhibiting only the little varieties of color and foliage which their several tribes admit, we had now around us a mixture of the several perennial green-leafed trees that have been mentioned as growing in spare quantities in different parts of the country through which we passed during the journey, with a larger proportion of the lines of more luxuriant growth. Along the banks of some of the brooks we now found strawberries; and here and there we perceived open spaces, covered with a variety of shrubs, among which were mingled currant bushes, the fruit of which, though not sufficiently advanced to exhibit color, was evidently of the red sort. Our men were in raptures of de-

light at the sight of this fruit even in its present state, and picked and ate quantities of it; but we reserved our appetites for something more solid in prospect. A variety of flowers were also seen flourishing here among the brambles and underwood, amidst which the rose and the flag-iris were predominant.

This change in the appearanceof the country and the vegetation, was as unexpected as it was agreeable to us, seeing that we had yet scarcely recrossed the 60th degree of latitude, and it seemed to make some amends for our physical deprivations. * * * * * *

After descending this range of hills, we came into a vale of extreme fertility. The green and broad leafed trees that chiefly flourished here, were the lime and the birch; of the hardier species of the fir tribes which were more familiar to our eyes, we observed only the larch. The wood was open, and the trunks of some of the limes were from three to four feet in circumference, and the branches were much larger than the proportion which is usual to that size of trunk in most forest trees, but they had very few small boughs, and very little fresh foliage.

Along the banks of a slow rivulet by which our path lay, we observed shrubs of various kinds in full bloom, and growing with such luxuriance as in several places to obscure the view of the stream. Among these, the rose-trees were predominant. In many instances they reached to seven or eight feet in height.

* * * * * *

The next morning, as we advanced, we found the fertility of this plain greater than that of any portion of the country through which our path had hitherto lain. Early in the day we passed by several Yakoute huts, where we were plentifully supplied with cream. The distances from one another at which the several families that inhabited these houses were dwelling, in the midst of a country where there is no scarcity of pasture to maintain their cattle, which furnish the sole means of their subsistence, seemed indicative of their race being of a gloomy and unsocial disposition. We believed this, however, not to be the case; and we made inquiries of them why they lived so far apart. But in reply we heard only the same reasons that are often given in very different countries, for the conservation of usages that ought long since to have been abolished, that such was the custom of their fathers.

Attached to all the houses that we passed by, after crossing the last hills, there were larger portions of pasture-ground than we had before seen; and the grass, though of a coarse description, was here growing most luxuriantly. By the stream, the abundance of wild productions of the several kinds with which

we were familiar, still more surprised us. The rose-bushes, which were everywhere in great plenty, were in some instances from six to nine feet in height. Early in the day, we crossed several times a stream of a chalky colour; and we observed that, whenever the stones broke its smooth course, appeared a foam like soap-suds, which covered the surface of the water as far down as the eye could reach."

Such is the nature of the country through which the proposed telegraph will pass; some of it is unfavourable, having but few settlements, and inhabited by people uneducated. Notwithstanding all the unfavourable features of the country, there are no formidable obstructions to the construction of a telegraph. We have built lines in America over worse country, climate more unfavourable, and among people no better than the phlegmatically disposed Siberians. We have not forced upon the reader wholly our own views, but we have given the information gained from a multiplicity of authorities. The distance from Irkoutsk to the sea of Ochotsk, is about 2,800 miles, and estimated to be about 6,550 miles from Moscow.

The port of Aian is superior as a harbor for vessels, and is destined to be a town of great importance; and, we suppose it will be the great Russian mart on that sea. From Aian, we propose to run the line around the sea of Ochotsk, north to the Cape Iamsk, and thence across the narrow neck of sea to Cape Utkaloka, in Kamtchatka.

Arriving in Kamtchatka, we will extend the line to a convenient point for connection with the Aleutian Isles. We can also run south to Petropavlovski, the principal fortress and town in Kamtchatka. For the benefit of the reader, we give a few facts on the Peninsula, which will serve to show that the country is not a range of desolate hills, covered with perpetual snow, and inhabited by barbarians.

"KAMTCHATKA comprises the whole of that great peninsula which stretches out from the coast of Asia at its north-eastern extremity, and is washed by the Pacific Ocean on the east and the sea of Ochotsk on the west. It lies between the 51st and 64th degree of north latitude, and between the 155th and 164th of east longitude. It is between 700 and 800 miles in length, and about 250 in breadth at its centre near the latitude of 55 degrees, but not above eighty or ninety at either of its extremities. The most remarkable natural features of this great peninsula are its volcanic mountains, which rise at intervals throughout a vast range, which stretches from its southern to its northern extremity, and appears to be but a continuation of

the volcanic range which forms the Kurile Islands, and extends even to Japan and the islands along the eastern coasts of the Asiatic continent. It has only one navigable river, called the Kamtchatka, which falls into the Sea of Kamtchatka near the centre of the peninsula, but it has many less considerable streams. The coasts and all the river of Kamtchatka abound in fish and water-fowl. The sea is frequented by whales of several species, and by walruses and seals in great abundance, besides cod and herring; and in the rivers are found great quantities of salmon. Geese and ducks, also, of several species, frequent the coasts and the rivers during the autumn and spring in great numbers.

The peninsula is inhabited by three aboriginal tribes, the Kamtchatdales, the Kouriaks, and the Ohlutors. The first of these occupy the southern, and the other two the northern districts of the country. But the whole of the native population is not supposed to exceed 4,000 or 5,000 souls.

The climate of Kamtchatka is much milder than that of the continent in the same parallel of latitude, owing, without doubt, to the influence of the sea on both sides of it. The maximum of cold in the southern districts does not exceed 20 degrees.

The country politically forms a part of the government of Ochotsk, and is comprehended within the grand province of Eastern Siberia. Its capital town is called Petropavlovski, or the town of St. Peter and St. Paul, and is seated in the bay of Avasha. * * * * *

The Kamtchatdales, however, live in villages like the Russians in winter, when they hunt and procure furs, some of which they exchange with the traders for useful articles, but the most part for *vodka* and tobacco. * * *

The imperial government, in conjunction with the Agricultural Society of St. Petersburg, has established two superintendents of agriculture, who travel and distribute seeds sent from Russia, and collect information concerning the condition and capabilities of the country.

On one occasion at the government-house, the commandant, whose interest seemed fully engaged in the advance and prosperity of the country under his government, exhibited a specimen of cloth manufactured by two Kamtchatdale girls of the interior of the country, and also some specimens of the plants from which it was made. The cloth was not very fine, but was said to be extremely durable. The plant which furnished the raw material is called *Krapeva* by the natives. It very much resembles our stinging nettle, but is of larger growth and of a fibre much stronger. Those which were exhibited were up-

wards of six feet in length. Specimens of the cloth had already been sent to St. Petersburg; and the agricultural society there had forwarded some rich presents to the two ingenious girls. *

The government has not been unmindful that moral culture, if it do not precede, must at least march hand in hand with material progress of any kind; and the true elements of proper civilization, the means of instruction, have been afforded the natives of the southern districts of the peninsula. Several schools have in effect been established; one at Milkova, 320 versts from Petropavlovski, and the other at Clutchifskoi, 600 versts from the capital. And besides these there are other small schools for young children, attached to the churches, which have been erected and endowed in different parts of the country."

The middle district of the peninsula is described as being very fertile, comprising an extensive valley, lying for

"The most part between two ranges of hills, and watered by the River Kamtchatka. Here the soil is composed of fine mould, similar to that which we have seen prevailing in Siberia; and its natural productions are abundant, consisting of all the varieties of the fir and the birch, of a finer growth than any to be found in the same latitude upon the Asiatic continent. It was the general opinion, that all this part of the country would produce hemp, flax, and the principal culinary vegetables. Ships of 100 tons burden may advance 200 versts up the river which here fertilizes the country. Raspberries, strawberries, whortleberries, currants, and cranberries, abound also in the same district. There is likewise much grass in the lower lands; and many forest trees flourish on the drier soils, such as larch, poplar, willow, cedar, and juniper.

The wild animals most abounding in the peninsula are, bears, lynxes, sea and river otters, reindeer, foxes of different colours, wolves, and martens or sables. The natives exchange annually about 100,000 of the skins with the Russian traders, for various articles of merchandise. Ducks, geese, and other birds of passage, are plentiful in spring and autumn.

Of the fish with which the rivers abound, salmon of several kinds is the most remarkable.

Herrings are as plentiful in spring and autumn, as upon the coast of Europe and America. Smelts are likewise plentiful at the same season. * * * *

There is little doubt that the peninsula is rich in mineral deposits, but it has been very imperfectly explored. The natives

are said to know of districts which abound in the precious metals, but which they judge it prudent to conceal, lest it should tend to increase the number of the Russians in their country, and by and by lead, as they seem to have a somewhat obscure presentiment, to their being forced to labour in the mines."

Iron ore, coal and other valuable mines, exist to a very great extent throughout the entire country!

"There is, perhaps, no country in the world that is of more purely volcanic formation than Kamtchatka. The *whole* peninsula must be considered to be composed of but one vast range of volcanic mountains, and the *debris* which remains of the substances emitted during their eruption at different periods in the geological history of our planet. Many of them still are in a state of action. * * * * *

From the crater of the Avasha, which is immediately behind Petropavlovski, have been thrown at the same time stones, lava, and water; and from the two mightiest in a state of action, Klutchewsky and Assachninsk, the ashes have been thrown beyond a hundred versts."

Much of the country is fertile, though abounding with hills and valleys. The river bottoms are cultivated, and produce the useful commodities of the inhabited countries. The people are very civil, and though not so rapid in life as the inhabitants of the modern world, yet, they would be less offensive to a telegraph line. Our readings on Kamtchatka teaches us to believe, that a telegraph can be as easily constructed, as across the great chain of mountains in America. Having now noticed the route of the proposed telegraph across the continents of Europe, and Asia, to the Pacific Ocean, on the eastern shores of Kamtchatka, we will examine the route to America across the Pacific Ocean.

We do not deem it necessary to discuss the advantages or disadvantages of the route around, and crossing Behring Straits. Many gentlemen regard that as the best for the telegraph. There are no mountain icebergs there to destroy the electric cable; there are no great slides of ice to break asunder the subterranean wires, as has been wildly imagined, and there are no elements in nature to injure the successful working of a line by that route. We do not propose to run by the Behring Straits, because it will cost less to run the line direct over to America, along with the chain of Aleutian Isles, which seem to have been placed there by the hand of nature, to aid the girdling of the world with the telegraph. We have no doubt of the practi-

cability of both routes, but as these telegraph isles are so beautifully arranged, and located at short distances from each other, and within a moderate climate, we have fixed upon that direction as the best for the purposes in view.

Aleutian Isles.—Proceeding from the eastern coast of Kamtchatka with the electric telegraph to the American continent, we propose to occupy these islands. They are in the possession of Russia. Many of them will not be used, because their respective proximity preclude the necessity. Such of them as may be deemed advantageous, will be employed for the enterprise. Many of them are surrounded with shoal water, broken and projecting rocks, rendering them inaccessible. There are many fine islands among them, well suited for the landing of a cable. If deep water be required, there are those that can be approached with deep water. If shallow water be required, then we can select those suited for that purpose. If inhabited islands should be required only, then we can select those alone, and if not, we can select those few upon which there are no people.

The inhabitants of these islands are very well informed, and are perhaps better disposed, than the people of any other part of the northern hemisphere. Their pursuits are directed, mostly in fishing and hunting. Cattle are grazed on some of them, and the products of the earth are, also, cultivated to a moderate extent.

The Aleutian Isles are divided into four divisions—the *Blignie* group is composed of four islands, the *Rat Islands* compose several more, the *Andréanoff* Isles compose another group, and the next are the *Fox Islands*, composed of several which extend to the Aliask Peninsula of the American continent.

We do not deem it necessary to go into details, as to the character of these islands. That can be done in the future. They are scattered across the Pacific Ocean, from Kamtchatka to America, at distances varying from one to fifty miles apart, and they are from one to eighty miles in length. Some of them are quite low, and others are composed of immense mountains, exceeding in height the great Ural Mountains. Some of the higher peaks are covered with perpetual snow. Some contain volcanoes and abound with hot springs. The volcanoes continually issue smoke, and one of the higher peaks contain a large lake of boiling water.

These islands have been examined, and we have before us very correct data as to their topographical features, the geological formations of the earth, the latitude and the longitude of each; the depth of the water around each, the products, the in-

habitants, and the climate of the whole. With this information we think we can safely come to proper conclusions, as to their fitness for the purposes of the telegraph. We have studied them very carefully, and the line can be carried by this route with the utmost facility.

Landing the line upon the western end of the Aliask Peninsula, which projects many miles into the ocean, from America, we will follow its most favourable formations. The length of the peninsula is 330 miles, and from 25 to 90 miles in breath. On this peninsula are high mountains, and a peak towering high in the heavens, on the summit of which is a volcano, that will equal in grandeur the Hecla, Vesuvius and Ætna. There are not many inhabitants on the land, perhaps not more than 10,000, but they are good and useful people.

The line will run around the head of Cooke's Inlet, proceeding south along the coast, to the British possessions, latitude 54° 40. The whole country between Cooke's Inlet and the British boundary is of varied formations, mostly hilly, having a few streams entering the ocean. The streams can be easily crossed, and the mountains in the interior are gradual in ascent, rendering them accessible to travellers, sufficiently so, at least, for the construction of a telegraph. The coast is more or less populated, having some 11,000 people scattered over the country.

The lands are capable of producing wheat, barley, oats, &c., and the climate favours their growth. With a better management of the people from that which is exercised over them now by the Fur Company, will make the inhabitants advance in the cultivation of the products of the earth. Their main commodity is fur, and that is the marketable article. If they would devote more attention to the cultivation of grains, the country would very soon change in its appearance, and where the fox and other fur tribes inhabit, the plough would occasion the coast to be beautified with the useful products of the earth.

Passing from the Russian territory in America across the British, to the United States, at 49° 50, we enter a country well understood by the people of the present age. We do not deem it necessary to speak of this country, nor of the people; as the character of both are well known to be favourable to the construction of a telegraph. The maintenance of the line is another question. In that we shall have trouble from the Indians. The rapid settlements of the whites along the coastwise territory, will occasion, perhaps, the hostility from the savage tribes; but a few years will dispel these fears. The Indians will be compelled to go into the interior, and the coast will be thickly settled by the enterprising whites. Ten years

will perhaps place a million of people in this country, scattered all along the coast! Proceeding along the coast of the Pacific Ocean, south to San Francisco, all the important towns will be placed in communication with the Atlantic, European and Asiatic people.

At San Francisco the line will connect with the great Atlantic and Pacific Telegraph, which is under arrangement of construction by the American people. For the particulars as to the plans of this gigantic enterprise, reference is requested to the article upon that subject in the second number of the present volume of the Companion.

From St. Louis, Missouri, we will have two connections with the Atlantic Ocean; one through the States and the other through Canada, via Chicago. If the Atlantic Ocean telegraph starts from Labrador, a line on the north side of the St. Lawrence can be run to make a connection, and another through the Provinces, Newfoundland, and thence to Labrador. These connections can be readily completed, as much of the lines are at present in operation.

We have devoted room enough to the consideration of this subject in the present number. Facts have been given sufficient to convince any one that a telegraph can be constructed around the world. We have shown that the country through which the line will run is well suited for the construction of the telegraph, that the climate is not unfavorable, and that the people are not barbarous, as has been slanderously promulgated to the world by conceited writers, but by people who are the best in the world, inhabiting the entire country, except, perhaps, the American coast where the savage tribes of Indians roam. There is no part of the route more covered with lakes, swamps, and inundations, than some parts of America where we have constructed lines of telegraph, and where they have been in operation for many years. We are sure there is no country through which the line will run so unfavorable, so difficult either to build or maintain a telegraph, as upon Newfoundland, where the energy of our people is rapidly approaching the Atlantic coast with the electric wires. As to the Atlantic Ocean section, we refer the reader to the article on that subject in the present number of the COMPANION. We have been as brief as we possibly could in the discussion of the subject. We have omitted many facts which would greatly favor the proposition, but we could not say all in a volume of less than five hundred pages. A route of thirty thousand miles over a country presumed to be but little known, circling the whole earth, cannot be discussed within a few pages. We do not address these remarks to the

mind limited by narrow boundaries, poisoned with envy, selfishness, and prejudice. We seek for the consideration of those persons who are imbued with a liberal state of patriotism, and a zeal commensurate with the progressive state of the age. They alone can grasp with justness and competency the vastness of this magnificent and stupendous enterprise. That it will be consummated, we have no doubt. That it will subserve the welfare of all nations, and be calculated to bless generations to come, we earnestly believe. So far as we can devote our energies to the realization of these hopes, we intend to prosecute the cause to the end of life, or until the enterprise is complete, and the world circled with one continuous stream of the electric flame!

ART. VII.—THE TRANSATLANTIC SUBMARINE TELEGRAPH.

EUROPE AND AMERICA TO BE CONNECTED BY THE ELECTRIC TELEGRAPH—A COMPANY FORMED—PROGRESS OF THE ENTERPRISE.

JOHN W. BRETT, OF EUROPE, } GERANTS.
TAL. P. SHAFFNER, OF AMERICA, }

THE connection of the eastern and western hemispheres, by electric telegraph, has been a subject of grave discussion for many years. More than a year ago, we announced to the American people that we were engaged in the earnest prosecution of that undertaking, and that we intended to adhere to it until success was triumphant. Of course, we have many times calcuculated the cost of the enterprise, as regards money, time and life. So far as we command these requirements, the undivided energies of our future life will be directed to this object. That we shall ultimately be successful, there can be no doubt. We care not for opposition, as we are confident none can arrest us in the satisfactory prosecution of the enterprise. There may be a few ambitious persons who are ready to grasp a favorable opportunity to make a noise, for a prospective gain, hoping to have their silence bought; but we can assure all such, that any vain boasting of great wealth and power, only occupies in our mind that consideration which is generally allotted to the music of "sounding brass and tinkling cymbal."

In order to consummate this vast undertaking, we need no high-sounding names of men who have figured in the affairs of state, in the Bourse, Lombard-street, Wall-street, or in any de-

partment of fancy life. A select group, of men from any one section of the world, will not be sufficient to carry out an enterprise of such magnitude. In its management the best and most experienced telegraph skill that can be employed from the whole world will be required in its prosecution. Money will be indispensable in its aid; but money, without the experience and knowledge of the science and art of telegraphing, will be of no avail.

It is often the case, that gentlemen embark in telegraphing, and because they are possessed of a few dollars, they imagine that in a few hours a thorough knowledge of the art and science of telegraphing can be comprehended. That which requires the devotion of years to obtain by the practical telegrapher, a man of money sometimes conceives he can grasp—with his self-conceited genius—in a few days. Such men are to be dreaded in any enterprise. They are like so many vampires upon the cause, however important. Public welfare never receives their solicitude; but, it is their own selfish ends that must be gratified before all others, even at the sacrifice of the public weal. All such men we are determined to eschew, and give no concern in the management of this grand undertaking. We would much prefer seeing the whole enterprise fail, than in the hands of speculators, who enter into the company solely for speculative gain, for the present, regardless of the future.

We are not particular in our feelings as to the proper place of running this submarine cable, though we are firm in the conviction, that it will be best to adopt the Greenland and Iceland route. Nevertheless, we desire that all shall be thoroughly examined and judged upon, before the final adoption of any. We desire to see a cable stretched from continent to continent, that will endure all time; one that will never fail, and be the means of advancing the interests of the people of all nations. We hope to see its management liberal and international. We do not seek any advantages for the American people, and we hope none will be sought for the people of any other country. The communication should be free to all alike and co-operatively under the shield of every nation of the globe. We hope to see it beyond the possibility of interruption through the power of the elements of nature; and also free from that most dreadful destroyer, the god of war. It is the uplifted sabre of this monster that gives us more fear than the combined elements of natural creation. With the pledged faith of nations, that this intellectual flame shall not be quenched, we can confide in the triumphant creation of a power, that can say, "there shall be peace and good will among men."

In this great undertaking we have with us that noble and intrepid submarine telegrapher, John Watkins Brett, Esq., of Europe. His name has ornamented the pages of European history, and the annals of years near at hand will record his deeds great in America. His energies have no bounds, and his abilities are equal to any emergency in the prosecution of these advancements of the electric telegraph. His devotion to the extension of the telegraph in Europe and Africa entitle him to the gratitude of nations, and particularly the governments most directly interested. In the erection of the Transatlantic Telegraph Mr. Brett will share largely, and his superior experience, judgment, and energy, will be of pre-eminent service in its consummation. We are not saying too much when we assert, that Mr. Brett stands foremast as a submarine telegrapher, and has no rival. With such aid we have no fears of a failure. We do not deem it necessary to give a full statement as to the plan of carrying out this enterprise. That will be promulgated in the future. Until all the routes are thoroughly examined, and all questions properly considered, we do not deem it proper to even form a fixed opinion. We have given the different routes much study; yet there are circumstances which may change any opinion we may have formed in the past; consequently future examinations must determine the best route to run the transatlantic submarine telegraph.

We give the following letter, which explains itself, and leave the further discussion of the subject for the future.

ATLANTIC OCEAN TELEGRAPH.

METROPOLITAN HOTEL,
New-York, February 2, 1855.

TO THE EDITORS OF THE EVENING POST:

Gentlemen:—You did me the honor to notice my proposed world-girdle telegraph, for which I thank you. I am also under obligations to the press throughout the land for copying your editorial upon the subject. A discussion of the scientific questions involved in the project of the telegraph across the ocean I do not deem at the present time opportune, for many reasons; nevertheless, it is well for the enterprise to be under public consideration.

I have seen in the *Louisville Courier* a notice purporting to originate with the *Philadelphia American*, relative to the telegraph across the Atlantic Ocean, in which the route I propose is regarded as a scheme of folly. The editor says:

"If we do not get a telegraphic communication with Europe before this line is constructed, we fear that a perpetual separation must exist. The account says, that there must be no submarine section of more

than five hundred miles; yet the map tells us that the distance between Iceland and Norway is eight hundred and fifty miles. The stupidity of the whole affair is evident; for the map will show any one that Iceland is nearer to Scotland than to Norway; and as for running telegraph lines into Russsia, Chinese Tartary and Kamtchatka, instead of to England, that seems particularly absurd. The three submarine sections, from Labrador to Greenland, from thence to Iceland, and from thence to Norway, are either impracticable or useless; for, if practicable, science will teach any one that the same reasons will make the direct line from Newfoundland to Ireland practicable. If Mr. Shaffner went to Europe on any such mission as that above stated, he has spent a great deal of money for nothing."

With your permission, gentlemen, I will briefly consider these points of difference in opinion, with a little more regard, however, for courtesy and respectful language than characterizes the editorial from the *American*.

It is a settled fact in philosophy that a galvanic current is arrested in its transit through a long submarine or subterranean wire. So great has this new impediment been experienced in Europe, that the most learned savans have been active in new discoveries to find a remedy. The difficulty may be overcome, ultimately. I will not say that a galvanic or magnetic electric current can never be sent from Newfoundland to Ireland; but I do say that, with the present discoveries of science, I do not believe it practicable for telegraphic service.

The distance between these two points is about 1,800 miles; and, allowing for a slack of a cable, the length of the electric wires will be at least 2,500 miles! As experience thus far has proved the impracticability of transmitting a current at will on a submarine or subterranean wire of 1,000 miles in length, how is it possible to transmit it 2,500 miles? The most extended submarine wire ever experimented upon is the Mediterranean telegraph cable, on which I witnessed many experiments, with a view to ascertain the necessities of an oceanic line. The length was 660 miles. On that distance success was evident. We have no knowledge of the successful working of a line in length as great as 1,000 miles, embracing submarine and subterranean wires; and if we have not the evidence of the practicability of transmitting telegraphic intelligence over a line of this length, it occurs to me that I should, indeed, be guilty of great "stupidity" were I to talk about a line direct from continent to continent—a distance of at least 2,500 miles! Nevertheless, new discoveries may at an early day overcome this formidable barrier in the science of telegraphing.

As to the Greenland route, I would say that the editor of the Philadelphia American has certainly exhibited great unfairness. On reference to the map, any one can see that the longest section is from America to Greenland, being about 500 miles. From Greenland to Iceland, or from Iceland to the Faroe isles, or from the Faroe isles to Norway, that distance is neither exceeded nor equalled. Estimating, however, the sections to be each as much as 660 miles, I am within the

bounds of practicability and certainty. These facts must prove one of two points, viz: that the Philadelphia editor was either ignorant of the existence of the Faroe isles, or wilfully omitted to mention them. They are nearly half way between Iceland and Norway, and are embraced in my grants from Denmark.

Again: this unfair editor urges objections to this route because it does not run direct to England. It is in contemplation to extend the line, if necessary, from the Faroe isles, not only to Norway, but also to North Scotland, and thence south to England. The great business relations between America and Great Britain cannot be overlooked; but I am not one of those who believe that England is the only place of importance upon the face of the earth. We have a large trade with that great country, but we have also a respectable trade with the nations on the continent.

I regard this question with an American proclivity, and in the negotiations with the governments of Europe, while I have consulted as well their interests and convenience, I have had in view the welfare of my own before that of any other country. And in the preservation of the rights of the people of America to transmit intelligence over the lines proposed by me, I have, also, not forgotten that there are other nations of the earth. As an evidence of my sincerity in this respect, and my regard for reciprocity between the people of the whole world, I give an example illustrative of the course which I have marked out for myself in all my treaties with the governments of Europe. The following clause, taken from my letters-patent, granted by his Majesty the King of Denmark, I presume will be sufficient to demonstrate the end I have in view:

"That the government of Denmark will forever defend and preserve the rights of the citizens of the United States, and the people of all nations, to transmit messages over the line herein contemplated, provided the said messages are not calculated to promote war, insurrection, riot, or the violation of peace among nations."

The editor of the *Philadelphia American* will see from the above, that I have not only considered the good of my own country, but also that of England. I could not regard the people of Great Britain with more favor than those of the German States, of France, and other powers of the Continent.

Supposing it was practicable to work at will a line of telegraph from Newfoundland, the French islands, or any other part of the American coast, direct to Ireland, I would not consider it worthy of American patronage unless the rights of our people were duly protected by fixed treaties with Great Britain. In case of war between the United States and Great Britain, the American people would have no opportunity of sending or receiving intelligence by telegraph. All communication between the people of this country and the nations of Europe would be cut off. The line would be in the sole service of the British Government in transmitting orders from the War Office in London to their forces in the provinces, exclusively in their own interests, and to the ruin of this country.

In the consummation of this important enterprise most formidable difficulties will doubtless arise, and they may possibly be too great ever to be overcome; but a small share of the indomitable energy so characteristic of the country in the successful achievement of bold enterprises may safely be relied upon to accomplish this grand and magnificent project, notwithstanding it has been so sneeringly characterized by the *Philadelphia American* as a "scheme of folly."

The *American* says that the Greenland route, as sections, is "either impracticable or useless," and, "if practicable, science will teach any one that the same reasons will make the direct line from Newfoundland to Ireland practicable." He gives no reason why the line would be "useless." I suppose he considers his *ipse dixit* to be sufficient to determine that question. The reason for making what he calls a direct line practicable amounts to this, viz: if it is practicable to work a telegraph cable five hundred miles submarine, it is also practicable to work twenty-five hundred miles! This is not the fact, however, and it is for the editor of the *American* to prove it. To show how ridiculous this proposition is, I will apply it to our own daily experience, viz: If it is practicable to work a line direct with one circuit from Boston to New York, it will work also from Boston direct to New-Orleans. This has never been done, and is yet to be proved practicable! Boston can work to New-Orleans by the combining of electric circuits; but we cannot have stations to combine circuits in the ocean. By the Greenland route I believe America can telegraph, by the connection of the galvanic circuits, with London, Paris, Copenhagen, St. Petersburgh, &c.

I am fully aware of the vastness of this undertaking. For years it has been the object of my desire, and I am now solely devoted to its consummation. Conflicting opinions and jealousy cannot arrest or temporarily postpone the girdling of the world with a telegraph. When Prof. Morse first said his telegraph could work around the globe, little did he dream of ever witnessing it, or even living to see the plan so favorably considered by the great powers of the earth. He may yet live to send the first despatch, and receive by the electric flash the congratulations of nations for giving birth to the most wonderful achievement of man.

Very respectfully, &c.,
TAL. P. SHAFFNER.

RELATIVE CONDUCTING CAPACITIES OF METALS.—The annexed table exhibits the relative capacities of the metals mentioned to conduct voltaic electricity. They are the results of experiments instituted by M. Becquerel:—

Copper wire	100.
Gold	93.6
Silver	73.6
Zinc	28.5
Platinum	16.4
Iron	15.5
Lead	8.3

ART. VIII.—AMERICAN PRESS ON THE WORLD GIRDLE TELEGRAPH.

[We give the following notices from the American press on the World Girdle Telegraph. We have seen hundreds of the like, and they manifest the most confident hopes of the consummation of the enterprise.]—EDITOR.

[*From the New-York Post.*]

SHAFFNER'S WORLD-GIRDLE TELEGRAPH.

"We announced several months since the departure of Tal. P. Shaffner, Esq., the editor of the American Telegraphic Magazine, for Europe, to make arrangements for the construction of a telegraph around the world. He has recently returned from his expedition, the results of which possess more than ordinary interest.

We learn from Mr. Shaffner that his recent tour in Europe was undertaken for the purpose, first, of acquiring a thorough knowledge of the different modes of telegraphing and constructing lines in the Old World; second, to negotiate with the Danish government for the exclusive right to lay a line over Greenland, Iceland, and Faroe isles, and Denmank, for the term of one hundred years; third, for the acquisition of similiar rights over Norway, Sweden, and Russia. With these and other rights, which he proposed to himself to secure, the success of his plan to girdle the world with the electric telegraph no longer appears visionary or impracticable.

The route of his proposed line is as follows:

Starting from the coast of Labrador, the width of the sea to Greenland is about five hundred miles. From the point of landing, the line is to extend under ground around Cape Farewell to a point on the east coast of Greenland, favorable for a submarine connection to Iceland. A subterranean line across to the eastern coast of that island will connect with a submarine wire running to the Faroe isles, and thence to Norway, landing at or in the vicinity of Bergen. Mr. Shaffner informs us that the land and climate of Greenland and the isles are well, and even better adapted to the construction of the telegraph than those of the United States. Greenland abounds with mineral wealth, and he thinks the telegraph will tend to develop the unappreciated resources of that country. By this route there will be no submarine section of more than five hundred miles, and the loss or failure of one section will not destroy the others. In a line direct from Ireland to Newfoundland the failure of any part occasions a loss of the whole.

After landing on the coast of Norway it is intended to run

the line to Christian, the capital of Norway, and from thence branches to Copenhagen and Stockholm. The Danish government has bound itself to furnish proper connections with the governments on the continent and Great Britain. Consequently, it will not be necessary to run a cable from the Faroe isles to the Shetlands, Orkneys, and to north Scotland. Treaties with the Emperor of Russia contemplate the extension of the line from Stockholm, in Sweden, to St. Petersburgh, across or along the coast of Finland. By the construction of this section America will be able to transmit intelligence direct to Russia, and thus establish most intimate relations between the subjects of the Czar and the sovereigns of the United States.

Leaving St. Petersburgh, Mr. Shaffner proposes to run his line to Moscow, or connect at the latter place with the imperial lines already in operation—from thence to Kazan, across the Ural Mountains, into Asia, passing through Omsk, Kolivan, Kansk, Oudinsk, to Irkoutsk, near Lake Baikal. This is near the great tea country in Chinese Tartary, from whence the Russian tea is brought overland on wagons. The trade in this tea, which is said to be the best in the world, is very large, and the telegraph, it is supposed, will tend to increase it materially.

From Irkoutsk it is intended to run the line to the sea of Ochotsk, either north the Yakoutsk, or south with the Amour river, and thence along the coast of the sea of Ochotsk to Iamsk, and across the Gulf to Cape Utkoloka, Kamtchatka, and thence along the Aleutian isles to Aliaska peninsula or Cooke's inlet, in North America. From this point the line will be run along the Pacific coast to Oregon, and south to San Francisco, California. This range is entirely south of the latitude of St. Petersburgh, and in fact the line can be carried around by Behring's Straits, and be south of the Arctic circle.

From San Francisco Mr. Shaffner proposes to run the line along the best route to the Salt Lake, and thence to the western boundary of Missouri, where it will intersect the existing section of the California line, built by him a few years ago. Joining the great lines in America, the earth will be girdled with one continuous and unbroken flame of electric light.

In the ocean or submarine department of the great work Mr. Shaffner has associated with him Mr. John W. Brett, who has been the projector and successful constructor of the vast ranges of submarine and subterranean lines of the Old World.

The consummation of this great enterprise will be productive of consequences which the human imagination strives in vain to realize. It will enable us to communicate daily with every civilized nation on the face of the globe, and many not so

civilized; for, as soon as possible after the completion of the main trunk, branch lines will be extended to Japan, Pekin, Nankin, Canton, and other cities of China.

We are informed by Mr. Shaffner that he expects but little trouble in maintaining the line through Russia in Europe, in Asia, or America. The roads are good and well improved; the climate is most favorable for the enterprise; and with the aid of the Emperor he thinks there will be no formidable hindrance. The military system is very perfect throughont the empire, and will constitute an ample guarantee against any troubles which telegraphic science cannot provide against.

In the negotiations of Mr. Shaffner in Europe he has been singularly fortunate, and his efforts have been crowned with flattering success. Depending upon his energy, he has succeeded where the most skilful diplomats have failed. He informs us that he had one great element of strength; that was, he was an *American*. His Majesty the King of Denmark intimated to him that he would not have considered the proposition had it come from a citizen of any other nation; but he informed Mr. Shaffner that he granted the patents under the belief that there were no obstacles in nature that could be a barrier against the genius and enterprise of his countrymen."

[*From the New-Orleans Crescent.*]

A WORLD GIRDLE.

"It is singular to notice how, in the history of the world, almost every great achievement of science has been at some time, long previous to its discovery, prefigured and prophesied by the pen of genius; has been foretold and partially described in fable, romance or poetry. For truly great minds live always in advance of their own age, and are chiefly great in that they see as probable and possible those things which to all other men are chimeras. Hardly any of the great inventions of the world but have been more or less fully and accurately pictured centuries before they were made practicable. Thus the winged wonders, which Ariosto and Spenser delighted in creating, now fly through the air as balloons, or thunder over the earth as locomotives, or plough the deep as steamships,

"Steadying with upright keel"

against wind and wave. Things that were the fables of a past age are the facts of the present, and what were once dreams have become realities.

In the Midsummer Night's Dream, Shakespeare makes *Puck* say:

"I'll put a girdle round about the earth
In forty minutes."

It is in proof of our statement that an American citizen, of the present day, is engaged in receiving subscriptions and making arrangements to perform actually what Shakespeare faintly foreshadowed, and to accomplish that which, if it had been advocated a century ago, would have constituted sufficient grounds for a writ *de lunatico inquirendo* against the enthusiast. Thus the fancies and fables of genius render themselves the facts of after-time.

This world girdling scheme to which we have referred is not dependent upon any new discovery in science, and is actually but the extension of our present telegraph system. But such an extension! It contemplates bringing us into neighborly converse and propinquity with those inhabitants of the antipodes that are far deeper under our feet than any Artesian wells ever sunk or to be sunk; it contemplates daily mails from the great tea countries of Chinese Tartary and regular news from the Faroe Islands and Cooke's Inlet. It is more grand and gigantic in its proportions than any scheme of the present day, and seeks to tie together, in commercial and friendly relations, the whole civilized world; if completed as contemplated, the reader in this city will be able each morning to peruse the records of yesterday's proceedings on the Bourse, the publications of the papers in St. Petersburgh, the successes of the armies in China, the news at Honolulu, and the state of the weather in Greenland. It will girdle the world like a new equator, and make Cancer and Capricorn mere figments of a fool's brain.

The Columbus of this telegraphic feat contemplates starting from the coast of Labrador, and laying an unbroken wire, five hundred miles in length, among the walruses and whales of the North Sea, to Greenland. The wire will cross Greenland and stretch again eastward to the Faroe Islands, from whence it will reach the Continent in the vicinity of Bergen, in Norway. Thence, sweeping on towards the circumference of the globe, the wire will reach Stockholm, and coast along Finland to St. Petersburgh. Leaving the city of the Czar, it will trend towards the Ural Mountains; leap across them into Asia; pass through the provinces of Omsk, Oudinska, Kansk, Kolivan, and the great tea country of Chinese Tartary; stretch away to the sea of Ochotsk and across the gulf to Kamtchatka; thence along the Aleutian Islands to Cooke's Inlet, in North America. Then running down the Pacific coast to Oregon and San Francisco, the line will strike to the east by the Salt Lake, and touch civilization at the western boundary of Missouri.

This gigantic scheme for crossing oceans, and islands, and continents; for bringing savage and civilized nations into daily communication; for outstripping the winds and annihilating time; for girdling the globe with one uninterrupted flame of electric fire; is not a scheme only, but a practical plan towards the accomplishment of which treaties and agreements have already been made—for the fulfilment of which scientific men are now daily laboring. A few years time is expected to see its accomplishment in full, and the present year is looked forward to as sufficient for a connection with Europe. The mind refuses to take in at once all the consequences of so grand an enterprise. American, European and Asiatic interests would be joined, and the great occurrences of one day, in this country, would be known to-morrow in the capitals and remote provinces of the whole world as would their day's business be published here. The scheme is worthy of our go-ahead countrymen, to whom there is not known any such word as fail.

Shakspeare's strange prophecy grows to its fulfilment, and the telegraph will yet do what Puck promised to accomplish."

[*From the Portland Argus.*]

THE TELEGRAPH.

"The Magnetic Telegraph is among the most important and wonderful inventions of modern times. Since 1774, when Le Sage, a Frenchman, made the first known attempt to render electricity available for the transmission of intelligence, there have been almost constant experiments to effect this desirable result. From 1820 to 1850, no less than sixty-three varieties of telegraph were invented, of which only those of Morse, Bain and House are much in use. In 1832, Prof. Morse, an American, commenced his experiments for an electro-magnetic telegraph, and was able publicly to announce his invention in 1837. Upon his petition, Congress appropriated $30,000 to test the practical advantages of the invention, and in 1844, the first line from Washington to Baltimore (40 miles) was established and put in operation. During the succeeding year, 1845, this line was extended eastward to Philadelphia, New-York and Boston. The line was constructed by stretching copper wires upon posts from 15 to 20 feet high, and placed at distances from 12 to 15 rods apart. The high cost of copper wire has caused it to be superseded by that of iron; the latter, however, must be six times heavier than the copper, to afford equal constructing power. About 250 pounds of iron wire are required to the mile, which, with posts, labor, &c., make the cost of constructing an ordinary telegraph, about $150 per mile.

Later experiments tend to show that wire, or a rod of iron, from three to five eighths of an inch in thickness, and weighing a ton to the mile, possesses very decided advantages over the smaller wire. It is less liable to be broken, and the mass of metal gives free passage to electrical currents, without insulation, and without being interrupted by the hardest rains. It is not sensibly affected by rust, and considering the less amount of repairs required, the rods are but little more costly than small wires. The rods will undoubtedly be found to be vastly superior for lines through a wild country, as from the valley of the Mississippi to California.

The average performance of the Morse instruments is said to be from 8,000 to 9,000 letters per hour, and the usual charge is twenty-five cents for ten words or less, for the distances of one hundred miles.

The amount of business which can be done on one of these lines is immense. As an example, it is stated that 154,514 messages were sent over the line from New-York to Washington in six months, for which $68,499 23 were paid. It may be safely stated, that from 500 to 1000 messages can be sent and received over a single line in a day.

Besides the advantages of the telegraph to business men for private correspondence, there is the more important public benefit which it affords for communicating intelligence through the newspaper press. By its aid, the Portland papers are usually enabled to publish all the important foreign and domestic news as early as those of Boston and New-York. The proceedings of Congress appear in the morning papers of Portland, just as early as those of Washington, where Congress sits. These advantages, which the public thus derive, can hardly be overestimated, although they seem to be lightly valued.

Newspapers are expected to be furnished at the old prices, notwithstanding the largely increased cost of publishing them, arising from the advanced prices of labor and material, in addition to the heavy expenses of the telegraphic communications.

The cost of dispatches to the New-York associated press is $64,000 per year. Yet the advantages of the telegraph, so overbalance the outlays it requires, that it has extended with wonderful rapidity.

In 1853, there were in operation in this country and in Europe, 27,168 miles of telegraph, without reckoning the lines then in process of construction in Austria, Russia, Spain, Bavaria, and some other States, and 16,735 miles of this were in the United States. The aggregate length of lines now constructed and in operation, can scarcely fall short of 40,000 miles—more than half of which is in this country.

A submarine cable across the English channel from Dover to Ostend, connects Great Britain with the continent of Europe, and places most of her principal capitals in telegraphic communication with each other. Lines are also progressing toward India and Africa, and the Crimea. In this country, some eighty lines form a net-work of wires connecting nearly all important points upon the Atlantic side of the continent; and it is now seriously contemplated to connect this Atlantic system with the Pacific coast, by means of a direct line across the country. A charter has been granted for the purpose, at the present session of Congress, to Messrs. Alder & Eddy, citizens of Maine, who are to undertake the project as a private enterprise, and great confidence is expressed that they will be able to accomplish it.

But this is not all. The telegraph is not only thus rapidly creeping over the two continents—bringing their extreme points in hourly communication with each other; but strenuous efforts are being made to connect these two systems of telegraph, by a line running from one to the other; and thus to girdle the earth with the lightning messengers.

There are two projects for accomplishing this result. One proposes to connect the Eastern point of Newfoundland with the Western point of Ireland, by a submarine cable, running directly across the ocean between them. The distance is 1,800 miles, and allowing for slack of cable, would require a wire 2,500 miles in length.

Recent soundings have showed that there is not a great depth of water between these points; that the bed of the ocean is not swept by currents, and that it is otherwise favorable to the security of the wires, and to the feasibility of putting them down. The great obstacle to the success of this project, is the scientific fact, that the electric current is arrested in its transit through long submarine or subterranean wires. The greatest length of submarine and subterranean wire ever yet experimented upon, is the Mediterranean Telegraph cable, which is 660 miles in length, and has been successfully operating, until some remedy is found (and the scientific are now actively in search for it) for the exhaustion of the galvanic current by transmission for long distances, under ground or under water. This project of sending messages under ocean upon a conducting wire 2,500 miles in length, must, so far as we are able to judge, be deemed impracticable. Future discoveries may render it possible.

The other project presents no insuperable obstacle, that we can discover. It proposes to run a line from the Northern point of this continent to Greenland, thence to Iceland, thence to the

Faroe Isles, thence to Norway; or from the Faroe Isles to the Orkney Isles, and thence to North Scotland. The longest water space by this route is from America to Greenland, estimated at 500 miles. It certainly does not exceed 660 miles; the distance which the magnetic current has already been made to operate.

The projectors of this line have been engaged for some time in experimenting, with a view to its construction; and have perfected negotiations for the right of way, in part at least, and are still actively and confidently prosecuting the work.

T. P. Shaffner, Esq., of New-York, has recently, through the press, warmly enlisted the public in favor of this magnificent enterprise, and inspired the hope that it will ere long be accomplished.

What a result! The earth encircled by a telegraphic wire, and its remotest inhabitants brought in hourly communication with each other! Stupendous achievement, indeed! Its beneficial results in harmonizing and humanizing the great family of man, and elevating them into one brotherhood, cannot be estimated or appreciated. We can, however, in a measure appreciate the advantage of reading, in our morning papers, an account of all the important events which transpire in the world, during the previous day, as we now read those of the extreme South or West."

[*From the Kentucky Rifle.*]

"On our first page will be found an article from the New-York *Post*, in reference to Tal. P. Shaffner's grand project of belting the earth with an electric telegraph.

Mr. Shaffner, as the Post informs us, has demonstrated beyond question that the scheme is practicable; and the fact that Tal. P. Shaffner is at the head of this magnificent enterprise, is a sufficient guaranty for its complete success.

What a bold, what a splendid achievement in science! The earth bound up in a net of iron nerves, diffusing intelligence to its remotest corners, and lighting up the world in a blaze of electric glory!—Truly this will, if accomplished, be regarded as the proudest victory of genius.

[*From the Boston Traveler.*]

A GIRDLE ROUND THE GLOBE.

"Tal. P. Shaffner, Esq., the editor of the American Telegraphic Magazine, has just returned from his expedition to Europe, where he has been making arrangements for the construction of an electric telegraph around the world. One great object of his visit was to negotiate with the Danish Government for the exclusive right to lay a line over Greenland, Iceland, the Faroe

Isles, and Denmark, for the term of one hundred years; and the acquisition of similar rights over Norway, Sweden and Russia.

The scheme is a bold one, and is certainly large enough for any capacity. The route the wire is to take is already sketched: Starting from the coast of Labrador, the width of the sea to Greenland is about five hundred miles. From the point of landing the line is to extend underground around Cape Farewell, to a point on the east coast of Greenland, favorable for a submarine connection with Iceland. A subterranean line across the eastern coast of that island will connect with a submarine wire to the Faroe Isles, and thence to Norway. By this route there will be no submarine section of more than five hundred miles. Treaties with the Emperor of Russia contemplate the extension of the line from Stockholm, in Sweden, to St. Petersburgh.

Mr. Shaffner proposes to run his line to Moscow, and thence into Asia, piercing Chinese Tartary, extending to the Sea of Ochotsk, and by the way of Kamtchatka, reaching Cooke's Inlet in North America. From this point the line will be run along the Pacific coast to Oregon, and south to San Francisco, California, &c., &c.

Joining the great lines in America, it is eloquently remarked that 'the earth will thus be girdled with one continuous and unbroken flame of electric light.'

In the ocean, or submarine department of the great work, Mr. Shaffner has associated with him Mr. John W. Brett, who has been the projector and successful constructor of the vast range of submarine and subterranean lines of the old world."

PRICES OF SUBMARINE CABLES.—The prices of submarine cables fluctuate with the cost of material and labor. The following were the prices for 1854, which we procured in London:—

No. of Miles.	Weight.		Price per Mile.
6	8	tons, not galvanized	£410
5	7	" "	380
4	6½	" "	320
4	6½	" galvanized	410
3	5½	" not galvanized	275
2	4½	" "	240
1	3	" "	195
1	2	" "	100
1	2	" galvanized	120

The above prices will change, of course, according to times. Add to the above the duty and cost of transportation to America, and the expense of cables for our rivers will be known.

ART. IX.—HONORABLE TESTIMONIALS TO PROFESSOR MORSE IN EUROPE.

LETTER FROM PRUSSIA—MORSE TELEGRAPH ADOPTED IN GERMANY—DR. STEINHEIL.

WE mentioned, in our last number, that Professor Wheatstone and a few other persons of high scientific attainments in England were disposed to consider Professor Morse's claims to priority and originality in the telegraph as doubtful, and this on the ground, as they intimated, that Professor Henry had some sort of undefined claims in the matter. The "defence by Professor Morse," published in our last, has, we think, effectually disposed of this mistake. But whatever may be said by the *illiberal* of England, the sentiment towards Professor Morse on the Continent has been, and is still, in striking contrast.

We have had frequent and conclusive proof in our own personal intercourse with the highest officers and philosophers in the various continental governments, that his name is held in the highest honor.

In a late visit to Prof. Morse, we were shown a letter to him from one of our highly esteemed ambassadors to one of the courts of Europe, which we have been allowed to copy, and which shows in a just light the sentiment held in regard to the inventor of the telegraph by the commanding intellects of the old world. It is as follows:—

Extract of a letter from the Hon. D. D. Barnard, late minister plenipotentiary of the United States of America to the court of the King of Prussia, to Prof. Morse, dated July, 1854:—

"I have been an indignant observer from the beginning, of the outrageous piracies to which you have been subjected at the hands of your countrymen, and the infamous course of a portion of the public press of this country towards you in reference to your wonderful invention of the telegraph. It was, therefore, with peculiar satisfaction that during my residence abroad I was accustomed to hear your name pronounced with emphasis and honor everywhere on the Continent where I chanced to be, and in whatever circle, whenever the subject of the electric telegraph was named. I became entirely satisfied that the general sentiment of the European world did not fail nor hesitate to award to you the chief merit of this grand invention, and that your name was as sure of unrivalled immortality in connection with it, as that of Galileo or Newton with astronomy, or that of Bacon with philosophy. I spoke to you briefly of this when I had the pleasure of meeting you, but I have wished to express to you the same thing in a more substantial form."

"In Germany, after the most mature and elaborate investigation, by the aid of the profoundest learning and wisdom of the age, your telegraph was adopted in a general convention of all the States assembled expressly to consider that subject. And I can give you the assurance, (without attempting to detail particular conversation,) that had you visited Berlin while I was there, and where I hoped to have seen you, you would have met from such a man as the *illustrious Humbolat* and from the *King of Prussia* himself, such a distinguished and honored reception, as would only be accorded from such quarters, to the few who have made themselves eminent and immortal by such rare benefactions of their genius to the world, as have satisfactorily passed the ordeal of trial and time. Regretting the necessity I am under of writing thus briefly, and wishing you all honor and prosperity,

"I am, very dear Sir,

"Most truly yours,

"D. D. BARNARD.

"To S. F. B. MORSE, ESQ."

But in connection with this testimonial, we have another which reflects so much credit on the heart of one of Europe's most estimable scientific men, that we cannot refrain from giving it to our readers.

Prof. Steinheil, of Munich, it is well known invented an ingenious electro-magnetic telegraph in 1837, although subsequent to, yet independent of Morse's. The name of Steinheil stands high on the continent of Europe, as connected with the wide diffusion of the telegraph, and its efficient and economical administration. His writings on the subject of telegraphy are profound and thorough, replete with sound and intelligent views. He was one of the promoters to the great Telegraph Convention held in Vienna, in 1849, which resulted in the adoption of Morse's Telegraph for the Austro-Germanic Telegraph Union, and which is alluded to in the Hon. D. D. Barnard's letter. To Steinheil's advice and influence is owing the decision of the Convention.

When we were in Paris last summer, anxious to learn from Dr. Steinheil himself the position in regard to telegraphs which he held, we addressed him a letter, to which he courteously replied from Munich, under date of June 9, 1854. After giving the date of his own invention, (1837,) and his various labors for the establishment of telegraphs in Europe, under the commission of various governments, he says—"In this way I have been enabled effectually to labor for the adoption of Morse's system

throughout all Europe, and that I have thereby extended his well-earned fame, has been to me the source of peculiar pleasure, which I beg you to testify to Professor Morse, in proper time, together with my most friendly respects."

When we consider that Dr. Steinheil must have resisted all the natural sympathies for his own mental offspring, urging him to a different course, in order to bring about this result, we can, to some extent, appreciate the nobleness of heart which could make a sacrifice of any mere selfish predilection in favor of another inventor—a stranger and a rival.

We scarcely know how to express our feelings of admiration, in view of such an example of genuine disinterestedness. No wonder that Steinheil is so universally beloved throughout all Europe.

[*From the North British Review.*]

ART. X.—HISTORY OF COOKE'S AND WHEATSTONE'S TELEGRAPH.

FAVORABLE NOTICES OF MORSE—COOKE AND WHEATSTONE AS THE INVENTORS OF THE ENGLISH NEEDLE TELEGRAPH CONSIDERED—INTRODUCTION OF THE TELEGRAPH IN ENGLAND AWARDED TO COOKE.

[We copy the following from the *North British Review*, for February, 1855, being extracts from a very able article on the early history of the electric telegraphs. We omit much of the article, and only copy so much of it as relates to Morse's, Cooke's, and Wheatstone's inventions. We think the facts disclosed will very much startle the telegraph pirates of America. We thank the Review for the just consideration given to the American invention. The chastisement awarded to the Quarterly Review for the publication of a patched article on telegraphs, regardless of the truth of history, meets our hearty concurrence. On reading the following, in the Review, we were much surprised to learn the true merits of Mr. Cooke, and in future we will give his claims that just commendation which his services so eminently deserve.

We earnestly solicit for the article a reading. The award of the jury is plain and positive in its meaning. The concurrence by Cooke and Wheatstone gives it an unquestionable character of authority.]—EDITOR.

"We come now to the most interesting part of our subject, namely, the history of the introduction of the electric telegraph into England. We regret that this question has not been discussed by Dr. Lardner, who is better fitted to do it skilfully and honestly than any person we know. He has declined, however, on account of the space which such a discussion would have occupied, and the little interest which it would have inspired in 'the masses to whom his Museum is addressed.' So com

pletely, indeed, has he shunned the subject, that he has hardly mentioned the names of the individuals to whom we are indebted for the introduction of this noble instrument into England. In the pages of a Review, however, such a discussion cannot be evaded, and we regret that a recent attempt to vitiate the history of the electric telegraph in England should give this discussion a controversial character.

About two years ago we became possessed of a printed document, containing the views, or rather the decision, of two of our greatest men upon this very subject; and we intended to have placed this decision before our readers without any argument of our own, on the basis of the few observations which we meant to oppose to the vitiated history to which we have referred. We have been fortunate enough, however, to obtain, only this day, the copy of a pamphlet which states the grounds upon which the above decision was pronounced, and which informs us, that all the documents and drawings relating to the subject are now in the press.

Mr. William Fothergill Cooke, to whom we owe the introduction of the electric telegraph into England, and who was the first English inventor of the telegraph apparatus, held a commission in the Indian army. Having returned from India on leave of absence, and on account of ill-health, he afterwards resigned his commission and went to Heidelberg to study anatomy. In the month of March, 1836, Professor Möncke, of Heidelberg, exhibited an electric telegraphic experiment, in which electric currents, passing along a conducting wire, conveyed signals to a distant station by the deflection of a magnetic needle enclosed in Schweigger's galvanometer or multiplier. The currents were produced by a voltaic battery placed at each end of the wire, and the apparatus was worked by moving the ends of the wires backward and forward between the battery and the galvanometer. Mr. Cooke was so struck with this experiment, that he immediately resolved so apply it to purposes of higher utility than the illustration of a lecture, and he abandoned his anatomical pursuits, and applied his whole energies to the invention of a practical electric telegraph. Within three weeks, in April, 1836, he made his first electric telegraph, partly at Heidelberg and partly at Frankfort. It was of the galvanometer form, consisting of six wires, forming three metallic circuits, and influencing three needles. By the combination of these signals, he obtained an alphabet of twenty-six signals. Drawings of the instrument are given in the work which we have alreday mentioned as in the course of publication. Mr. Cooke soon afterwards made another electric telegraph of a

different construction. He had invented the *detector*, for discovering the locality of injuries done to the wires, the *reciprocal* communicator, and the *alarm*. All this was done in the months of March and April, 1836; and in June and July of the same year, he recorded the details of his system in a manuscript pamphlet, from which it was obvious, that in July, 1836, "he had wrought out his practical system from the minutest official details up to the records and extended ramifications of an important political and commercial engine.".

When his telegraphic apparatus was completed, he showed it in November, 1836, to Mr. Faraday, and he afterwards submitted it and his pamphlet, in January, 1837, to the Liverpool and Manchester Railway Company, with whom he made a conditional arrangement, with the view of using it on the long tunnel at Liverpool. In February, 1837, when he was about to apply for a patent, he consulted Mr. Faraday and Dr. Roget on the construction of the electro-magnet employed in a part of his apparatus, and the last of these gentlemen advised him to consult Professor Wheatstone. He accordingly went to him on the 27th February, 1837. The following is Mr. Cooke's account of the interview and its results:—"He politely invited me to King's College, where I found, that in connection with about four miles of wire, he was in the habit of using two galvanometers of different constructions in his experiments on the effects of electric currents in deflecting magnetic needles. He had no apparatus of any kind for giving signals; but he had two keyboards, one of which was occasionally used in our experiments.

"What he had done towards inventing the practically electric telegraph was confined to the 'permutating principle' of his keyboard. This principle, which diminished the requisite number of wires, was engrafted on my reciprocal telegraph, and became very valuable in connection with later improvements; but though diminishing the number of wires, the permutating keys by themselves, and without the later improvements, would have been more complex than my first galvanometer keys; for each of the latter gave two signals by a single needle, (the plan now adopted on the Blackwall Railway,) while the former required the concurrent action of at least two keys and two needles.

"Though Professor Wheatstone was, when I first consulted him, in possession of a valuable principle, he had gone no further. Excepting the permutating principle, he was practically behind Möncke; for the latter had an instrument for giving signals, and Mr. Wheatstone had none. Even had all his

apparent intentions been worked out, he would not then have fulfilled any of the fundamental conditions of the practical electric telegraph,—the power of detecting injuries to the wires by fracture, water, or contact,—of attracting attention at the commencement of the communication,—of sending signals alternately backwards and forwards by the same apparatus, and of exhibiting the signals to the operator, as well as to the recipient. In a word, he had no detector, no alarm, no reciprocal communicator."

The result of this interview was the formation of a partnership in May, 1837, when it was agreed that in the joint patent, Mr. Cooke's name should stand first; that Mr. Wheatstone should pay £80, and Mr. Cooke £50 of the expense of the patent, and that an allowance of £130 should be made to Mr. Cooke for his past experiments.

After these arrangements were completed, and the invention had become the subject of conversation, it was ascribed to Mr. Wheatstone alone. Mr. Cooke's name, though standing first in the patent, and though undoubtedly the original inventor, was never mentioned, and to such a length did this go, that in an account of the electric telegraph, published in *Chambers's Edinburgh Journal* for the 25th July, 1839, and obtained from conversation with Mr. Wheatstone, Mr. Cooke's name never appears. The inventions of Mr. Alexander Bain, a most meritorious individual, the inventor of electric clocks, and of the beautiful electric telegraph which we have explained, were all ascribed to Mr. Wheatstone; and the members of the different scientific societies and coteries in London, the dispensers of contemporary fame, and to whom Mr. Cooke and Mr. Bain were unknown, were the tools by which these acts of injustice were perpetrated. Mr. Cooke, a soldier, an educated man, and a gentleman, was represented as a mechanic, and Mr. Bain as a workman, who had pilfered the inventions of Mr. Wheatstone.

The day of retribution, however, came, as it always comes, both in defence of Mr. Cooke and Mr. Bain. Mr. Cooke attempted in vain to have these erroneous impressions effaced by the help of Mr. Wheatstone himself, but having failed, he insisted upon having it ascertained by arbitration, "in what shares, and with what priorities and relative degrees of merit the said parties hereto are inventors of the electric telegraph, due regard being paid to the original projection thereof, to the development of its laws and properties, to the practical introduction of it into the United Kingdom, since the improvements made upon it since its introduction there, and to all other matters which the arbitrators, or any two of them, shall in their discretion

think deserving of their consideration." The arbiters were Sir Isambard Brunel, named by Mr. Cooke, and Professor Daniell, of King's College, by Mr. Wheatstone, both colleagues of Mr. Wheatstone in the Royal Society, and Mr. Daniell, a brother professor of Mr. Wheatstone in King's College,—an important remark, the reason of which will soon appear. Mr. Cooke was a member of none of the London societies or coteries, but felt himself safe, as he might well do, in the high talents and established character of Sir Isambard Brunel.

In the course of five months, the arbiters examined all the documents submitted to them, and on the 27th April, 1851, they made the following award :—

"As the electric telegraph has recently attracted a considerable share of public attention, our friends, Messrs. Cooke and Wheatstone, having been put to some inconvenience by a misunderstanding which has prevailed respecting their relative positions in connection with the invention. The following short statement of the facts has, therefore, at their request, been drawn up by us, the undersigned, Sir M. Isambard Brunel, engineer of the Thames Tunnel, and Professor Daniell, of King's College, as a document which either party may at pleasure make publicly known.

"In March, 1836, Mr. Cooke, while engaged at Heidelberg in scientific pursuits, witnessed for the first time, one of those well-known experiments on electricity, considered as a possible means of communicating intelligence, which have been tried and exhibited from time to time, during many years, by various philosophers. Struck with the vast importance of an instantaneous mode of communication to the railways then extending themselves over Great Britain, as well as to government and general purposes; and impressed with a strong conviction that so great an object might be practically attained by means of electricity, Mr. Cooke immediately directed his attention to the adaptation of electricity to a practical system of telegraphing; and, giving up the profession in which he was engaged, he from that hour devoted himself exclusively to the realization of that object. He came to England in April, 1836, to perfect his plans and instruments. In February, 1837, while engaged in completing a set of instruments for an intended experimental application of his telegraph to a tunnel on the Liverpool and Manchester Railway, he became acquainted, through the introduction of Dr. Roget, with Professor Wheatstone, who had for several years given much attention to the subject of transmitting intelligence by electricity, and had made several discoveries of the highest importance connected with the subject. Among these were his well-known determination of the velocity of electricity

when passing through a metal wire;—his experiments, in which the deflection of magnetic needles, the decomposition of water, and other voltaic and magneto-electric effects, were produced through greater lengths of wire than had ever before been experimented upon; and his original method of converting a few wires into a considerable number of circuits, so that they might transmit the greatest number of signals, which can be transmitted by a given number of wires, by the deflection of magnetic needles.

"In May, 1837, Messrs. Cooke and Wheatstone took out a joint English patent, on a footing of equality, for their existing inventions. The terms of their partnership, which were more exactly defined and confirmed in November, 1837, by a partnership deed, vested in Mr. Cooke, as the originator of the undertaking, the exclusive management of the invention in Great Britain, Ireland, and the colonies, with the exclusive engineering department, as between themselves, and all the benefits arising from the laying down of the lines, and the manufacture of the instruments. As partners, standing on a perfect equality, Messrs. Cooke and Wheatstone were to divide equally all proceeds arising from the granting of licenses, or from sale of the patent rights,—a per centage being first payable to Mr. Cooke as manager. Professor Wheatstone retained an equal voice with Mr. Cooke in selecting and modifying the forms of the telegraphic instruments; and both parties pledged themselves to impart to each other, for their equal and mutual benefit, all improvements, of whatever kind, which they might become possessed of, connected with the giving of signals, or the sounding of alarums, by means of electricity. Since the formation of the partnership, the undertaking has rapidly progressed, under the constant and equally successful exertions of the parties in their distinct departments, until it has attained the character of a simple and practical system, worked out scientifically on the sure basis of actual experience.

"Whilst Mr. Cooke is entitled to stand alone as the gentleman to whom this country is indebted for having practically introduced and carried out the electric telegraph as a useful undertaking, promising to be a work of national importance, and Professor Wheatstone is acknowledged as the scientific man, whose profound and successful researches has already prepared the public to receive it as a project capable of practical application, it is to the united labors of two gentlemen, so well qualified for mutual assistance, that we must attribute the rapid progress which this important invention has made during the five years since they have been associated.

"MC. Id. BRUNELL,
J. F. DANIELL.

"*London*, 27*th April*, 1841.

"*London, 27th April,* 1841.

GENTLEMEN,—We cordially acknowledge the correctness of the facts stated in the above document, and beg to express our grateful sense of the very friendly and gratifying manner in which you have recorded your opinion of our joint labors, and of the value of our invention. We are, gentlemen, with feelings of the highest esteem, your obedient servants,

"WILLIAM F. COOKE.
"C. WHEATSTONE.

"Sir M. Isambard Brunel and
J. F. Daniell, Esq., Professor, &c. &c."

With such a distinct verdict from so distinguished a jury, we should have thought that this controversy was for ever closed. The parties expressed their satisfaction, and it was to be presumed that the two arbiters, whose European reputation was at stake, had conscientiously discharged their duty to the real claimants and to the public. This, however, was not the result of the award. Mr. Cooke claimed nothing more than was adjudged to him, while Mr. Wheatstone again attempted to monopolize the honor of being the inventor of the electric telegraph. His numerous scientific friends propagated the tale, and against such odds the real and little-known inventor had no chance of protection. An humble inventor or discoverer in the provinces, or in the private circles of the metropolis, has no chance against the combination and partisanship of London institutions; but as has happened before, a day of retribution again arrives for the protection of the helpless and the establishment of truth. In the eagerness to seize the bubble-reputation, it often bursts in the grasp. In the present case, a fact transpires in the ardor of pursuit which speaks volumes on the subject.

Under these circumstances, Mr. Cooke applies for redress to Mr. Wheatstone, his partner in a lucrative concern, and on the 16th January, 1845, thus addressed him:—

"It is now nearly two years since I remonstrated with you on the endeavors which your friends were making to undermine the award of Sir Isambard Brunel and Mr. Daniell, of April, 1841; but as these remonstrances were met by the assurance of your solicitor (made in your name and by your expressed desire) in his letter of the 20th May, 1843, that there was no truth in the report that you denied your full consent to the declarations contained in the printed paper,—an assurance further confirmed by his letter of the 27th June, in these words—'Mr. Wheatstone does not desire to escape from a single conclusion

which the award warrants;'—all I could do, was to express myself satisfied with an explanation so unqualified.

"The same cause of complaint has, however, been repeatedly obtruded upon me since. And I *now hear from your own lips, that you have absolutely armed yourself with a letter from Mr. Daniell to counteract a certain construction of the award, which you consider objectionable.*

"This is indeed an alarming document to hold in reserve; and how Mr. Daniell could reconcile any such letter with the character of a judge, remains to be explained."

If the letter from Mr. Daniell, thus singularly referred to, is a real document intended to affect the history of science, and the rights of an individual, Mr. Cooke and the public ought to call for its production. It will reveal a fact, hitherto unsuspected; that the arbiters did not agree on their verdict, and that Mr. Daniell conceded something to Sir Isambard Brunel in favor of Mr. Cooke, and against Mr. Wheatstone. In this there was nothing wrong. It happens in almost every arbitration when two individuals are appointed by two contending parties, that each concedes something to the other to obtain a harmonious settlement; and it would not be unjust if each arbiter were to leave on record, in the hands of their respective friends, a memorandum of the points which have been thus conceded. But if one of the arbiters does this without the knowledge of the other, and puts it in the power of his friend, at any future time, to bring it forward in support of his original and rejected claims, that arbiter has acted *unjustly, illegally, and dishonorably;* and society should protect itself by marking such conduct with its severest rebuke. If this letter should ever fall down upon Mr. Cooke's neck, above which it is now suspended, we shall then *conjecture* for ourselves the amount of concession which Sir Isambard Brunel must have made against his own client, to balance the concessions made by his brother arbiter; for we are sure that he has left no letter in the hands of Mr. Cooke to assist him in escaping from a single conclusion of the award. But if this letter is brought forward to alarm Mr. Cooke, the friends of Professor Daniell may well be anxious about the result, and we think it is their duty to demand its production. We have ample faith in the honor of Professor Daniell, and we willingly adopt the liberal sentiment of Mr. Cooke, that if he "did express himself, incautiously in writing to his friend, no one acquainted with his manly and upright character, can suppose that he intended to sanction a clandestine use of his letter to assist Mr. Wheatstone," or to injure Mr. Cooke. Ignorant though we be of the nature of this singular document, we have

no difficulty, if it was written by Professor Daniell, in predicting its contents. Its object, doubtless, was to sweeten the bitter pill of the award. It was an opiate tenderly administered to disappointed vanity,—a curb, perchance, to that morbid appetite for fame, which respects neither individual rights nor social feelings. By this anticipation of its purpose, we at once protect the character of its author, and the rights of the individual which it has been brought forward to assail.

The future history of this remarkable partnership is soon told. Mr. Cooke pursued, with unflinching ardor, his scheme of making the electric telegraph a work of "national importance," and being prepared by his own inventions, and by the joint invention in Cooke and Wheatstone's patent, he took steps, in the autumn of 1845, to organize a joint-stock company, which he effected in 1846. This company, under the name of the *Electric Telegraph Company*, applied to Parliament in the session of 1846 for a bill of incorporation. This bill was opposed by Mr. Alexander Bain of Edinburgh, who asserted in his petition that he had invented an Electric Clock, and an Electric Printing Telegraph,—that he had communicated these inventions confidentially to Mr. Wheatstone, and that the latter had claimed them as his own. Notwithstanding this opposition, the directors of the company carried their bill, though not without difficulty, through the House of Commons; but when it came to the House of Lords, Mr. Bain's statement and the evidence which he gave in its support made such an impression on the members of the Lord's Committee, that on the afternoon of its third sitting, the Duke of Beaufort, as chairman, intimated to the counsel of the Electric Telegraph Company that they should make an arrangement with Mr. Bain, "hinting," as Mr. Cooke says, "pretty plainly, that their bill might be thrown out if they declined to do so." Mr. Bain accordingly received, we believe, £12,000, and thus, to Mr. Wheatstone's extreme displeasure, became associated with the Company, binding himself to give them the use of his inventions. "About the same time the directors had, unluckily, made an arrangement with a Mr. Henry Mapple, in ignorance that this person had a similar controversy with Mr. Wheatstone respecting an improved alarum and a telegraphic rope," and "in consequence of these untoward circumstances, Mr. Wheatstone sent in an account of his expenses, and retired altogether from the company's service."

Let us now see under what obligation, and how richly rewarded, Mr. Wheatstone left the service of the company. So early as the 12th April, 1843, Mr. Cooke entered into an agreement, by which he was to pay Mr. Wheatstone a royalty vary-

ing from £20 to £15 per mile for every ten miles of telegraph he should complete during the year, £20 for the *first* ten miles, and £15 for the *sixth* ten miles, and all beyond it, Mr. Wheatstone assigning to Mr. Cooke all the letters patent of Cooke and Wheatstone, and all future patents for improvements. In 1845, when the electric telegraph company was in contemplation, and when many lines of telegraph had been already laid down by Mr. Cooke, he entered into a new agreement with Mr. Wheatstone, by which he bought up his royalty for £30,000, together with all arrears of royalty due at the date of the agreement.

Thus liberally rewarded for half of the joint patent held by Mr. Cooke and himself, one would have thought that all farther controversy was at an end. The company succeeded beyond their most sanguine expectations, and Mr. Wheatstone became discontented with his reward. He claimed to be the inventor of the electric telegraph! He forgot the rights of his partner and benefactor as conceded and signed by himself,—and as adjudicated by Sir Isambard Brunel and Professor Daniell. He forgot the concession of £12,000 by the Lord's Committee to Mr. Bain for his electric clock and his beautiful electric telegraph; and those eminent individuals ceased to be named but as mechanics and workmen, whom he had taken into his service! Mr. Cooke, whose forbearance we cannot but admire, maintained a dignified silence as long as the injuries which were done to him were whispered in private, or circulated in scientific coteries. The time, however, at last came, and the crisis in Mr. Wheatstone's history as well as in his, when he was dragged before the public by a representative of Mr. Wheatstone's feelings as well as opinions, and compelled to appeal to its tribunal, in a voice as articulate as the railway whistle or the electric thunder.

An article on the Electric Telegraph appeared in the Quarterly Review for June, 1854, in which the claims of Morse and Steinheil, and Cooke and Bain, are unceremoniously thrown overboard, and Mr. Wheatstone pronounced the inventor of the Electric Telegraph!! That such a perversion of scientific history, and such a violation of recorded truth, should have appeared in such a respectable journal, has greatly surprised us, and we confess that we feel as much for the author who has permitted himself to be a dupe, as we do for Mr. Cooke, whom that dupe has so wantonly made a victim. Roused by this attack upon his honor, and this attempt to wrest from him not what he claims, but what was given to him by the solemn decree of two of the most distinguished men of the day, and one of them Mr. Wheatstone's particular friend, Mr. Cooke has been

driven to write the pamphlet to which we have referred, and to publish in support of its statements a volume of documents, illustrated by numerous plates.

Having been the first individual who introduced the eelectric telegraph into England,—having been the first constructor of a working telegraph and various pieces of valuable telegraph apparatus, invented by himself,—having availed himself of Mr. Wheatstone's talents for completing the particular telegraph patented by Messrs. Cooke and Wheatstone,—having paid Mr. Wheatstone £30,000 for his interest in the joint patent,—having established beyond the power of challenge his claim to "*stand alone as the gentleman to whom this country is indebted for having* PRACTICALLY INTRODUCED AND CARRIED OUT THE ELECTRIC TELEGRAPH AS AN USEFUL UNDERTAKING, Mr. Cooke succeeded, in 1846, in establishing the ELECTRIC TELEGRAPH COMPANY, of which he is now one of the principal directors.

Mr. Cooke was fortunate in obtaining the co-operation of such a man as Mr. Lewis Ricardo, M. P., by whose zeal and sagacity this company has attained its present gigantic magnitude. By the outlay of *three quarters of a million of money*, this company has covered England and Scotland with a complete net-work of telegraphs, extending along 5480 miles of railway lines, and employing no less than 24,000 miles of wire.

INVENTION OF THE MORSE TELEGRAPH.

DEDICATED TO THE NEW-YORK SKETCH CLUB.*

BY W. H. COYLE.

HERE from the city's surging roar shut out
By academic walls, are gathered in
A gifted group, at Arts high festival,
Painters and sculptors, orators and bards,
High born disciples of the Beautiful—
The noble brotherhood of Genius:
Each bringing offerings of homage to
The altar of his heart's fidelity.
These are the city's solitary men;
Not sordid, battling with the multitude,
For gold, or glory with its blood-bought plume,
Not aspirants for venal spoils or power;
But leading gentle, quiet, cloister'd lives,
Young hermits in imagination's cells—
Patient, yet panting to adorn the domes
And galleries of the outer world,
With glorious trophies of the ideal.

* At a late meeting of the Club, in the University Building, a room formerly occupied by Prof. Morse, while perfecting his invention of the Telegraph, was the same in which was assembled the festive association. Brilliant speeches were made upon the occasion, one of which referred to the great invention of the Electro-Magnetic Telegraph, by Morse, which occasioned the delivery of the beautiful poem, here published, by Mr. Coyle. It is a rich tribute,—embracing ideas and language most excellent.

Toil on, brave brothers—though the weary night
Of penury and cold indifference
Be long and dark, faint not upon your path—
For in the Orient, soon the morning star
Shall rise, and golden dawn, with radiant smiles,
Beckon you onward to immortal day!

Not many years ago, in this same hall,
Musing an Artist sat; he was not old
In age, yet pondering on a problem
Which became a restless, ever-present thought,
Had furrow'd with deep lines his fever'd brow,
But still like a Chaldean seer, or some
Grey-bearded necromancer studying
The mystic circles of astrology,
Or alchymist, he fed the crucible
Of his wild, burning hopes, and sleepless worked
The wizard spells of his philosophy.
E'en he forsook the first love of his youth
Painting, that sweet Madonna of the mind,
At whose pure shrine he bent the knee of fresh
And early worship, and turned coldly from
Her costly gems which flashed upon his walls,
To render fealty to his soul's new queen.
One mighty purpose loomed before his life—
Spectral, and vast and vague, but taking form
With each day's intimacy, till at last
He grappled with its mystery, and like
A giant wrestled for the victory!
Out on the wild sea, 'mid the hurtling storm,
Where hissed the lightning's blinding blaze, and shook
The strong ship like an aspen to her keel
Beneath the thunder crash, was born the great,
Sublime conception; and upon the shore
It haunted him amid the city's hum,
And would not leave him—till, Prometheus-like,
He dared to steal from heaven the sacred
Fire, and animate his own creation!

The hour at last had come—Silence and night
Had hushed the Babel-city to deep sleep.
Around the walls of the magician's room,
A circuit ran three miles, of air-hung wires;
And on a table stood the sealed jar
Where coiled the fearful fiery messenger.
Trembling he wrote "Eureka!" when a flash
Electric, like a ray swift travelling
From the sun, thrill'd thro' each palpitating,
Iron vein, and lo! upon a spotless
Scroll unrolled, a hand invisible wrote
The winged word, "Eureka!" The artist's dream
Was realized; and now blooms on his brow,
The laurel of his country's gratitude!

MARCH 8th, 1855.

ART. XI.—PROTEAN RUBBER INSULATOR.

[THE following communication has been sent to us for consideration. We publish it, with the drawings; also, the letters of commendation. We have heard the insulator highly approved. Mr. Eddy, the able superintendent of the Eastern Lines to the British Provinces, has well tested its merits on a very large scale. By such practicable experiments reliance can be entertained and confidence inspired. We would rather have the practical tests on a well managed telegraph line, conducted by a competent superintendent, than the certificates from every Professor of schools in America. Mr. J. M. Batchelder is the proprietor of the patent, and supplies lines with the insulator.]—EDITOR.

THIS insulator, which has been introduced during the past year, possesses those properties that have been long sought for by all persons engaged in the practical management of lines of electric telegraph. The great value of the Protean Rubber for the insulation of telegraph wires is shown by its

ELECTRIC PROPERTIES.—In this particular it is equal to the best kinds of glass. A plate electrical machine has been made of it, and electricity is more readily excited than it is in the common cylinder or plate-glass machines.

It does not absorb moisture:—The material is hard, and of fine and uniform texture, and moisture cannot penetrate below the surface in the slightest degree.

Dew is not deposited so quickly upon its surface as it is upon glass or porcelain. This quality gives it especial value during the early hours of the morning, and when fogs prevail.

DURABILITY.—This substance is not injuriously affected by exposure to air and moisture, or by the ordinary changes of the weather; it does not become soft at a less temperature than 280° F. It is not liable to those molecular changes which so soon affect gutta percha, and entirely destroy its insulating properties.

ECONOMY.—The first cost of this insulator is greater than that of many kinds now in use, but the saving of battery expenses, and a less expenditure for repairs will, it is believed, insure its use by those who have full knowledge of the difficulties and loss of income caused by the present defective system of insulation.

FIG. I.

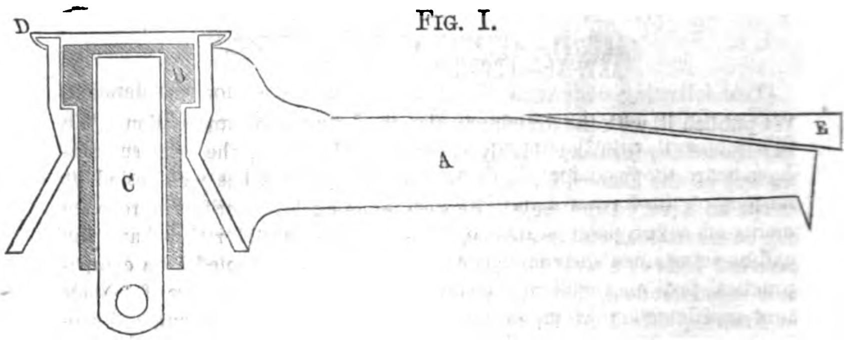


FIGURE I. is a vertical section of a side insulator. A, iron support; B, protean rubber cap; C, suspension pin; D, cover; E, wedge. The rubber while baking contracts upon the iron pin, so that it cannot be drawn out, and obviates the necessity of using sulphur or other cement.

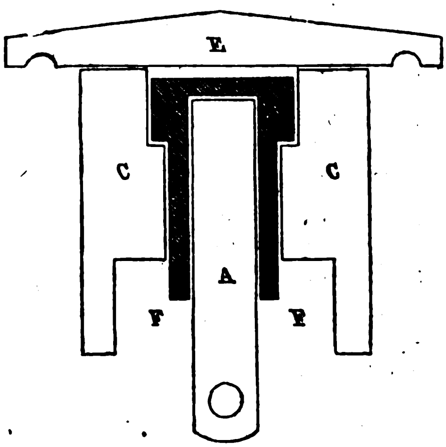


FIG. II.

FIGURE II. Represents another form of side insulator. A, is the suspension pin, with its rubber covering B, inserted in a round hole at the end of a wooden arm or support, C; E, cover; F, circular, open space.

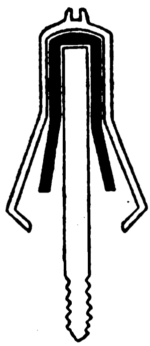


FIG. III.

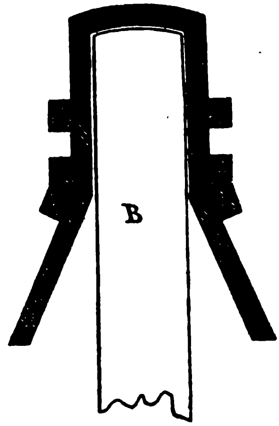


FIG. IV.

FIGURE III.—Top insulator. The shield is of cast iron, the support of wrought iron, with the rubber cap intervening. The re-entering angle at the base of the shield prevents rain, when driven by the wind, from entering the inside of the shield.

FIGURE IV.—Top insulator. The cap A is composed wholly of rubber, and is mounted upon an iron screw bolt B; or it may be supported upon a stout pin of wood, in which case the cap is shrunk on, no cement being used. If the wooden pin swells the cap is not injured.

PORTLAND, *October* 10*th*, 1854.

J. M. BATCHELDER, ESQ.,

SIR,—Having given some attention to the insulation of telegraph wires upon India rubber as prepared by you, I can say that, in my judgment, it is better adapted for insulating purposes than any other material in use.

It is a perfect non-conductor; it is lighter and much stronger than glass, and for insulating wires in the air it has great superiority from the fact that moisture does not gather so readily upon its surface, and it is capable of being made upon iron so strong that only extraordinary violence can break it.

One hundred insulators of this material put up by me last season have proved satisfactory, and our company has used the present season nine thousand of them.

We are continuing to order insulators of the same kind for air lines in preference to all others.

Respectfully yours,

JAMES EDDY,

Supt. Maine Telegraph Co.

PLACERVILLE, CAL., *February* 24, 1854.

MR. J. M. BATCHELDER,

DEAR SIR,—I am perfectly satisfied with the insulators; they fully answer my expectations, and are in fact the best I ever saw. If any country in the world will test the qualities of an iusulator, it is this, where we have incessant rain for a week at a time, and often the wind blowing a perfect hurricane. During the worst rains that we have had this winter, the line has worked as perfectly as in the dryest weather; in fact, we can perceive no difference between wet weather and dry in the working of the line. We use fourteen cups Grove's battery, seven at each end—distance one hundred and fifteen miles.

Your obedient servant,

J. E. STRONG,

Supt. Alta California Telegraph Co.

BOSTON, *March* 15, 1854.

MR. J. M. BATCHELDER,

DEAR SIR,—I believe protean rubber to be the very best substance known for insulating either air or subterranean telegraph lines.

Yours, very truly,

MOSES G. FARMER,

Supt. Telegrayhic Fire Alarms.

TO OUR PATRONS.

In consequence of a sudden attack of fever, we have no opportunity of presenting, in the present number, the many editorials which we had expected.

We leave by the first steamer for Europe, and will return some time during the summer.

SHAFFNER'S
TELEGRAPH COMPANION,

DEVOTED TO THE SCIENCE AND ART OF THE

MORSE AMERICAN TELEGRAPH.

VOL. II. OCTOBER, 1855. No. 4.

Art. I.—SUBMARINE TELEGRAPHS OF THE WORLD.

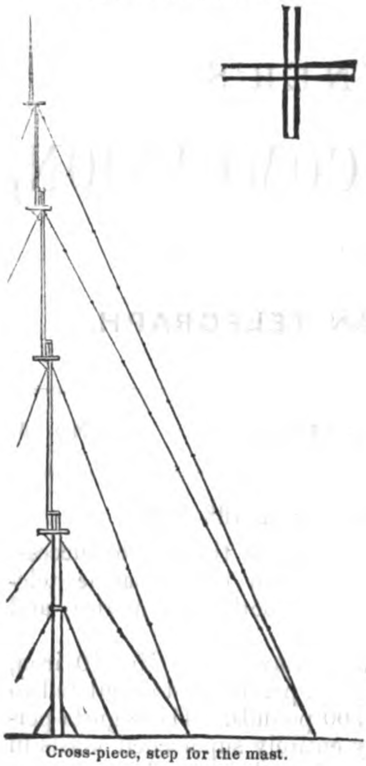
WE do not propose to decide who were the first to successfully accomplish the practical operation of submarine telegraphs. The originality is claimed both in America and Europe.

In America, the submarine wires have been No. 10 iron, covered with three coatings of gutta-percha, and calculated to resist a force equal to at least 1300 pounds. These gutta-percha insulated wires have nearly entirely superseded masts in the crossing of rivers, notwithstanding the difficulties encountered in sustaining them. The inland rivers of America are so powerful in currents, that the strongest cable capable of being laid, will, sooner or later, yield, and become lost forever in the sand at the bottom of the restless stream.

For several years we served as President of a telegraph line, having the most extensive river crossings in America, and we well studied the scientific and mechanical difficulties. Owing to the navigation of the rivers by vessels, the wires had to be elevated very high, or submerged in the water. The annexed cuts represent the mode of crossing with masts. The spars were made of cypress, and the guys were of inch, three quarter, and half inch iron rods. The elevation of the wire, on the

highest, was 307 feet, being, we suppose, the highest "pole" ever erected. They were constructed with much skill and ornament.

Fig. 1—Ohio River Mast.



Cross-piece, step for the mast.

Fig. 2—Ohio River Cable.

These masts were erected on the Mississippi, Ohio, Tennessee, and Cumberland rivers. A few weeks after their construction, those on the Mississippi were carried away by a tornado, and parts of them were found seven miles distant. Houses, trees, (four and five feet in diameter at base,) were also levelled to the earth. Soon after, those on the Ohio yielded to similar disasters. Had the masts been of wrought

iron, they could not have resisted the power of these terrific tornadoes.

Submarine crossings succeeded the ill-fated masts on the Mississippi, Ohio and Tennessee rivers. At first the wires were only covered with gutta-percha, and sunk to the bottom by iron balls. The continual moving of the sand, in the water, soon wore away the insulation, and left the wire bare. The plan of covering the gutta-percha with osnaburg followed, and then the addition of iron wires laterally, as represented by the annexed cut, fig. 2, was adopted. Some of these cables have been in successful use for several years.

The gutta-percha insulated wires originally laid, were composed of a No. 10 iron wire, made from the best Swedish bar, and drawn with great care, being capable of sustaining a strain of 1,300 pounds, then carefully covered with three coatings of gutta percha. Such wires were laid across many of the American rivers. The like was, also, laid across the English Channel, between Dover and Calais. This effort failed. We have a piece of the Dover wire, and it is still in good order, but the billows of the sea were too powerful to be resisted.

As we before alluded, the covering of the insulated wires, with exterior iron, followed the fragile originals. This mode proved successful.

The representation of these improved cables is given in figure 2. The inner or electric wire (*a*) is No. 10 Swedish iron, letter (*b*) is the three coats of gutta-percha, letter (*c*) is the three coats, by lapse, of osnaburg, and letter (*d*) is the longitudinal covering with No. 10 iron wires, being well lashed with one of similar size. With a slight improvement, we believe these cables are better for the western waters than the English cables. We presume we have experimented as much upon the submarine crossings in America, as the remainder of the efforts for the same purposes, and many unsuccessful plans, abandoned by us years ago, we now learn are being tried by less experienced gentlemen. It is well to continue in the line of improvement, as occasionally a good idea is brought forth. As an evidence of this, we find, that Mr. S. C. Bishop, the gutta-percha manufacturer of America, has devised a new plan in the making of cables.

Figure 3 is the representation of a cable made for the Magnetic Telegraph Company, which is successfully working across the Hudson River. Letter (*a*) are the electric wires, of copper, letter (*b*) is gutta-percha covering around the copper wires, letter (*c*) is a full covering of gutta-percha around the insulated copper wires, and letter (*d*) is a spiral covering of tarred yarn. Over this can be laid iron wires as desired. We

think, however, Mr. Bishop has very greatly improved upon the above cable in the arrangement, as represented in figure 4.

Fig. 3

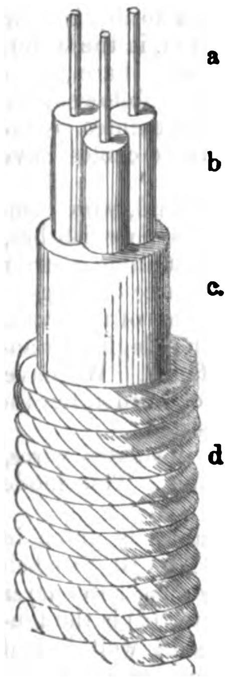
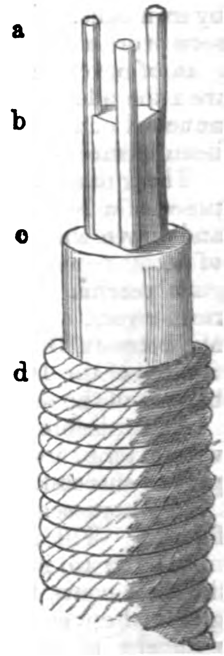


Fig. 4



The electric wires, three in number, are No. 10 Swedish iron, each of 1,300 pounds strength. The interior between the wires *b*, is solid gutta-percha, well united as one mass with *c*, the covering around the wires. Around this is the hempen twine, well tarred and spirally wove. Upon this, wires can be spirally or longitudinally placed, as circumstances of locality may require. We are of the opinion, that this cable is decidedly the best plan ever presented for the American rivers; and, in fact, it is suitable for any water-crossing, whether of sea or of inland. We are not informed as to the strength of the English cables, but from succeeding cuts it will be seen that they are quite frail, compared with those necessarily adopted in America, having only one electric wire.

It is true, the English cable has been tried at New-Orleans, and also at New-York. These are not proper test places. The like would not resist the force of an ordinary freshet at

St. Louis, where the full volume of the Mississippi current is narrowed to a passage of a half mile. A cable then must be of the greatest strength to endure the greatest length of time. On some occasions, such as a flood of 1844, and on the breaking up of the ice, no cable can resist the power brought against it. All that can be done is to employ cables that will serve the longest time under the circumstances.

In regard to the proper kind of a cable for especial places, we believe the best policy would be to consult with the energetic manufacturer, Mr. S. C. Bishop, who can bring into consideration the results of the hundreds of efforts made in America to accomplish the great desideratum. By comparing the various plans and necessities of places, the most efficient and serviceable cable can be devised to subserve the ends in view.

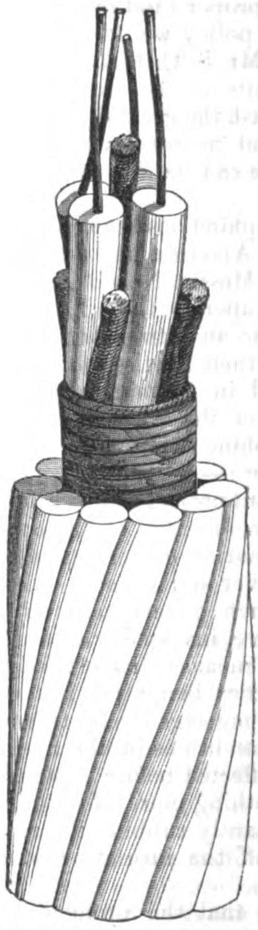
Submarine telegraphing has been carried to a greater extent in Europe, than in America, mostly through the agency of Mr. John W. Brett, Messrs. Newall & Co., Messrs. Statham & Co., and Messrs. Kuper & Co. These gentlemen have advanced the business to an extraordinary extent; and the world is much indebted to them for the perfection of the science and art, as now realized in submarine telegraphing. In reference to this branch of the art, we extract the following from the work on telegraphing, written by that distinguished philosopher, Dr. Lardner:—

"The first important project of this kind which was executed in Europe, was the connection of the coasts of England and France by the submarine cable, deposited in the bed of the channel between Dover and Calais. A concession being obtained from the French government on certain conditions, a single conducting wire, invested with a thick coating of gutta-percha, was sunk by means of leaden weights across the channel, and the extremities being put into connection with telegraphic instruments, messages were transmitted from coast to coast. One of the conditions of the French concession being that this should be effected before September, 1850, this object was attained, but nothing more; for the action of the waves, near the shore, constantly rubbing the rope against the rocky bottom, soon wore off the insulating envelope, and rendered the cable useless.

It is right to state that the projectors themselves did not expect, from this first trial, permanent success, and regarded it merely as the experimental test of the practicability of the enterprise. It was, therefore, immediately resolved to resort to means for the effectual protection of the conducting wires from the effects of all the vicissitudes to which they would be

exposed. With this view, Messrs. Newall & Co., the eminent wire-rope makers of Gateshead, were charged with the difficult and unprecedented task of discovering expedients, by which a cable of gutta-percha, containing the conducting wires, could be invested with an armour of iron, at the same time so strong as to resist the action of the forces to which it would be exposed,

Fig. 5—Dover Cable.



and yet not too ponderous or too rigid to allow of being deposited in the bed of the channel. The result was, the invention of the form of submarine cable, which has since been successfully adopted upon the various lines of international electric communication, which will be presently described.

The conducting wires inclosed in these cables are usually copper wires, having a diameter of the sixteenth of an inch. Each wire is first separately covered with two coatings of gutta-percha. Each successive coating increases the thickness by a certain fraction of an inch. The object of laying on this succession of coats of the gum, is to guard against accidental defects which might render the insulation imperfect. If such a defect happened to exist at any point of the first coat it would be covered by the second, the chances against a defect occurring at the same point of both coatings amounting to an impossibility.

The conducting wire thus invested, or so many of them as it is intended to deposit, are then twisted together, and surrounded with a mass of spun yarn, soaked with grease and tar, so as to form a compact rope. Around this rope are then twisted a number of stout iron wires, sometimes coated on the surface with zinc, or as it has been called, galvanised. The cable is then complete, and is fabricated in one continued length sufficient to extend from shore to shore, or from bank to bank. Perspective side views of the several cables, and transverse sections of them in their full size, are given in the figures indicated in the first column of the following table, the number of conducting wires insulated by the gutta-percha and included within the cables, the number of surrounding iron wires, the total length from coast to coast, and the weight of the cables per mile respectively, being indicated in the columns.

	Fig.	No. of copper wires.	No. of iron wires.	Weight per mile—Tons
Dover and Calais	25,26	4	10	7
Holyhead and Howth	27,28	1	12	1
Dover and Ostend	31,32	6	12	7
Portpatrick and Donaghadee (Magnet Co.)	35,36	6	12	7
Orfordness and the Hague	37,38	1	10	2
Across the Great Belt (Denmark)	41,42	3	9	5
Across the Mississippi	45,46	1	8	2
Across the Zuyder Zee	43,44	6	10	7½
Newfoundland & Prince Edward's Island	39,40	1	9	1¾
Portpatrick and Donaghadee (British Co.)	35,36	6	12	7
Spezzia and Corsica	35,36	6	12	8
Corsica and Sardinia	35,36	6	12	8

In the Dover and Calais cable, which was the first fabricated and laid, each of the four copper wires is surrounded by gutta-percha, which, in figs. 5–6, is indicated by the light shading round the back central spot, representing the section of the copper wire. The four wires thus prepared were then enveloped in the general mass of prepared spun yarn, represented by the darker shading. The ten galvanised iron wires were then twisted around the whole, so as to form a complete and

close armour. The external form and appearance of this helical coating is represented in figs. 5–6.

Fig. 6.
Dover Cable.

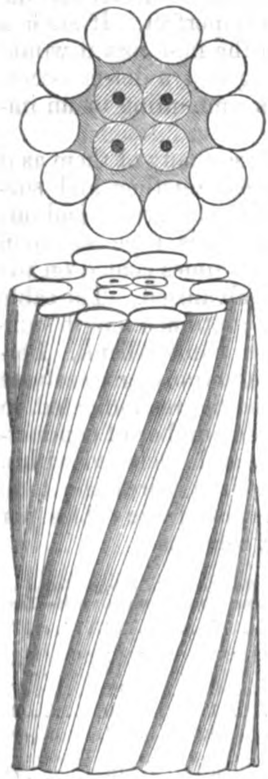


Fig. 7.
Holyhead and Howth.
Deep sea part.

Fig. 8.
Holyhead and Howth.
Shore ends.

This cable, which was completed by Messrs. Newall & Co., in three weeks, measured, originally, 24 miles in length. Owing to the manner in which it was laid down, this was found insufficient to extend from coast to coast, although the direct distance is only 21 miles. It was, therefore, found necessary to manufacture an additional mile of cable, which being spliced on to the part laid, the whole was completed, and the electric communication between Dover and Calais definitely established on the 17th October, 1851.

The cost of the cable itself was £9,000, being at the rate of

£360 per mile. The total cost for cable and stations at Dover and Calais was £15,000.

The next submarine cable laid down was that which connected Holyhead on the Welsh with Howth on the Irish coast. While several companies which had been formed for the purpose, were occupied in raising the capital necessary for this project, they were surprised by the announcement that the project was already on the point of being realized by Messrs. Newall & Co., on their own account.

The distance between the points to be connected being 60 miles, the cable was made with a length of 10 additional miles, to meet contingencies. In this cable, which enclosed only one conducting wire, the external wires enclosing the insulating rope were made thicker at the parts near the shores than for that which lies in deep water, the former being subject to much greater disturbing forces. A side view of the part immersed in deep water is given in fig. 7. A side view of the shore ends is given in fig. 8, all being in their full size.

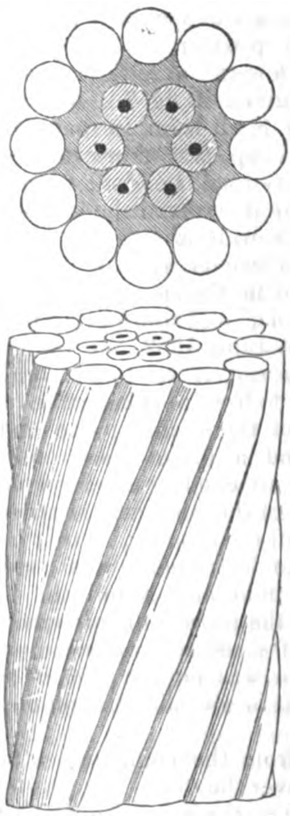
The gutta-percha rope was fabricated by the Gutta-Percha Company in the City-road, London, from whence it was sent to Gateshead, where it received the iron wire envelope at the works of Messrs. Newall & Co., in the short space of four weeks. Loaded on twenty wagons, it was next sent by railway across England to Maryport, where it was embarked on board the "Britannia," and transported to Holyhead. On the morning of the 1st June, 1852, one of its extremities being established at Holyhead, it was laid in the bed of the channel. This was done as follows:—The cable was very carefully coiled in the hold of the steamer; one end was then passed several times round a brake-wheel, and was conveyed on shore, when it was attached to a telegraph instrument. The other or lower end of the cable was attached to another instrument in the cabin of the steamer, so that any message passing from instrument to instrument, was conveyed through the entire cable in the hold, and round the brake-wheel as the cable passed off in the process of submersion. The shore end having been made fast securely, the steamer was put in motion, and a certain strain was put on the cable by means of the brake-wheel, so that is was laid straight on the ground, or bottom of the sea.

The cable rises from the hold, guided between rollers, to a drum, and passes over the stern. A counter and indicator was applied to the shaft of the drum, by which the length of cable which at any moment had been delivered off into the sea was shown.

The wind and tides have the effect of drawing the vessel out of her course, so that the quantity of cable expended must always be greater than the distance between the two points in a straight line. In the case of the Holyhead and Howth cable, the quantity expended was 64 miles. The depth of water is 70 fathoms, being more than twice that of Dover.

The entire process of laying it down was completed in 18 hours. In another hour the cable was brought ashore, and put in connection with the telegraph wires between Howth and Dublin, and immediately afterwards London and Dublin were connected by means of instantaneous communication.

Fig. 9—Donaghadee and Portpatrick—Magnetic Telegraph Company.



This cable was lighter considerably than that between Dover and Calais, its weight being a little less than one ton per mile,

and consequently its total weight did not exceed 80 tons, while the Dover and Calais cable, weighing 7 tons per mile, its total weight was 180 tons.

From some cause which could not be ascertained, this cable, after being worked for three days, became imperfect. It was supposed to have been caught by the anchor of some vessel, for on being taken up lately, it was found broken near Howth, and the gutta-percha and copper wire stretched in an extraordinary manner.

On the 9th October, 1851, Messrs. Newall & Co. attempted to lay a cable across the narrowest part of the Irish channel, between Portpatrick and Donaghadee. This cable contained six conducting wires, similar to fig. 9. The distance across is the same as between Dover and Calais, viz., 21 miles, and 25 miles of cable were placed on board the "Britannia" steamer. The process of submersion was carried on until 16 miles had been successfully laid down, when a sudden gale came on, which rendered it impossible to steer the vessel in the proper course, and Mr. Newall was reluctantly compelled to cut the cable, when within 7 miles of the Irish coast, and having 9 miles of cable remaining on board.

The whole of this 16 miles of cable had been recovered in June, 1854, after being nearly two years submerged. This proved a most arduous undertaking. The depth of the water in this part of the Irish channel is 150 fathoms, or 900 feet, and from this depth the cable was dragged by means of a powerful apparatus worked by a steam engine placed on the deck of a steamer. The operation occupied four days, for, from the great force of the tide, which runs at the rate of 6 miles an hour, it was found impossible to work except at the times of high and low water. The cable was also imbedded in sand, so that the strain required to drag it up was occasionally very great.

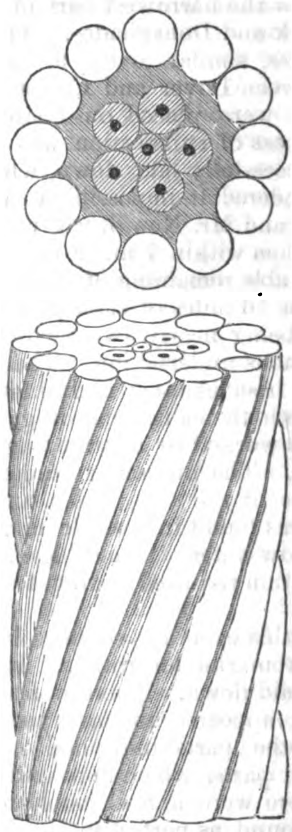
The recovery of this cable has so far solved the question of the durability of submarine telegraphs. It was found nearly as sound as when laid down. There was a slight corrosion in certain parts which appeared to have been imbedded in decaying sea-weed—the parts imbedded in sand were quite sound, and on other parts, which appeared to have rested on a hard bottom, there were a few zoophytes. The cable, on being tested, was found as perfect in insulation as when laid down.

The next great enterprise of this kind, of which the accomplishment must render for ever memorable the age we have the good fortune to live in, was the deposition in the bed of the channel of a like cable connecting the coasts of England

and Belgium, measuring ***seventy miles in one unbroken length!*** This colossal rope of metal and gutta-percha was also constructed at the works of Messrs. Newall & Co.

The probable extension of these extraordinary media of social, commercial and political communication between countries separated by arms of the sea, may be conceived, when it is stated that during the winter of 1852–'53, Messrs. Newall & Co. executed under contract not less than 450 miles of such cable.

Fig. 10—Dover and Ostend Cable.



The cable laid between Dover and Calais includes, as already stated, four conducting wires. That between Dover and Ostend contains six wires insulated by the double covering of

gutta-percha, manufactured, under Mr. S. Statham's directions, by the Gutta-Percha Company. The gutta-percha laid into a rope is served with prepared spun-yarn, and covered with twelve thick iron wires, of a united strength equal to a strain of 40 to 50 tons—more than the proof strain of the chain cable of a first-rate man-of-war.

A side view and section of this cable, in its natural size, are given in fig. 10.

The Belgian cable weighed seven tons per mile, so that its total weight was about 500 tons. Its cost was £33,000. It took 100 days to make it, and 70 hours to coil it into the vessel, from which it was let down into the sea, and 18 hours to submerge it.

On the morning of Wednesday, the 4th of May, 1853, the vessel called the "William Hutt," Capt. Palmer, freighted with the cable, being anchored off Dover, near St. Margaret's, South Foreland, the process of laying the cable was commenced. This vessel was attended and aided by H. M. S. "Lizard," Capt. Rickets, R. N., and H. M. S. "Vivid," Capt. Smithett. Capt. Washington, R. N., was appointed, on the part of the Admiralty, to mark out the line and direct the expedition.

At dawn of day about 200 yards of the cable were given out from the "Hutt," and were extended by small boats to the shore, where the extremity was deposited in a cave at the foot of the cliff. There telegraphic instruments were provided, by means of which, through the cable itself, a constant communication with the vessel was maintained during the arduous process, corresponding telegraphic instruments being placed on board the "Hutt."

At six o'clock the process of laying commenced, the "Hutt" being taken in tow by the steam tug "Lord Worden."

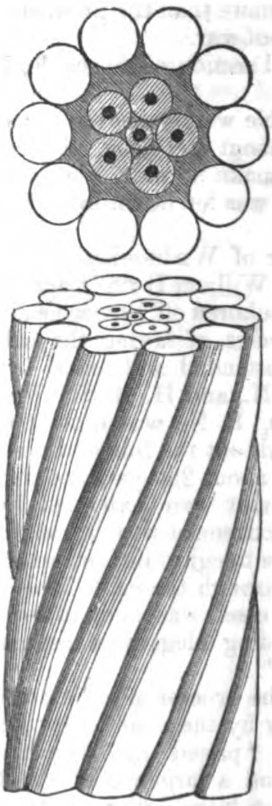
The cable was "payed out" from the hold, being passed several times round a large brake-wheel, by means of which the cable was kept from going out too fast, and its motion maintained, so as to be equal to the progress of the vessel.

On arriving off Middlekerke, on the Belgian coast, a boat sent from shore took from 500 to 700 yards of the cable on board, for the purpose of landing it. The boats of the British vessels taking her in tow, the end of the cable was safely landed, and deposited in a guard-house of the Custom House, where the telegraphic instruments brought in the "Hutt" being erected, and the communications made, the following despatch was transmitted direct to London:—

Union of Belgium and England, twenty minutes before one, P. M., 6th May, 1853.

The next submarine cable laid was that of the Magnetic Telegraph Company, connecting Donaghadee with Portpatrick, also manufactured by Messrs. Newall & Co.

Fig. 11—Zuyder Zee.



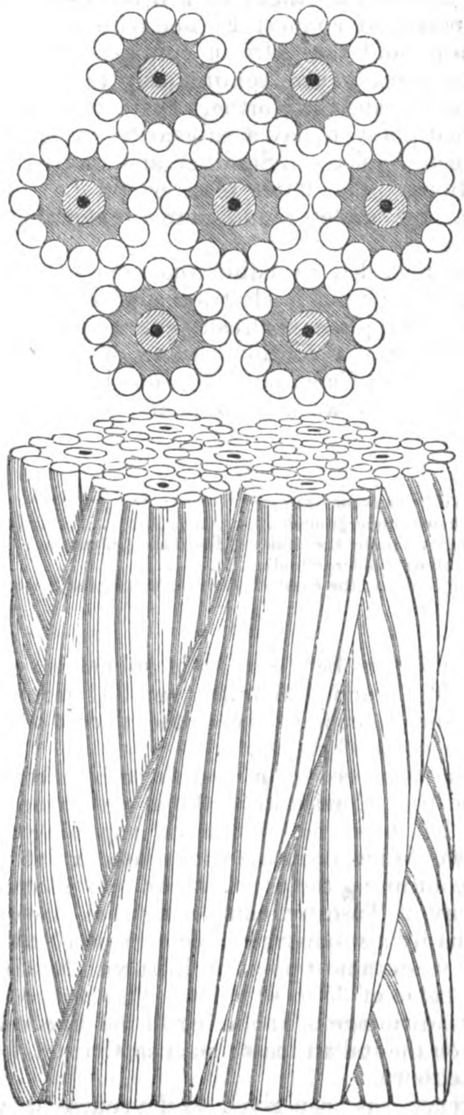
This cable, which contains six conducting wires, is represented in its proper size in fig. 9, and corresponds in weight and form to the Belgian cable. But in the details of its construction and composition, some improvements were introduced. This rope was manufactured in 24 days, and cost about £13,000.

The cable laid down by the British Telegraph Company, between the same points, is precisely similar to this.

It is proposed to connect Orfordness, on the Suffolk coast, with the Hague, by seven separate submarine cables, each containing a single wire. Near the shore, on each side, these

will be brought together and twisted into a single great cable, as represented in fig. 12.

Fig. 12—Orfordness and the Hague.



Of these, only three have been laid down. The distance from Orfordness to the Hague being 120 miles, the cables

were made 185 miles in length. They were laid down separately at a little distance one from another. At 3½ miles from the shore they were brought together. When the telegraph business increases, the other four will be deposited.

It is proposed to connect Europe with the islands of the Mediterranean and the African continent, by extending the wires which already run continuously to Genoa from the United Kingdom and the Northern States of Europe to Spezzia, and from that point to lay a submarine cable to Corsica, another between Corsica and Sardinia, and another between Sardinia and Bona. The latter place would be connected with Alexandria by underground wires extending along the coast.

It is even regarded as within the scope of probability that Alexandria may be put in electrical connection with Bombay; and as the latter place is already connected by a telegraphic line with Calcutta, a continuous line of communication between London and Calcutta would thus be established.

The distances between Spezzia and Bona on the coast of Algeria are:—

	Miles.
Spezzia to Corsica (submarine)	76
Across Corsica (underground)	128
Corsica to Sardinia by the straits of Bonifacio (submarine)	7
Across Sardinia (underground)	203
Sardinia to Bona, on the coast of Algeria, (submarine) about	125
	539

There would thus be 208 miles of submarine cable in three lengths of 76, 7, and 125 miles, and 331 miles of overland wires necessary to connect the southern coast of Europe with the northern coast of Africa.

This is the proposed plan, and the cables from Spezzia to Corsica, and from Corsica to Sardinia are already laid and in operation; but it will be obvious on inspecting the map, that the object would be attainable with a less extent of submarine cable by continuing the overland line to Piombino, in the Grand Duchy of Tuscany, connecting that place with the Island of Elba by a submarine cable of 8 or 10 miles, and connecting the westernmost point of Elba with Bastia, in Corsica, by another cable of 35 to 40 miles. This method would have the further advantage of including in the line several important places on the Italian coast; such as, Carrara, Lucca, Massa, Pisa, and Leghorn.

A preference has been given to the course above described in consideration of the benefit conferred upon the company

by the concession and guarantee granted by the government of Sardinia, which would not have been given had the other course been followed.

The cable now deposited contains six conducting wires, and is in all respects similar to that represented in fig. 9.

The short submarine cable laid down between Prince Edward's Island and the coast of New-Brunswick (fig. 13), was intended as part of a more extended submarine line connecting Newfoundland with Canada."

Fig. 13
P. Edward's Island.

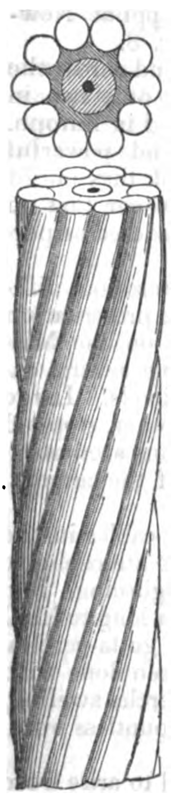


Fig. 14—Great Belt.

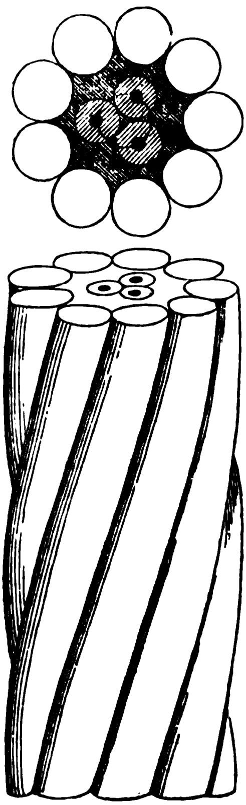
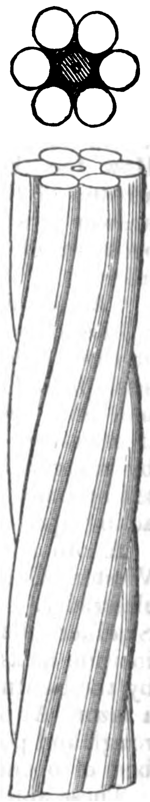


Fig. 15—*Balize.



The cable, fig. 13, was a part of the original Newfoundland Electric Telegraph Line. This Company is now represented in the name of the New-York, Newfoundland,

* Fig. 8 should be 15, and fig. 15 should be 8.

and London Telegraph. The route has been changed, and it is contemplated to run the line from Newfoundland to Cape North, in Nova Scotia, and thence in connection with the lines of that province. The cable of this company will be considered hereinafter, and we only refer here to the fact, that the one attempted to be laid in 1855, contained three electric wires, and was similar to the Danish and Swedish cables.

The Danish submarine cable (fig. 14,) is carried across the Great Belt from Nyborg to Korsoe, the nearest point of the opposite coast of Zealand.

The cable laid across the Zuyder Zee is shown in its proper size in fig. 11. The cable across the Mississippi at New-Orleans, on the Balize Line, is represented in fig. 8.

The House Line has a cable of the same kind across the Hudson River near New-York. These are the only two in use in the United States which were manufactured in Europe. How the like would answer in the turbulent and powerful streams of the west, is yet to be tested. We think they might answer as well as any other cable, confident, however, that on occasions of floods and ice, no cable can be considered as permanent.

"At certain places on the great western rivers serious difficulties have been and are still encountered in the preservation of these subaqueous conductors. At St. Louis on the Mississippi, and at Paducah on the Ohio, for example, several cables have been successively swept away by floods. Large trees carried down the stream are, one after another, stopped by being caught in the cable, and the number thus accumulated becomes at length so great, that the force of the current, acting upon them, breaks it.

Another frequent cause of destruction to these cables in the Western Continent is the attraction they offer to atmospheric electricity. They are frequently destroyed by lightning. Mr. Shaffner tells me that he has sometimes found a longitudinal incision measuring ten feet in length, made in gutta-percha, by the lightning, and cut as clean as if it had been done with a razor. At other times he has found the gutta-percha swelled, rough and porous, and sometimes pierced with countless numbers of openings like pinholes.

These appearances are supposed by Mr. Newall to arise from imperfection in the covering of the wire. The slit, he thinks, is caused by air getting in behind the arm, which holds the mandril through which the copper wire passes before leaving the cylinder, and the porous covering arises from air mixed with the gutta-percha. Mr. Newall has ascertained that a wet

hair, or a hole of equal size, is sufficient to destroy the insulation of the wire.

Some eminent scientific authorities express doubts as to the durability of the submarine cables. In the case of the Dover and Calais cable it has been observed that the bottom of the channel at that part of the strait is proved by the soundings to be subject to undulations, so considerable that the summits of some of its elevated points rise to such a height, that the water which covers them is not deep enough to secure them from the effects of the tumultuous agitation of the surface in violent storms. It is here well to remind the reader that the agitation of the ocean, which seems so awful in great tempests, has been found to extend to a very limited depth, below which waters are in a state of the most profound repose. The objection we now advert to is, therefore, founded upon the supposition that the crests of some of the elevations upon which the submarine cable rests, are so elevated as to be within that limit of depth; and it is feared that such being the case, the violence of the water in great tempests may so move the cable against the ground on which it is deposited with a motion to and fro, as to wear away by frequent friction its metallic armour, and thus expose the conducting wires within it to the contact of the water, and destroy their insulation.

But it has been most satisfactorily proved by a part of the experimental wire which was laid down between Dover and Calais, in 1850, and which was picked up two years afterwards in as perfect a state as when laid down, that the action of the waves does not affect the bottom of the channel there. The greatest depth is 30 fathoms, and the bottom shelves regularly from Dover to near Cape Grinez, where there is a ledge of rocks rising suddenly from the bottom.

It has been also feared that, notwithstanding the effect of the galvanization of the surface of the surrounding wires, the corrosive action of the sea water may in time destroy them; and it has been suggested that some better expedient for protection against this effect might be contrived upon the principle suggested by Davy, for the preservation of the copper sheathing of ships, by investing the cable at certain intervals with a thick coating or glove of zinc, which would increase the efficiency of the thinner coating of that metal given to it in the process of galvanization.

To this practical men who have had as much experience as is compatible with the recent date of these novel and extraordinary enterprises, reply that the results of their observations give no ground for apprehension of any injurious effects from tidal or tempestuous action, and that the fine iron used in the

wire is not affected by sea water, as larger masses of coarser iron, such as anchors, are. They cite as proof of this, the slightly decayed state in which nails and small fire-arms have been found when recovered from vessels long sunk. They further state that the tar contained in the layer of hemp within the protecting wires acts as a preservative, whether the wires be galvanized or not. It has been found, for example, that, in the case of the submarine conductor between Donaghadee and Portpatrick, a perfect concrete of tar and sand has been already formed, upon which masses of shell-fish attach themselves at all parts that are not buried in sand, and it is apparent that in a few years a calcareous deposit will be formed around it which will cement it to the bottom, and altogether intercept the action of the sea water.

In the deposition of submarine cables great care should be taken to select suitable points on the shore for beaching them. Sandy places are always to be sought. If this precaution be taken, it is affirmed that they are not subject to tidal action. A cable was partly laid by the Magnetic Telegraph Company, in 1852, near Portpatrick, but abandoned in consequence of the vessel employed to deposit it being exposed in the process to a violent storm. The wire was left exposed upon the beach down to and beyond low water mark, and was in June, 1854, still in a perfect state, the galvanized iron wires, even to their zinc coating, being absolutely in the same state as when they were deposited.

It is contended by practical men that the great and only risk of failure in the submarine cables is from defects produced in the process of their deposition, or from original faults in the principle of their construction.

The greatest care is necessary in conducting the process of delivering out the cable into the sea, or "paying it out," as it is technically called. All sudden bending of the cable is to be especially avoided. "Kinks" or "hitches" are apt to occur in the process, by which the gutta-percha covered wires within the cable are strained.

In laying the Calais cable it was found too short to extend to the opposite coast, and it became necessary to splice a supplementary piece to it. The joint thus formed afterwards failed, and it was found necessary to splice it anew, and to insert a fresh piece. Since this was done the cable appears to have continued in excellent order.

It is said that the Belgian cable has been subject to some imperfection arising from the position of the wires within the case. The sixth wire being in the axis of the cable, surrounded by the other five, it was found that when the outer casing

of the protecting wires was laid around it, the pressure on the centre wire rendered it imperfect, while the five surrounding it suffered to some extent.

Similar defects are said to exist in other cables constructed upon the same principle.

A hempen base well tarred in the centre, is considered to form the best safeguard for the gutta-percha covered wires in the process of making the cable, since it will yield to any compression itself without affecting injuriously the wire.

Imperfectly informed persons have expressed an opinion that the cable would not sink below a certain depth, at which the increasing density of the sea water would render it, bulk for bulk, as heavy as the cable. The well-known physical properties of water prove such a supposition to be groundless.—Although not incompressible in an absolute sense, water is susceptible of compression, even at the greatest depths of the ocean, in so small a degree, that the cable must always greatly exceed it in specific weight.

Putting out of view the financial part of the question, there appears, then, to be no good reason for pronouncing the project to construct such a cable, and to deposit it in the bed of the ocean, impracticable in an absolute sense.

It may be asked whether, if deposited, an electric current could be transmitted through it so as to produce telegraphic signals?

There can be only two reasons for doubting this—*first*, the length of the conducting wires, and, *secondly*, the inductive effects of the water upon the cable.

The intensity of the current transmitted by a battery of given power upon a wire, is in the direct ratio of the conducting power of the wire and the magnitude of its transverse section, and in the inverse ratio of its length. A length so great as 1,500 or 1,600 miles, would of course considerably attenuate the current.

But it will be recollected that, in the experiments described in chap. I, par. 9, made by M. Leverrier and myself, messages were transmitted over a space of 1,000 miles of wire without intermediate battery power, and with a terminal battery of very limited power. In that case 336 miles of the wire upon which the current was transmitted were iron, a very indifferent conductor, and the remaining 766 miles were copper wire of extremely small diameter. It is certain, therefore, that by reason of the inferior conducting power of the one part, and of the very small transverse section of the other part, this length of 1,082 miles offered a much greater resistance to the

transmission of the current than would 1,600 of copper wire, such as is usually selected for submarine cables.

But, independent of these considerations, nothing would be easier than to give the copper wire enclosed in the cable such a thickness, and to apply to it such batteries as would ensure the transmission of a current of sufficient intensity.

After the underground and submarine wires had been constructed and laid upon a considerable scale, the attention of Dr. Faraday was called by some of the parties engaged in their management to peculiar phenomena which had been manifested in the telegraphic operations made upon the lines thus laid. After experiments had been made upon a large scale with lines of subaqueous and subterranean wires, extending to distances varying from 100 to 1,500 miles, it was found that the electricity supplied by the voltaic battery to the covered wire was in great quantity arrested there, by the attraction of electricity of an opposite kind evolved from the water or earth in which the wire is sunk; the attraction acting through the gutta-percha covering exactly in the same manner as that in which the electricity developed by a common electric machine, and deposited on the inside metallic coating of an electric jar, acts through the glass upon the natural electricity of the external coating, or of the earth in connection with it. The two opposite electricities on the inside and outside of the coating of the wire by their mutual action neutralize each other; and under certain circumstances, a person placing his hands in metallic connection with both sides of such coating, may ascertain the presence of a large charge of such neutralized fluid, by receiving the shock which it will give, like that of a charged Leyden jar.

It is apprehended that this unforeseen phenomenon may interfere more or less with the practical working of all telegraphs having underground conducting wires; and I have been informed by the agents engaged in the bureaux of the Paris telegraph, that they are sensible of its effects in all direct communications between that capital and London.

The use of underground wires, and the discovery of the phenomenon of inductive action above described, are too recent to justify any certain inference as to their effects on telegraphic operations. Time and enlarged experience alone can settle the questions which have been thus raised.

Although as a general rule the overground lines of telegraphic wire are sustained by supports at intervals of about sixty yards, many exceptional cases are presented in which they are extended between supports at much greater distances asunder. Every recent visitor to Paris may have observed the long lines

of wire which are in several cases extended along the Boulevards and across the river.

But the most surprising examples of long lines of wires without intermediate support, are presented on the telegraphic line passing north and south through Piedmont between Turin and Genoa. There, according to a report published in the "Piedmontese Gazette," in the course of the line passing through the district intersected by the chain of the Bochetta, the engineer, M. Bonelli, had the boldness to carry the wires from summit to summit across extensive valleys and ravines at immense heights above the level of the ground. In many cases the distance between these summits amounted to more than half a mile, and in some to nearly three-quarters of a mile. In passing through towns, this line is carried underground, emerging from which it is again stretched through the air from crest to crest of the Maritime Apennines, after which it finally sinks into the earth, passing through Genoa under the streets, and terminating in the Ducal palace.

It is stated that the insulation of the wires on this picturesque line has been so perfect, notwithstanding the adverse circumstances of its locality, that although it was constantly at work day and night, during the first winter, no failure of transmission or extraordinary delay ever occurred."

COMPLIMENTARY TO PROF. MORSE.—During the pendency of a suit at Frankfort, Kentucky, Sept. 9th, 1848, Chancellor Henry Pirtle, an attorney for the defendant, and against Prof. Morse, wrote the following lines, and presented them to Mrs. Morse, viz:

> "Et non 'eripuit cælo fulmen,'
> Fulguri mentem fudit, et orbem lumine cinxit."

Translation, we make as follows:

> Though he did not "snatch the thunder from heaven,"
> He gave to the lightning thought and girdled the earth with glory.

While this honored the great inventor, it showed the heart of one of the purest and noblest of Kentuckians; one whom we always admired and loved to honor.

Art. II.—NEWFOUNDLAND TELEGRAPH.

The early history of this line we copy from a recent work, written by Mr. John Mullaly, and published by T. W. Strong, Esq., of New-York. The work is styled a "Trip to Newfoundland," and contains much valuable information. It is also embellished with numerous engravings, and the incidents of the voyage to Newfoundland for the laying of the telegraph cable, are well portrayed by the graphic pen of the author.

"In June, 1851, Mr. H. B. Tebbetts of the City of New-York, associated with him several influential gentlemen, for the purpose of organizing a company to build steamers of a large size, to run between the ports of New-York and Galway, Ireland. These ships were to be specially adapted to perform the mail service between the two continents, and to accommodate the large emigrant travel from Ireland to the United States.

In originating this enterprise, Mr. Tebbetts conceived the idea of the Newfoundland Telegraph, which is at present so prominently before the public. Confident of the practicability of the project, he entered into a correspondence with different members of the Government of Newfoundland in regard to the subject, and with the view of making St. Johns a port of call for the steamers to and from Galway. He was assured that his plan was perfectly feasible, and that the Government would make liberal grants and concessions to secure its accomplishment.

Soon after, the government ordered a survey to be made, and on its completion sent the engineer with his report and a letter of introduction from Mr. S. G. Archibald, dated December 17, 1851, to Mr. Tebbetts. The introduction resulted in the offer of the liberal sum of twenty thousand dollars by Mr. Tebbetts to the engineer, on condition that he would return and procure such a charter from the government as he desired. The offer was accepted, the engineer returned and succeeded in procuring the required charter, which was granted in March, 1852, and under which Mr. Tebbetts organized an association entitled, "The Newfoundland Electric Telegraph Company."

When Mr. Tebbetts first conceived the project, it was his design to run small steamers across the Gulf of St. Lawrence between Cape Ray and Cape North, the proposed termini of the land lines in Newfoundland and Cape Breton. This was the only means of communication, as up to this period every attempt to manufacture a submarine cable had been attended with a signal failure. Shortly after, however, it was discovered that by means of gutta percha, the conducting wires could be completely insulated, and in less than a

year the first cable was laid between France and England, a distance of twenty-six miles. This great achievement was performed in September, 1851.

The success of this cable led to the abandonment of the plan of running steamers between Cape North and Cape Ray, and to a change in the proposed route of the line. It was decided that the line should run from New-Brunswick to Prince Edward's Island and thence to Newfoundland. The company accordingly ordered a submarine cable to be made, which was successfully laid down in September, 1852, between New-Brunswick and Prince Edward's Island—a distance of ten miles. This was the first laid on this side of the Atlantic.

After expending about one hundred thousand dollars in the prosecution of the work, numerous embarrassments arose, and the company was eventually obliged to suspend payment. Through the exertions of Mr. Tebbetts, however, the gentlemen now engaged in the enterprise were induced to take hold of it, and they did so with an alacrity which showed their confidence in its ultimate success. Its practicability had been satisfactorily proved, and it only required men possessing the means and energy to carry it to a successful completion. The property of the old company was purchased by the new. Previous to the dissolution of the "Newfoundland Electric Telegraph Company," the charter was surrendered to the Government, and the gentlemen who had now the control and management of the enterprise proceeded at once with due diligence and energy to the accomplishment of the great work which they had undertaken.

The new association was organized under the title of the "New-York, Newfoundland and London Telegraph Company."

The gentlemen composing this new company, having carefully weighed and considered the difficulties by which the enterprise was beset, applied to the Newfoundland Government for a new charter, in which they obtained some additions to the privileges and grants conferred in that procured by the old company. They were given the exclusive privilege for fifty years, which was an increase of twenty over the former grant, of running a telegraph across the island and through any of the adjacent waters. In addition to this the government, realizing the great advantage such a work would be in opening up the country and developing its resources, made them a present of fifty square miles of land, which was twenty more than they gave to the company organized by Mr. Tebbetts. Their liberality, however, did not stop here; they also, as an encouragement to the enterprise, appropriated five thousand pounds sterling, towards the construction of a bridle path across the

island, a work indispensable for the repair and regulation of the telegraph. The land was granted with the privilege of selecting it in any part of the country, and the interest on fifty thousand pounds sterling guaranteed to the company for twenty years. In addition to all this, fifty miles are to be given when the great Transatlantic Telegraph is laid.

The company having now obtained all they had asked for, proceeded energetically to work, and, as a preliminary step, made a contract with Professor Morse, by which they secured the use of his patents and all renewals. An engineer and assistants were engaged for the construction of the land telegraph across the island from St. Johns to Cape Ray, and about six hundred men having been employed, operations were immediately commenced. The route over which it was proposed to run the line is almost a wilderness, and presents, one would suppose, an insuperable obstacle in the way of the enterprise; but the men who had undertaken it were not to be deterred by difficulties, and they went to work with an energy that ensures success. While they had operatives employed in clearing the wilderness and constructing their line, they had others engaged in the selection and exploration of the land granted by the Government. The services of three mineralogists were secured, and their investigations resulted in the discovery of two coal mines, one lead mine, and one of copper, besides valuable tracts of ship timber and several quarries of alabaster and slate. The discovery of these, however, is only one of the many benefits which it is expected the new telegraph will confer upon Newfoundland. The length of the route which will be traversed by the line of the new company is seven hundred miles, and extends from St. Johns to Cape Tormentine. Commencing at this cape, it runs through the Straits of Northumberland to Prince Edward's Island, a distance of ten miles and a half; thence to Cape East, thence to Cape Breton, and thence to St. Johns. A one wire cable, ten miles long, has already, as we have stated, been laid between New-Brunswick and Prince Edward's Island.

A contract was made with the "Transatlantic Telegraph Company," composed of French and English capitalists,* by which that company agreed to construct and lay down at their own expense and risk, a submarine cable extending across the Atlantic to Newfoundland.

This line is to be not only completed according to the terms of the agreement by the 22d of January, 1858, but in success-

* The contract was made with Tal. P. Shaffner, and John W. Brett sole gérants of the Transatlantic Telegraph.

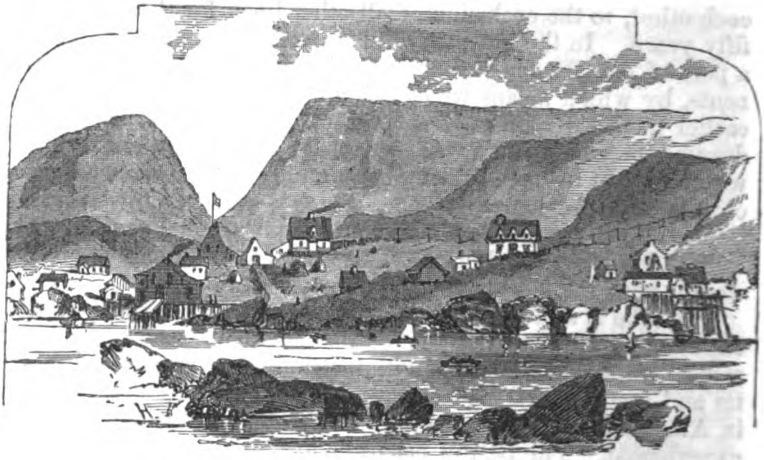
ful operation. The contract also binds the two companies, that is the American and European, to operate in connection with each other, to the exclusion of all other lines, for the period of fifty years. In the meantime it is intended to make St. Johns a port of call for the steamers passing between the two continents, by which means we can obtain news at least three days earlier than we receive it at present. Among the many inducements which this route presents to steamers, there is one which cannot be overlooked: by stopping at St. Johns, a very considerable portion of the space which is taken up by coal can be devoted to freight, as a sufficient supply of fuel can be obtained there in a few hours. This fact alone will have great weight with the mercantile community."

This line is alluded to in the above extract, sufficiently to explain the ultimate designs of the company. How far the results will be realized, time will determine. It passes over water and land, embracing the most difficult route for a telegraph in America, and in its working, the greatest difficulties will be experienced. The best of scientific and practical skill will be required in its construction and in its management. In its progress, so far, it is clear to our mind that a want of skill has been manifested; but, if not, the difficulties of the route are extraordinary. It is the most liberal to contribute the delays and mishaps to the latter, and we prefer to place the question on that basis, and hope for better success in the future.

The line starts from the City of St. Johns.

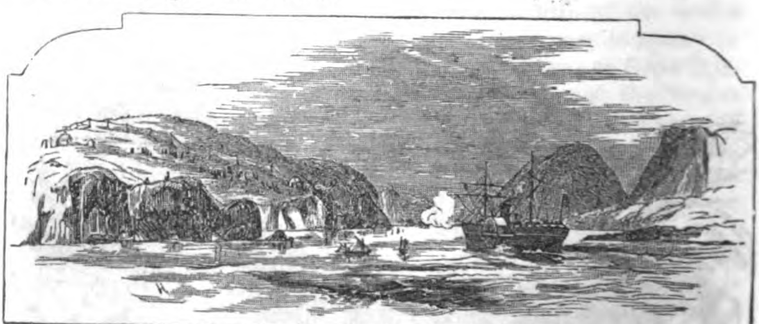
ENTRANCE TO ST. JOHN'S, N. F.

It will run across the island near the southern coast. It was intended to strike the west coast at Port au Basque.



PORT AU BASQUE.

The entrance to this place was not so favorable for the purpose, and while the ship was preparing to lay the cable, the steamer went out exploring for other localities. This, however, ought to have been fully executed long before. We give the following from Mr. Mallaly's book, which we think will be interesting to the reader.



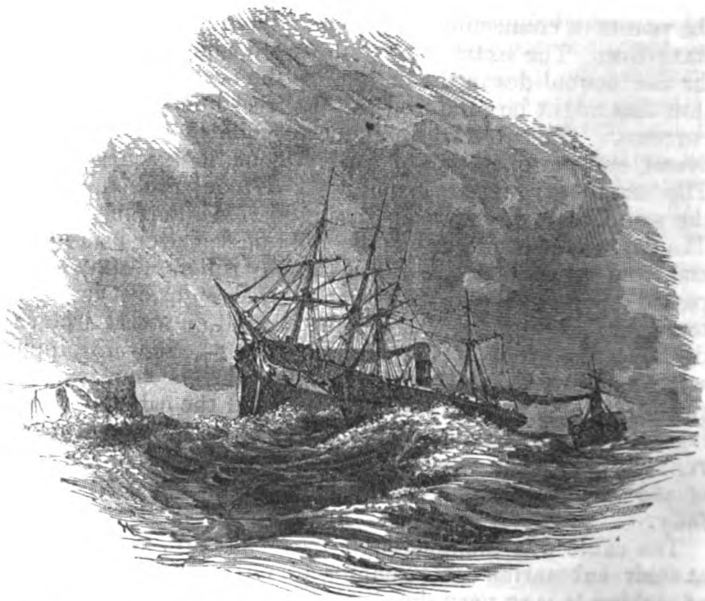
HARBOR OF PORT AU BASQUE.

On the arrival of the James Adger at Port au Basque, we found that the mechanical arrangements on board the Sarah L. Bryant, for the laying of the cable, were not completed. It was resolved, under these circumstances, that the steamer should go to Cape North and select the best and nearest por-

tion of the coast to Cape Ray, the point of connection. Some sixteen or eighteen of the passengers remained at Port au Basque till the return of the steamer, and as we were among those we took advantage of the earliest opportunity to visit the bark, which was about five hundred tons burthen, and strongly built. The cable itself weighed four hundred tons, and was seventy-four miles long, while the distance between the points of connection on Newfoundland and Cape Breton is sixty-five. The extra nine miles were allowed to make up for the inequalities in the bottom of the ocean, and any variation that might be produced in the direct line by the wind or currents. The cable lay in immense coils in the hold of the vessel, and the operation of coiling alone took fourteen days. The machinery was very simple in its construction, and was the same that was used in laying the Mediterranean cable. The cable as it came out of the hold passed over iron rollers, and from these between vertical guide rollers, from which it passed again over two large wheels, each eight feet in diameter. As these revolved, it was thrown out on a cast iron saddle, over the stern of the vessel. The wheels were supplied with four breaks, worked by two long levers and two compressors, which were employed to prevent the cable from surging as it passed round the wheels, as well as to prevent it from running off by its own weight. These completed the whole of the machinery, and it was found to work most successfully.

The cable was manufactured by Messrs. W. Kupert & Co., at their submarine cable manufactory, London. The process of making it is so very simple that it will be easily understood by every one. The copper wires, of which there are three, and each of which is about as thick as a knitting-needle—are first insulated with two coatings of gutta-percha. They are then bound with hemp yarn so as to form a perfect circular rope or cable, the yarn being previously soaked in a preparation of Stockholm tar, pitch, oil and tallow. Over this again is wound the outside covering of twelve, No. 4 guage, iron wires, which beside the protection they afford, give the whole cable great strength and durability. The process of manufacturing, with the exception of the insulation of the copper wires with gutta-percha, is carried on at the same time, by extensive machinery erected for that purpose, and by means of which cables can be made of any continuous length and with any number of wires that may be desired. That portion of the cable which connects immediately with the shore is generally galvanized to preserve it from the corroding

action of the atmosphere. We saw a piece of the Dover cable which had been taken up after lying in the water about four years, and which was as perfect as when first laid down. The gulf cable, on board the Sarah L. Bryant, was about an inch in diameter, and about the same size as it is represented in the engraving.



THE VICTORIA, TOWING THE CABLE-SHIP FROM PORT AU BASQUE, TO CAPE RAY COVE.

The James Adger returned on Tuesday evening, the 21st, to Port au Basque, and there was a grand reunion of the company. Those who had gone in the steamer to Cape North had wonderful stories to tell us of the scenery, and still more wonderful accounts to give us of their fishing exploits.

The following morning the Sarah L. Bryant was towed by the Victoria up to Cape Ray Cove, which was decided upon as the starting place, being nearer by five miles to Cape North. There was also another great advantage it possessed over Port au Basque; it had a fine sandy beach, which experience has proved, forms a better and safer resting-place for the cable than rocks. Once it becomes embedded in sand, it may lie there for a century, but if exposed to friction on rocks, it would be worn away or cut through in less than a year.

It was found necessary to remove the telegraph instruments from Port au Basque to the point selected on the beach of Cape Ray Cove, which in itself was a most tedious and laborious work. As a number of the passengers volunteered their assistance, however, it was expedited, and by twelve o'clock everything was transported to the place designated. Here it was decided to erect a frame house, which was an undertaking of no small magnitude, when the limited means and facilities of the place are considered. The Victoria was employed in carrying the frame and timber for the purpose from Port au Basque, but when she arrived with them at the Cove, it was found that she could not approach within several hundred feet of the shore on account of the shallowness of the water. They were obliged under these circumstances therefore to form a raft, and on it to land all the timber required for the building of the house. The largest planks were accordingly thrown over the propeller's side, lashed together with ropes in the form of a square, and on this was placed the frame work, the shingles, and the other parts of the structure.

CAPE RAY.

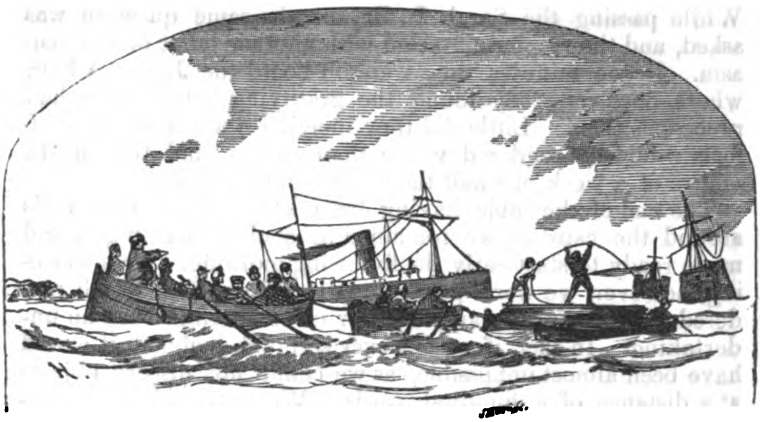
After an hour's hard work, in the course of which the raft gave way two or three times, they succeeded in getting all the timber upon it, and attaching it to a boat prepared to tow it ashore. The progress made in rowing was rather slow, but they at last succeeded by hard tugging and pulling to get it within fifty or sixty yards of the beach. Here, however, the waves were so high, that it was considered by some exceedingly perilous to land in the midst of them; but as the whole

shore was lined with breakers, and it became evident that there was no other resource, they went to work in utter defiance of the danger.

When all the timber was landed, the frame of the house was put up, and in an incredibly short space of time it was prepared for the reception of the batteries and other telegraph instruments. A deep hole was dug in the centre of the building, and in this was sunk a heavy piece of timber about the thickness of an ordinary capstan. A hogshead was placed over this again, and the intermediate space between it and the capstan, as we shall call it, being filled up, it was rendered so firm that it would hold the largest vessel in a gale of wind. Around this the cable was to be wound, and although the straining produced by it was comparatively slight, it was considered necessary to have it well secured in case of emergency.

Everything was now prepared and in readiness for the laying of the cable, which was commenced on Thursday, the 23d of August.

It was a most exciting scene, although attended with little danger to those employed in the laying or paying out of the line. The Sarah L. Bryant was lying a little less than a mile from the shore, and the Steamer Victoria about half that distance. A sufficient quantity of the cable was taken from her hold and placed in the form of a coil upon two boats, lashed together. This was performed with little difficulty; but the towing of it ashore was a most critical task, and required all the attention and care of Mr. Canning. It was impossible, without imminent risk, to employ either the James Adger or the propeller in this part of the work, as neither could approach sufficiently near the shore to land the cable. It was therefore decided, as the only safe and practicable plan, that the boats should be towed ashore by two others manned by fishermen, and some of the hands from the steamers. As soon as the cable was placed on board the boats, they were taken in tow, and then commenced the tedious process of paying it out. Its whole weight was about four tons, and as it had to be paid out with more caution than would be required in laying it from the ship, at least five hours were consumed in landing and placing it in connection with the batteries.



TAKING THE CABLE ASHORE.

When the boats having the cable on board commenced paying it out, they moved so slowly that their progress was hardly perceptible from the deck of the steamer. It was known that the work had begun, but, unfortunately, the James Adger was too far off to allow the company on board to see what was doing. A portion of the most enthusiastic volunteered their services, and having procured one of the steamer's boats, assisted in towing. They were determined on sharing the glory of the undertaking, that they might hereafter have the gratification of saying they were among those who laid the great submarine cable on this side of the Atlantic. They worked hard for two or three hours, and did not give up till they saw it successfully landed: then giving three enthusiastic cheers, which were answered in the same spirit by those on shore, they started for the steamer with the gratifying intelligence.

"Now boys," said one of the party, "let us be the first to bring the news, and we will call ourselves the Submarine Telegraph Express, for the occasion." A general assent was given to this proposal, and away they started for the James Adger, making their little boat fly over the waves in their impatience to reach the vessel. As they passed the propeller, one of the hands hailed them, and asked the news.

"What is the matter?" he inquired. "Have they got through? Is all right?"

"Yes," they all replied, in one voice; "the cable is laid—all right. Let us have three more cheers—hip, hip, hurra."

And three more cheers were given that made the welkin ring. While passing the Sarah L. Bryant, the same question was asked, and the response greeted with another burst of enthusiasm. In ten minutes they were on board the James Adger, where, however, they found the gratifying intelligence had preceded them. Little did they imagine then that their efforts would be rendered worse than useless, and that in the course of a week one-half the cable would be lost.

The end of the cable having been secured by several coils around the capstan, we remained at anchor that night, and made ready to start early the following morning. That morning, however, we were prevented by a dense fog, which rendered it exceedingly dangerous for us to attempt such an undertaking. In fact, if we felt ever so much inclined, it would have been almost impossible, as we could not discern objects at a distance of a hundred yards. We were obliged, therefore, to remain where we were during the greater part of the day, anxiously watching every sign of a change in the weather. One of our boats, containing seven or eight persons, ventured out, and having mistaken the direction of the land, came very near being lost. The error, however, was discovered before the steamer was out of sight, and corrected immediately. Up to eight o'clock that evening no change had taken place in the weather; and we began to lose all hope of the fog clearing away that night. About 9 o'clock, however, we caught faint glimpses of the moon through the murky atmosphere, and in a few minutes more we could see her dimly, as through a veil. Slowly the fog began to disappear, and in the course of an hour we discerned the ship and propeller lying on our larboard bow, and about one fourth of the distance between us and the shore. A light breeze sprung up which assisted in clearing the atmosphere, and there was every indication that we would have fine weather in the morning for the prosecution of our work. At last, after knocking about here for four or five days, we had a favorable prospect of getting away, and we congratulated each other on our good fortune. In two days more, and with a continuance of such weather, we would be at Cape North with the end of the cable, and ready to start for home. But here, again, we were doomed to disappointment, and to a longer stay off this bleak and desolate coast. The breeze to which we were indebted for clearing away the fog, freshened near midnight, and before daybreak it blew perfect gale. Notwithstanding the state of the weather it was decided to start in the morning, and about six o'clock we accordingly weighed anchor and made ready to tow the ship to sea. All this time we were under shelter of the land,

and although it blew with great violence, the waves ran low. Having succeeded, after the greatest difficulty, in attaching the Sarah L. Bryant with a hawser, we prepared to tow her, but in this we were prevented by another obstacle. It was found, after repeated attempts, impossible to raise her anchor; and, having no other alternative, her captain was obliged to slip it, having previously attached a buoy to the chain to mark its location. All this time the submarine cable held on securely to the ship, although subjected to great straining. In the midst of the intense excitement which prevailed on board the steamer, it was rumored that it had given way, but it had only disappeared from our view for a few moments, and when we looked again, there it was, holding on with a death-like tenacity. In the midst of all the trouble it was encouraging to see this; we felt grateful that our labour had not been in vain, and re-assured as to the strength it was said to possess.

We now endeavored to get into a proper position to tow the bark, but after several ineffectual attempts, were obliged to give it up in despair. Both the steamer and the bark were almost completely at the mercy of the elements; the hawser got under our wheels, and serious apprehensions were felt that it would interfere with their action. Fortunately, they escaped without damage; but we had hardly got clear of it when the ship was observed drifting down upon us with such rapidity as rendered a collision inevitable. From the moment her anchor was slipped she became unmanageable, and although every effort was made to get her bow in a straight line with our stern, it was found impossible to do so. There seemed to be some terrible fatality hanging over her, and as she came down stern foremost upon her bow, our worst fears were excited for the safety of both vessels. The propeller was lying off at a distance of two or three hundred yards, but she could render no assistance, and any attempt she might make would only render the matter more serious.

The scene on board our steamer was painfully exciting; every one crowded to the larboard side, awaiting the collision with breathless anxiety. The captain, as soon as he discovered the imminence of the danger, gave orders to reverse the wheels, and we were now moving out of the way of the ship, but so slowly that we appeared to make no progress. "Back her! back her!" he cried out to the first mate, who passed the order to the engineer. "Back her! why don't you back her?" roared the captain of the Sarah L. Bryant; but the ships appeared to be drawn together by some irresistible attraction, and in a few minutes after the order was given they struck. The larboard bow of our steamer came in contact with the

stern of the bark; but not with such violence as we anticipated. None of our timbers were started, the only damage we received being two slight scratches about five feet above the water line, while the bárk was uninjured. Our escape appeared almost miraculous, for at one time it seemed as if nothing could save us, but now that the fearful suspense was over, the excitement soon died away. The ladies were not on deck when the accident occurred, as they had in compliance with the request of the captain retired to the cabin a short time before. They were ignorant of our danger, therefore, till it was all over.

We escaped, as we have said, almost by a miracle, a serious catastrophe; but we were not as yet clear of the bark, and more than once we were near coming in contact again. It was found necessary to cut the hawser on board the steamship, and to let her take care of herself until we could get into a better position. As soon as we parted from her she dropped her remaining anchor, still holding on to the submarine cable, and we also came to anchor about the same time. We remained in this state for about an hour, when we saw two or three flags or streamers run up at half mast on board the bark—a signal of distress. Shortly after she unfurled some of her sails, and stood out to sea. She had lost her anchor, and to save herself from drifting on the rocks, was obliged to cut the submarine cable, and stand off from the shore. In a few minutes we were after her, and by a series of most skilful manœuvres attached her to our stern by a hawser. When we first approached her, several efforts were made to throw a rope over her side, but without success, when our captain changed the position of our vessel so as to let her drop under our stern, and allow a rope to be flung to one of the men on her bowsprit. The rope was caught, the hawser hauled on board, and in less than a quarter of an hour we had her safely in tow. Four cheers were given to Captain Turner, for the skill he displayed in the management of his vessel, and they were well deserved.

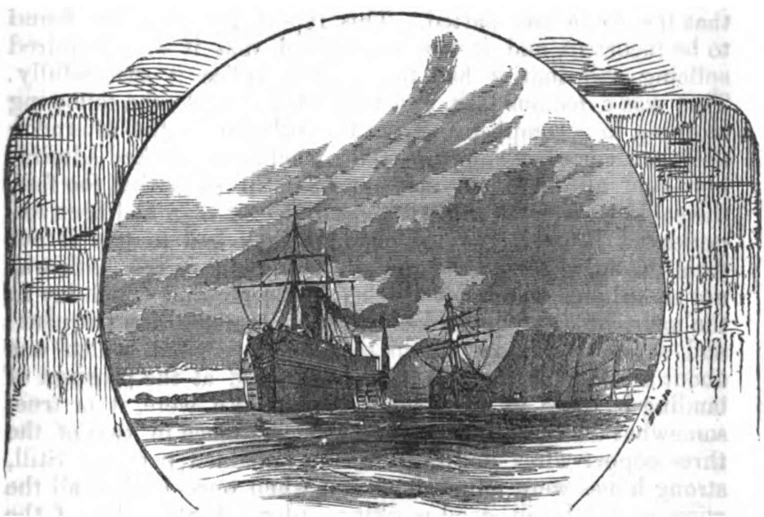
During this difficulty the bark lost two of her anchors, and the steamer was obliged to part with one of hers, leaving only two between both vessels. Both of these belonged to our steamer, but as it was impossible for her to return near the land without some security, our captain was obliged to give her one of his own.

The 26th being Sunday we did not move from the Cove, and a part of the day was spent in repairing the cable, which broke again soon after. It was evident now that the portion which had been laid must be abandoned, and that it should be

relanded and secured anew to the fastenings in the telegraph house.

At an early hour on Monday morning the 27th, the Victoria took the bark in tow, and brought her within a distanee of about six hundred yards from the beach. The cable was then successfully landed, and placed in connection with the batteries. A stiff breeze from the northwest, however, prevented the prosecution of the work, and it was deemed advisable to defer it till the next morning. Outside the Cove the waves ran so high that any attempt to lay the cable would endanger the safety of both vessels. That day therefore, we remained at anchor, and flattered ourselves with the hope that the weather would soon prove more auspicious.

The following morning was all that could be desired; the waves had subsided to a gentle ripple, there was scarcely a cloud to dim the brightness of the sun, Cape Ray appeared resplendent in his beams, and everything seemed to favor the enterprise. As the first dawn of morning tinged the eastern horizon, the bark raised her anchor and was towed out to our steamer, which lay at a distance of half a mile from the beach. In less than an hour she was attached to the James Adger with a hawser, and the process of laying the cable was commenced in earnest.



SARAH L. BRYANT AND JAMES ADGER LEAVING CAPE RAY.

All our delay seemed trifling in view of our certainty of success—for no one entertained any doubts now of its success, so long as the weather proved favorable. The first two miles of the cable were laid without an accident, but just as they were commencing on the third a kink occurred in it, and it was found necessary to stop the steamer to repair the damage. In the course of an hour all was set right and we were under way again; but in a few minutes more the white flag which had been agreed upon as a signal before starting, was displayed, and we were obliged to stop. Mr. Canning afterwards said, that the speed of the steamer, even at its lowest rate, was too fast for the purpose, and that it was almost impossible for his men to pay out the cable with sufficient rapidity. Eight were employed in the hold turning out the coils, and eight more in attendance on the machinery. The position of those in the hold was one of considerable danger, and two or three were severely bruised by the cable as they were in the act of uncoiling it. It required their constant vigilance, and greatest activity to keep clear of it as it swept up through the hold, for if once caught within its folds, the consequences would have been serious, if not fatal. To avoid this, they stood on the outside of the coil, raising it up and passing it out at the rate of two, and sometimes, three miles an hour.

Several kinks occurred up to twelve o'clock on Tuesday night, and it was reported on board of our steamer at one time that the cable had parted. This report, however, was found to be incorrect, and it was ascertained that it only required splicing, and that it had to be cut to splice it successfully. This was a tedious task, and took till 7 o'clock the following morning to accomplish. From this till four in the afternoon they had very few stoppages—the machinery worked admirably—and although our steamer was still somewhat too fast, the cable was payed out with less difficulty than had been experienced before. Up to this time they had to pay it out from the small coil in the bow of the vessel, but the work was not so arduous when they reached the larger one, which lay in the main hold. The kinks, therefore, became less frequent; and as we were now within sight of St. Paul's, which was about fourteen miles distant, we felt elated at the prospect of landing it there in a few hours more. We were, it is true, somewhat discouraged by a break taking place in two of the three copper wires, one only having remained perfect. Still, strong hopes were entertained that when once landed, all the wires would be in good working order. Forty miles of the cable had been paid out from the time we started, while the actual distance traversed did not exceed thirty-two at the ut-

most. It was, therefore, considered advisable to land it at the Island of St. Paul's, instead of Cape North, as was at first proposed, and to make the connection next year. Not more than thirty-three miles of the cable remained, and it was on making allowance for the loss on this, that Mr. Canning reluctantly concluded to give up the design originally entertained of running to Cape North.

At four o'clock the wind, which had been increasing for the last two or three hours, blew with such violence as to render it impossible to continue the work on board the bark. The sea ran so high that it was only at intervals we could discern those on her deck. The sky looked wild and threatening, and the waves broke in spray over the decks of both vessels. The ocean was covered with a mist that rendered objects, at the distance of four or five miles, invisible, and St. Paul's Island could no longer be seen. To render our position still more critical, another kink occurred in the cable, and both vessels were compelled to lay to. They made several attempts to repair the damage, but all was useless, the bark rolled with such violence that the men could not work, and it was with the greatest difficulty they could even stand on the deck. Every eye was now fixed on Mr. Canning, and they all waited with feverish anxiety for him to give the order to cut the cable. They had for more than an hour abandoned all hope of being able to land it, and their fears were aroused for their own safety and that of the vessel. But Mr. Canning was unwilling to give the word, still hoping, even against hope, that the gale would abate, and that before morning he would be able to resume work. Although both vessels were holding on by the cable, it showed no sign of parting, and would doubtless have remained whole to the end, had it been considered prudent to hold on by it. It was at this juncture that its strength was tested, and successfully proved. We had heard that it was capable of holding a seventy-four in a gale of wind, but it seemed hardly possible that even a rope of iron wire, not much more than an inch in diameter, could hold two vessels under such circumstances.

When Mr. Canning refused to cut the cable, and there appeared to be no prospect of the gale abating, the captain of the bark, Mr. Pousland, told him he would have to give the order, as the safety of his ship was now endangered.

"Mr. Canning," said he, "I shall be obliged to cut the cable."

"You can do as you please," said Mr. C. in reply, for he would persist no longer in his attempts to save it, particularly as it had now become a matter of life and death. The next minute the cable was cut, the white flag which had been displayed on the bow for the last two hours was lowered, and we were once more in motion with the bark in tow."

THE TELEGRAPH FLEET IN A GALE.

The cable having been cut, the remainder on the vessel was placed on shore, and the company abandoned further efforts to lay it, expecting to settle the question with the Insurance Company. An agent was sent to London, and the members of the company very coolly, and yet very sensibly told the agent, "that there was no loss, the cable being at the bottom of the sea, just where you wished to put it." And, also, that "they were advised that the assured's duty was to join that part of the cable already laid down to the part saved, and thus complete the line."

Of course, this should have been the duty of the Telegraph Company. No effort was made to connect the cables, notwithstanding, it is a well known fact, that a cable can be raised from a greater depth of water than is to be found on the track of the lost cable. It is not our object to criticise the misfortunes of the company; but, we certainly think that it was the duty of the assured to go to work and raise the cable and finish the undertaking. There are many important considerations involved in this subject which we do not feel at liberty to discuss, and therefore we dismiss the subject. We understand it is the purpose of the company to lay another cable, of one electric wire composed of some three or four in a twist. The advantages of such a cable we regard as questionable, though in some respects it has favor on its side.

STRENGTH OF WIRE.—The following results of the strength of No. 10 iron wire, we find in our memorandum book. The experiments were made at Messrs. Washburns, in Worcester, Massachusetts, some three years since:—

Galvanized broke at	925	pounds.
Do. annealed, broke at	875	"
Not galvanized, annealed,	1050	"
Bright wire, neither galvanized or annealed	1300	"

WEIGHT OF COPPER WIRE.

No. 12	176	pounds per mile.
" 16	63	" " "
" 18	38	" " "

Art. III.—INTENSITY OF ELECTRIC CURRENTS.

THE subject of electric currents is of so much interest, that we give the following consideration of intensity currents from Lardner, as worthy of reading. We have on former occasions referred to *intensity* and *quantity* currents, and the difference between the two is to be remembered, when either of them is discussed.

"To produce the effects, whatever these may be, by which the telegraphic messages are expressed, it is necessary that the electric current shall have a certain intensity. Now, the intensity of the current transmitted by a given voltaic battery along a given line of wire will decrease, other things being the same, in the same proportion as the length of the wire increases. Thus, if the wire be continued for ten miles, the current will have twice the intensity which it would have if the wire had been extended to a distance of twenty miles.

"It is evident, therefore, that the wire may be continued to such a length that the current will no longer have sufficient intensity to produce at the station to which the despatch is transmitted those effects by which the language of the despatch is signified.

"The intensity of the current transmitted by a given voltaic battery upon a wire of given length, will be increased in the same proportion as the area of the section of the wire is augmented. Thus, if the diameter of the wire be doubled, the area of its section being increased in a fourfold proportion, the intensity of the current transmitted along the wire will be increased in the same ratio.

"In fine, the intensity of the current may also be augmented by increasing the number of pairs of generating plates or cylinders composing the galvanic battery.

"Since it has been found most convenient generally to use iron as the material for the conducting wires, it is of no practical importance to take into account the influence which the quality of the metal may produce upon the intensity of the current. It may be useful nevertheless to state that, other things being the same, the intensity of the current will be in the proportion of the conducting power of the metal of which the wire is formed, and that copper is the best conductor of the metals.

"M. Pouillet found, by well-conducted experiments, that the current supplied by a voltaic battery of ten pairs of plates, transmitted upon a copper wire, having a diameter of four-

thousandths of an inch, and a length of six-tenths of a mile, was sufficiently intense for all the common telegraphic purposes. Now, if we suppose that the wire instead of being four-thousandths of an inch in diameter, has a diameter of a quarter of an inch, its diameter being greater in the ratio of 62¼ to 1, its section will be greater in the ratio of nearly 4,000 to 1, and it will consequently carry a current of equal intensity over a length of wire 4,000 times greater, that is, over 2,400 miles of wire.

"But in practice it is needless to push the powers of transmission to any such extreme limits. To reinforce and maintain the intensity of the current, it is only necessary to establish at convenient intervals along the line of wires intermediate batteries, by which fresh supplies of the electric fluid shall be produced, and this may in all cases be easily accomplished, the intermediate telegraph stations being at distances, one from another, much less than the limit which would injuriously impair the intensity of the current.

"Having thus explained the means by which an electric current can be conducted from any one place upon the earth's surface to any other, no matter what be the distance between them, and how all the necessary or desired intensity may be imparted to it, we shall now proceed to explain the expedients by which such a current may enable a person at one place to convey instantaneously to another place, no matter how distant, signs serving the purpose of written language.

"It may be shortly stated that the production of such signs depends on the power of the agent transmitting the current to transmit, suspend, intermit, divert, and reverse it at pleasure. These changes in the state of the current take place for all practical purposes simultaneously upon all parts of the conducting wire to whatever distance that wire may extend, for although strictly speaking there is an interval, depending on the time which the current takes to pass from one point to another, that interval cannot in any case exceed a small fraction of a second.

"Although there is some discordance in the results of experiments made to determine the velocity of the current, they all agree in proving it to be prodigious. It varies according to the conducting power of the metal of which the wire is composed, but is not dependent on the thickness of the wire. On copper wire, its velocity, according to Professor Wheatstone's experiments, is 288,000 miles; and according to those of MM. Fizeau and Gonelle, 112,680 miles per second. On the iron wire used for telegraphic purposes, its velocity is 62,000 miles per second, according to Fizeau and Gonelle;

28,500, according to Professor Mitchel, of Cincinnati; and about 16,000, according to Professor Walker, of the United States.

"It is evident, therefore, that the interval which must elapse between the production of any change in the state of the current at one telegraphic station, and the production of the same change at any other however distant, cannot exceed a very minute portion of a second; and since the transmission of signals depends exclusively on the production of such changes, it follows that such transmission must be practically instantaneous."

Art. IV.—TELEGRAPHS IN GREAT BRITAIN.

EXTENT OF LINES—RESPECTIVE COMPANIES—TARIFFS AND KINDS OF MESSAGES, &c.

THE telegraph lines in England, Ireland and Scotland, are mostly confined to a few companies of gigantic proportions. They are managed with great ability, and a very fair consideration for the public welfare. The systems of telegraph are the needle, except a few lines operated by the Bain apparatus, which is similar to the chemical telegraph, decided by the United States Federal Court as an infringement of the Morse invention.

We extract the following valuable information, from the writings of that eminent electrician, Dr. Lardner, and at the same time we cordially refer to his able book on telegraphs, for further information.

TELEGRAPHIC LINES OF THE UNITED KINGDOM.

"The telegraphic lines established throughout these countries have been constructed altogether by private companies, chartered or incorporated by the legislature. The total extent of lines in actual operation in the beginning of 1854, was a little more than 8,000 miles, upon which about 40,000 miles of conducting wire were laid, which would give an average number of five conducting wires over the entire telegraphic net-work.

This vast machinery of electric communication has been erected by five or six different companies, but the chief part of it by two—the Electric Telegraph Company, and the English and Irish Magnetic Telegraph Company: the former possesses nearly 4,500 miles of line, and more than 24,000 miles of wire; and the latter 2,200 miles of line, and 13,000 miles of wire.

The capital of the former is nearly 800,000*l*., and that of the latter 300,000*l*.

It is estimated that the total amount of capital invested in the telegraphic lines of the United Kingdom may amount to about a million and a half sterling.

THE ELECTRIC TELEGRAPH COMPANY.

This company was the earliest established, and was in operation for four years without any rival whatever, and for six years without any real competition. These circumstances will explain the large proportion in which the extent of this company's lines exceed all others.

The consequence of the exclusive possession of this important machinery of intercommunication, combined with the want of all experience as to the extent to which the public in general might be disposed to avail itself of the advantages offered to them, was naturally and very excusably the establishment of a high tariff. The use of the telegraph was regarded, so far as related to private individuals, as a luxury rather than a necessary of social life, and so far as related to men of business, as an expedient likely to be resorted to only in cases of the most pressing urgency: conceding the justice of these views, a high tariff was not only defensible, but absolutely necessary to the protection of the interests of those who had invested their capital in the enterprise.

Time, experience, and habit, on the one hand, rendered the public familiar with the uses of the telegraph, and created a greater disposition to profit by it for the ordinary purposes of life; and on the other, supplied to the Company that experience of which its managers stood in need, and enabled them, without imprudent risk, to develope liberal and enlightened views in the commercial management of the enterprise. Gradual reductions were made in the tariff, which were further stimulated by the establishment of competitors; and a standard of tariff has been established which, as will presently appear, can leave no reasonable ground of complaint as compared with those of other countries. Whether a still further reduction and a nearer approach to the principle of the uniform postage system would not benefit the companies as well as the public is a question that time and experience alone can solve.

According to the tariff, as last arranged by the Electric Telegraph Company, all messages consisting of not more than 20 words are transmitted to distances not exceeding 50 miles for 1*s*., to distances not exceeding 100 miles for 2*s*. 6*d*., and to all greater distances for 5*s*. For each additional ten words, or fraction of ten words, proportionate charges are made.

In certain exceptional cases the shilling charge is extended to much greater distances than 50 miles, and the half-crown charge to much greater distances than 100 miles. These exceptions include towns of the highest commercial and manufacturing importance, with which a large telegraphic business must always be transacted. Thus, between London and Birmingham (112 miles) the charge is only 1*s*., and between London and Liverpool (210 miles), London and Manchester (180 miles), London and Carlisle (309 miles), the charge is only 2*s*. 6*d*.

The charge for transmission is of course increased in proportion to the length of the message; but the daily experience of the telegraphic offices demonstrates that, with the exception of reports transmitted to the newspapers, the average length of the messages does not much exceed twenty words. I have obtained a return of the lengths of 74 messages transmitted, without any particular selection of subject, the total length of which, exclusive of the address, is 1151 words. The total length of the addresses is 540 words. This gives for the average length of the messages 15½ words, and of the addresses 7⅓ words, the average length of the messages, including the addresses, being therefore a little under 23 words.

Besides the convenience offered to the public by the transmission of messages to the various stations throughout the country, this Company has established a system of metropolitan intercommunication by means of seventeen branch stations in connection with each other and with the principal station at Lothbury. These stations are dispersed through the metropolis at points which have been found to be the most active centres of intercourse.

Messages of twenty words are transmitted between any two of these metropolitan stations for 1*s*.

In all cases the charge for the telegraphic message includes its delivery at the place of address, provided that such place be within a radius of half a mile round the station, 6*d*. being charged for each mile additional, and no charge is made for the addresses of the sender or receiver.

According to the half yearly balance sheet of the company it appears that in the six months ending December 31, 1853, the gross revenue amounted to 56,919*l*., and that the dividend was 7 per cent. per annum on the capital.

The receipts would represent an average daily business of about 6,200 shilling messages.

This company possesses the English patent of many forms of telegraph, including those of Bain. It works, however,

chiefly with the double needle telegraph, impelled by currents from the ordinary plate battery of zinc and copper, excited by acidulated water. The transmission of each despatch, consequently, occupies two conducting wires, and two batteries with their accessories.

On certain lines, as for example between London and Liverpool, the instrument of Bain is used. This is attended, as compared with the needle instrument, with two advantages; first, that it requires only one line wire; and secondly, that it writes its own despatch. With the needle instrument two copies of each despatch must be made, one to be delivered as addressed, and the other to be retained by the office. In using Bain's method, that which is written in telegraphic cipher by the instrument is retained by the office, so that the time of one clerk is saved.

In the organization of its establishment, the Electric Telegraph Company have made an innovation on our national customs, which cannot be regarded as otherwise than happy and judicious, by rendering electro-telegraphy the means of enlarging the sphere of female industry in this country. In no part of the civilized world,—except perhaps the United States, where our customs have been retained,—are females excluded from so many employments suited to them, as in England. In France they are extensively employed as clerks in various branches of commercial business. As money-takers or ticket-sellers in railway offices, theatres, concert-rooms, and in short in all public exhibitions, they are engaged, to the entire exclusion of the other sex. As box-keepers and box-openers in all the theatres, and in numberless other occupations in which no bodily labor is needed, they are preferred to men.

Now the working of telegraphic instruments, and the general business of telegraphic offices is precisely the kind of occupation for which they are best fitted, and we notice with great pleasure the independent and enlightened step taken by the Electric Telegraph Company in their employment, which it may be hoped will prove only the commencement of a general movement, having a tendency to improve the condition of that portion of the sex who are obliged to seek the means of living by their industry.

The battery department is not one of the least interesting objects presented in the Lothbury establishment. The cellars of the building are appropriated to this generator of electric currents. They consist of two long narrow vaults, in which upwards of 300 batteries are arranged, consisting of various numbers of pairs of plates, six, twelve, and twenty-four, adapted to carry smaller and greater distances.

The entire amount of voltaic power employed by this company throughout the country consists of 96,000 cells composed of 1,500,000 square inches of copper, and an equal surface of zinc. These are kept in action by the consumption of six tons of acid annually.

In the half year ending 31st December, 1851, the paid up capital of the company was augmented, and the tariff for the transmission of messages was reduced in the large proportion of 50 per cent. upon its original rate. The extent of the line was increased 8 per cent., and that of the conducting wires nearly 35 per cent. The average number of wires upon the lines was augmented by this change from 4 to 5. The effect of this, and the gradual increase from month to month in the next half year was an increase of above 60 per cent. in the amount of business, and nearly 13 per cent. in the receipts, the dividends having been augmented from 4 to 6 per cent.

Among the more recent improvements in the transaction of telegraphic business which have been made by this company, the following may be mentioned.

"Franked message papers," pre-paid, are now issued, procurable at any stationer's. These, with the message filled in, can be dispatched to the office when and how the sender likes; and the company intend very quickly to sell electric stamps, like Queen's heads, which may be stuck on to any piece of paper, and frank its contents without any further trouble. Another very important arrangement for mercantile men is the sending of "remittance messages," by means of which money can be paid in at the central office in London, and, within a few minutes, paid out at Liverpool or Manchester, or by the same means sent up to town with the like dispatch from Liverpool, Manchester, Bristol, Birmingham, Leeds, Glasgow, Edinburg, Newcastle-on-Tyne, Hull, York, Plymouth, and Exeter. There is a money-order office in the Lothbury establishment to manage this department, which will, no doubt, in all emergencies, speedily supersede the government money-order office, which works through the slower medium of the post-office.

THE MAGNETIC TELEGRAPH COMPANY.

This company has established an underground line of ten wires from London to Liverpool, by Manchester, and one of six wires from Liverpool to Portpatrick, and from thence to Belfast. The line from Belfast to Dublin, and from thence to Cork, with branches, is overground on poles. The underground system is again adopted from Cork to Queenstown.

Lines are in progress of construction along the Waterford and Limerick Railway, and six additional wires are being laid between Dublin and Belfast.

The instruments used are the needle-telegraph, and chiefly the double needle instruments, the current being produced not by galvanic batteries, but by magneto-electric machines, on the principle patented by Messrs. Henley and Forster, improved in various details by the Messrs. Bright, the secretary and engineer of the company.

The speech delivered by the Queen on opening the parliamentary session of 1854, was supplied verbatim to the Belfast journals at 2 h. 25 m., to those of Dublin at 2 h. 40 m., and to those of Cork at 3 h. 20 m. on the afternoon of its delivery.

The tariff is regulated upon principles similar to that of the Electric Telegraph Company.

Although this company was not incorporated until the middle of 1852, it has now (July, 1854) upwards of 2,000 miles of telegraphic lines, and 13,000 miles of wire in active operation, and from the rapid progress it has hitherto made, and its power to extend its capital of 300,000*l.* to 600,000*l.*, it is probable that ere long its scale of operation will be much further extended, to the great benefit of the public.

SUBMARINE COMPANIES.

The CHARTERED SUBMARINE TELEGRAPH COMPANY, between Great Britain and the Continent, has been formed with a nominal share capital of 150,000*l.*, of which the half has been for the present reserved, the actual amount of the subscribed capital being only 75,000*l.*

The operations of this company have hitherto (1854) been limited to the establishment of electric communication with Belgium, by means of the cable already described, connecting Dover with Ostend.

This company has recently coalesced with the Submarine Telegraph Company.

The SUBMARINE TELEGRAPH COMPANY, between France and England, has a nominal share capital of 100,000*l.*, of which about 75,000*l.* have been subscribed and expended, the shares representing the remainder being still unallotted. The operations of this company have been limited to the establishment of electric communication between France and England, by means of the submarine cable laid between Dover and Calais.

The EUROPEAN and AMERICAN ELECTRIC TELEGRAPH COMPANY has been established to form a link between the cables

of the two submarine companies, and London, Manchester, and Liverpool, and intermediate places. This company has laid underground wires from Dover to London, and from London by Birmingham and Manchester to Liverpool. Of this line, the first section between Dover and London was opened for public correspondence on 1st November, 1852, and has since been in constant operation. Of the remainder, 190 miles were completed on 1st March, 1854, passing through Birmingham, Wolverhampton, Stafford, and Macclesfield, to Manchester. The remaining 30 miles to Liverpool has been since completed, and the entire line is now in operation. The total cost of this line, with its accessories, has been 100,000*l.*

By an arrangement between this and the Submarine Company, all despatches between the offices of the latter from the Continent are transmitted upon the lines of the former, being delivered and received at the offices of the latter. In fact, so far as the public are concerned, the continental correspondence going or coming by France or Belgium is transmitted by these three companies, acting in common and as a single administration. Offices for correspondence between England and the Continent are established in London, Birmingham, Manchester, Liverpool, Gravesend, Chatham, Canterbury, Deal, Dover, Calais, Paris, Brussels, and Antwerp; despatches, however, being forwarded to England from all continental stations.

The tariff for all single messages between London and the Continent is 8*s.*, in addition to the Continental charge for transmission between the Continental station to or from which the message is transmitted, and Calais or Ostend. If the message is sent to or from any provincial town (except Dover,) there is an additional charge for its transmission between London and such town.

The originators of the novel and bold project of submarine electric communication are stated to be the Messrs. Jacob and J. W. Brett Brothers, of Hanover-square, London. Their first propositions were addressed to the English government, and were directed to the deposition of a submarine cable between Holyhead and Dublin, which they offered to undertake if the government would make them a grant of £20,000, for which, of course, the state would have for public purposes the free use of the line. This offer was declined.

The next propositions, addressed to the French and Belgian governments, were attended with more success. An exclusive privilege was granted by both governments, to which the English government acceded for the use of such submarine conductors as the parties should succeed in depositing, and in consequence of this, the companies were formed, by which the pro

ject has since been realized, and the cables already described between the English coast near Dover and the coasts of France and Belgium, near Calais and Ostend, were laid, by which London, Paris, and Brussels have been brought into and now are in instantaneous electric communication; and through these capitals the whole Continent, wherever telegraphic wires have been established, has been put in connection with the United Kingdom.

The actual celerity with which correspondence can be transmitted between London and parts of Europe more or less remote, may be judged from the fact that the Queen's speech, delivered at the opening of the parliamentary session of 1854, was delivered verbatim and circulated in Paris and in Berlin before her majesty had left the House of Lords.

Messages have been sent from the office in Cornhill to Hamburg, Vienna, and, on certain occasions, to Lemberg, in Gallicia, being a distance of 1,800 miles, their reception being acknowledged by an instantaneous reply.

It is satisfactory to be able to state that measures are being taken by many of the most important continental states to extend the benefits of telegraphic communication by multiplying the stations, by increasing the number of conducting wires, and by lowering the tariff.

The electric communications with the continent may now be considered as secure from all chance of interruption. Accidents from the dragging of anchors may occur, by which any one of the submarine cables may be disabled for a time, but in that case the communication with the continent will be maintained by either or both of the others, such a coincidence as the simultaneous disabling of all the three not being within the bounds of moral possibility.

Art. V.—ELECTRIC TELEGRAPHS IN EUROPE.

MEDITERRANEAN, FRENCH, BELGIAN, PRUSSIAN, AUSTRIAN, DANISH, AND THE LINES GENERALLY.

From the same author referred to in the former article, we gather the following valuable information relative to the respective telegraphs on the continent, and we also add additional data which we have collected during the year 1855, while travelling through Europe.

MEDITERRANEAN ELECTRIC TELEGRAPH COMPANY.

"Another company has been formed by the spirit and enterprise of the Messrs. Brett, under the auspices of the governments of France and Piedmont, for connecting the coasts of Europe and Africa by electric wires, in the manner already explained. This company is formed with a share capital of £300,000. An exclusive privilege for fifty years has been granted to it by the two governments, and a guarantee of interest of four per cent. on £180,000 is given by the French, and five per cent. on £120,000 by the Sardinian government.

This enterprise is now (1854) in rapid progress of realization, several hundred men being occupied in constructing the lines across the islands of Sardinia and Corsica. It is expected that the lines to the coast of Africa will be completed and in operation soon after these pages will be in the hands of our readers.

While we write these lines, (June, 1854,) we learn that the cable has been laid between Spezzia and Corsica, and between Corsica and Sardinia, and is already in successful operation.

The condition and form of the bottom between coast and coast has been ascertained by soundings, and is found to present no obstacles, being free from any considerable inequalities of depth. The conducting wires within this cable have received a special form, the advantage of which is, that in case of the cable being bent by any accidental inequalities of the bottom, or accidents in the process of its deposition, the wires will not be strained, but will easily yield as a spiral spring would. In the cables already laid, it has been found that some of the wires have been more or less injured from this cause, so as to render their performance unsatisfactory.

The weight of this cable is at the rate of eight tons per mile. It contains six conducting wires, each of which is covered with a coating of gutta-percha, and the whole is surrounded with hemp, properly tarred, so as to form a compact

rope, which is finally enclosed, like those already described, in a compound heliacal armor of twelve galvanized iron wires.

Until the cable and wires destined ultimately to connect Alexandria with Sardinia can be completed, it is intended to establish a special line of steamers between Malta and Sardinia, so as to be enabled to transmit intelligence instantaneously from the centre of the Mediterranean to London, Paris, and all parts of Europe. Two mercantile houses, Messrs. Rubattino & Co., of Genoa, and Messrs. Antonio Galea & Co., of Malta, have undertaken conjointly to place two steamers to run between Malta and Sardinia, to take the despatches coming from the East, to be transmitted to Paris and London.

It is intended, however, meanwhile, to connect Malta by a cable with the nearest point of the African coast, and by this, and an underground line of wires to Bona, to establish an electric communication with Sardinia, and thence with London.

In an elaborate table, collected from the most recent reports, are shown the telegraphic stations established in various countries of Europe in July, 1854. Annexed to each place is the charge at which a single message is transmitted between it and London. Of this charge 8*s.* is the part applicable to the transit between London and Calais or Ostend, the remainder being the cost of transmission between one or other of these places, and the continental station. A single message cannot exceed 20 words if transmitted by Calais, or 25 words if transmitted by Ostend. The charge is increased in a two-fold ratio for messages which exceed this number of words, but which do not exceed 50, and in a three-fold proportion for such as exceed 50, but do not exceed 100. In general, messages exceeding 100 words are not transmitted.

In some cases a message may be transmitted by different routes, at the option of the person sending it. Thus, for example, a message to Vicenza may be sent via Baden, via Bavaria, via Switzerland, via Sardinia, or via Belgium. The cost of transmission in such cases varies with the route chosen.

BELGIAN TELEGRAPH LINES.

Although in the extent of its territory Belgium is one of the least considerable of the continental states, it derives from its position in relation to this country much importance, so far as regards telegraphic communications. By the submarine cable between Dover and Ostend, or failing in that, by the cable between Dover and Calais, Belgium constitutes the most direct stage in the telegraphic route to the northern states.

The Belgian telegraph lines, as well as the railways, are constructed, maintained, and administered by the state. Separate

systems of conducting wires are appropriated to the service of the railways, which is performed exclusively with the alphabetical apparatus of M. Lippens. There are a few exceptional cases on branch lines of railway, upon which the state has not yet constructed telegraphs for the public service, where private dispatches are sent by the railway telegraphs, but generally on extensive system of independent wires, with their accessories, are adapted to this purpose, for which a large corps of telegraphists has been formed.

The state telegraph lines, appropriated to the public service, have at present (1854) a total length of about 550 miles, upon which about 16,000 miles of wire have been erected. With the exception of some distances through Brussels, these wires are everywhere supported on posts.

The total capital absorbed in this establishment is estimated at £23,000, and the gross annual receipts in 1854 were computed at £10,000, of which the net profit was £3,600, being nearly 16 per cent. of the capital.

Immediately on the completion of the submarine cable between Dover and Ostend, an active daily intercourse between London and Brussels commenced, and has since been sustained. The connections were completed on the 20th June, 1853, and on the 27th of the same month, 111 dispatches were interchanged between the two capitals.

It is proposed to construct wires and apparatus sufficient to maintain the communications on this important line, so that even with the greatest pressure of business, the public shall not have reasonable ground of complaint on account of delay. "A telegraphic line," observes the Minister of Public Works, "should not be organized with the mere powers which suffice for the ordinary or average business, but should be such as to meet the exigencies of occasional pressure, without subjecting the public to delay, or interrrupting other regular business. Besides which, it ought never to be forgotten, that in telegraphic business great pressure must always come at particular hours, when prompt expedition is indispensable. This will be easily understood in the business of the Belgian lines, which constitute the route upon which the quotations of the money markets of all the great centres of affairs—London, Paris, Amsterdam, Berlin, Antwerp, &c.—are transmitted at certain hours."

The business transacted by the Belgian telegraphs consists of three classes of dispatches:

Home dispatches, being those transmitted between two Belgian stations.

International dispatches, being those between a Belgian and foreign station.

Foreign dispatches, being those transmitted through Belgium in passing between two foreign stations.

Of these three classes of telegraphic business, the second has proved to be the greatest in number, and the third the most productive, as appears by the following statement of the results of the year ending 31st December, 1853.

Despatches.	Number of Despatches.	Receipts.
Home	14,160	£1,813
International	20,664	3,831
Foreign	17,232	5,227
Total	52,056	£10,871

It appears from this statement that about 40 per cent. of the dispatches transmitted and received in Belgium, are interchanged with foreign countries, and that one-third of all that passes on Belgian wires is matter passing *en route* between foreign places. Nearly half the gross amount received for telegraphic dispatches is produced by dispatches transmitted between foreign stations, and only passing *en route* through Belgium. This is explained by the fact that such dispatches, passing always from frontier to frontier, and in the majority of cases from Ostend to the Prussian frontier, the entire length of the kingdom, pay for the longest class of telegraphic distance. This is one of the advantages which the Belgian telegraph derives from the geographical position of the country.

To show the proportion in which the telegraphic service is shared by different subjects of correspondence, we shall take the classified subjects of dispatches of August, 1853, the month in which the correspondence was most active. In this month there were 5,799 dispatches transmitted on the Belgian wires, which are thus classified:—

	Number.	Per cent. of total.
Commerce	3,247	56
Money market	1,566	27
Private	754	13
Press	116	2
Government	116	2
Total	5,799	100

In relation to length the proportion was as follows:—

	Number.	Per cent. of total.
From 1 to 20 words	4,741	81·8
From 21 to 50 words	921	15·9
From 51 to 100 words	122	2·1
Above 100 words	15	0·2
Total	5,799	100·0

Thus it appears that commerce and the Stock Exchange supply 83 per cent. of the whole telegraphic business, 13 per cent. being personal and domestic, and the press and government each employing the insignificant proportion of one dispatch in every fifty.

It is also apparent, that a very small proportion of the dispatches exceed the length of 20 words, and almost none that of 50 words.

According to the Belgian tariff, messages not exceeding 20 words are charged 2*s.* for distances not exceeding 60 miles; 4*s.*, from 60 to 140 miles; and 6*s.* above 140. No distances within the limits of Belgium exceed 200 miles.

For messages of 21 to 50 words the charges are doubled, and for 51 to 100 words are tripled.

It will be seen that these charges are more than double the corresponding charges on the English lines.

The large proportion of international and foreign despatches transmitted upon the Belgian wires, and the necessity of prepayment for dispatches, in all cases, to their ultimate destinations, rendered it necessary for the Belgian administration of telegraphs to make some general arrangement with the principal contiguous states, for such an interchange of correspondence. A telegraphic congress was accordingly convened at Paris, in September, 1853, which was attended by delegates from France, Belgium, Prussia, Austria, and the minor German States. A telegraphic convention was concluded and signed on the 4th of October, 1852, fixing definitely a general tariff for all despatches transmitted to or from the several States.

According to this convention, each telegraphic region was divided into a series of zones, measured from the Belgian frontier, according to a series of direct distances (as the bird flies), the charges to places in each successive zone, for single dispatches (1 to 20 words), being fixed at 2*s.*, 4*s.*, 6*s.*, 8*s.*, and so on, an increasement of 2*s.* being made for each increase of distance.

France is, by this convention, resolved into six telegraphic zones, the tariff for single messages being 2*s.*, 4*s.*, 6*s.*, 8*s.*, 10*s.*, and 12*s.* The first zone includes the chief northern towns, Arras, Douai, Lille, and Valenciennes; the second, Amiens, Boulogne, Dunkerque, &c.; the third, the chief places in the nearer central parts, including Paris, Orleans, Havre, &c.; the fourth, the more distant central parts, such as Châlons, Lyons, Strasbourg, &c.; the fifth, the nearer southern parts, Avignon, Grenoble, Bordeaux, &c.; and the sixth, the most remote southern parts, Marseilles, Bayonne, &c.

The German States, including Lombardy, are resolved into eight zones, of which the tariff is 2*s*., 4*s*., 6*s*., 8*s*., 10*s*., 12*s*., 14*s*., and 16*s*. These zones include the whole extent of Northern and Eastern Europe beyond the Rhine, as well as the north-eastern part of Italy.

The tariff for single messages crossing the channel, by the Ostend submarine cable, is 8*s*. For these charges, however, they are transmitted, if required, to London.

At the chief stations on the Belgian lines, the double needle instruments, as used in England, the French State instruments, and the Morse Telegraph, as used in the German States, are provided. By the first the telegraphic correspondence with England, by the second with France, and by the third with the German States, is carried on.

It is intended generally to receive and transmit dispatches written at the option of the sender, either in French, German, or English, at all the Belgian stations; but for the present this is only done at Brussels, Antwerp, and Ostend.

Dispatches transmitted between Holland and Belgium can be transmitted and received in Dutch, and all dispatches between Belgian stations may be sent in Flemish. At all stations dispatches are transmitted and received in French.

If the place to which a dispatch is addressed be not a telegraphic station, the dispatch will be forwarded to its destination either by post or by a special messenger, at the option of the sender. If the former, the postage is 10*d*., if the place be within the State where the telegraphic station at which the dispatch arrives is situate, and 20*d*., if in another State. If the latter, a charge of 10*d*. is made for a distance of a kilomètre (five furlongs), and 5*d*. for every additional kilomètre.

FRENCH TELEGRAPHIC LINES.

Although late in the adoption of this improved agency of intercommunication, France, having once commenced, has prosecuted the work with great vigor, and the country is now overspread with a net-work, the extent of which, in actual operation at the close of the present year, 1854, will not be less than 6,000 miles. This system is everywhere erected upon posts chemically injected to insure their durability, and there are nowhere less than two conducting wires; but a greater number between all stations where an active correspondence is maintained.

The instruments used for the transmission of all home dispatches, that is, all dispatches transmitted between any two French stations, are the French State telegraphs. For international dispatches, the double needle and Morse's instruments

are used. These instruments are provided at the central station, in the Ministry of the Interior at Paris. The double needle instruments are provided also at Calais, and Morse's instruments at Strasbourg. As the system is developed and extended, the double needle instruments will be provided in addition to the French telegraphs, at all stations which may be in direct communication with England, and Morse's instruments at all stations which may be in direct communication with the German States.

The French telegraphic lines communicate with those of England at Calais by the submarine cable; with those of Belgium at Lille and Douai; with those of Prussia and Northern Germany, at Metz; with the Rhenish States, Wirtemburg, Bavaria, and Austria, at Strasbourg; with those of Switzerland, at Mulhouse and Macon, the former communicating with Bale, and the latter with Geneva; and, in fine, with those of Savoy and Piedmont, at Grenoble.

Other links of electric connection will speedily be formed. Thus the present lines are continued to the Spanish frontier at St. Sebastian, and lines of wire are now being laid between that place and Madrid, so that the capital of Spain will be in electric connection with that of France, and therefore also with London, and the other capitals of Europe, most probably, before these pages are in the hands of the reader.

In practice the transmission of dispatches is not always so direct or immediate as it would appear to be upon the inspection of a telegraphic map. Thus, by the submarine cable between Dover and Calais, Paris is in permanent direct communication with London. But when it is desired to transmit a dispatch from Paris to any of the provincial towns of England, the dispatch is at present received and written down at the central station in London, and then repeated and transmitted to the place of its destination in the provinces. This repetition could of course be avoided, by uniting, in the London station, the wire from Paris with the wire leading to the provincial station to which the dispatch is addressed, and if the dispatch were one of extraordinary length this course would be the most expeditious; but to adopt it with the ordinary class of short messages, would involve much inconvenience and more delay in general than is incurred by its repetition and retransmission. Thus, to send each message direct to its destination in the provinces, it would be necessary that, previously to the transmission from Paris, notice should be transmitted to London to connect the Paris wires with those between London and the place of destination, and as this change would have to be made separately for every provincial message, and as the wires between London and the various provincial stations must necessarily be occupied, more or

less, at all times, in the transmission of home correspondence, the business of transmission in this direct manner would not only be far more dilatory than the process of repetition, but would, in fact, at busy times of the day, be totally impracticable.

What has been here stated respecting the Paris and London line will be applicable, *mutatis mutandis*, not only to all international messages, but in many cases to messages transmitted between home stations, which it is often more convenient and expeditious to repeat and retransmit at certain intermediate stations, than to send direct by the connection of the wires at those stations.

It will be understood, nevertheless, that the necessity for this circuitous transmission, and intermediate repetition of dispatches, arises in all cases from the insufficiency of the number of conducting wires in relation to the quantity of correspondence to be transmitted. In the transmission of each dispatch by the English and French instruments, two wires are employed. Now, if the direct correspondence between London and Paris, during the most busy hours of the day, be sufficient to employ one pair of conducting wires, another pair would be necessary to communicate with intermediate places, and if the correspondence with these were very unequal, some engrossing a large share of it, a third pair might be required, and so on.

It must be, therefore, very apparent that great convenience would in such cases be gained by substituting, for the English and French telegraph, that of Morse or Bain, or any other which transmits by a single conducting wire. In that case, the four wires contained in the submarine cable, between Dover and Calais, would do much more than double their present duty. Instead of carrying two streams of messages simultaneously, as they do at present, they would carry four. If one were put in permanent connection with London and Paris, the three others could be reserved, one for direct connection with the chief provincial towns, such as Birmingham, Manchester, Liverpool, Glasgow, Dublin, &c., and the two others for messages to less important stations, subject to occasional repetition. These latter would be to the telegraphic line what the second and third class trains are to the railway. It might be found even advantageous to fix a higher price of transmission for messages thus sent without intermediate repetition; just as a higher fare is paid for express than for ordinary trains.

The French Government has recently re-organized the administration of the telegraphs throughout its entire territory, and besides modifying and reducing the tariff, it has placed

the whole upon a more efficient footing. It now constitutes an important department of the state, placed under the superintendence of a director-general, four inspectors-general, twelve chief directors, and an hundred inspectors. The director-general, established in Paris, holds his office under the Minister of the Interior, and has authority over all the inferior functionaries. The four inspectors-general control and direct under him the entire telegraphic service throughout the empire. These inspectors, aided by scientific men nominated from time to time by the Minister, form a superior council, charged to consider and decide upon all improvements proposed to be made in the processes, or in the telegraphic apparatus.

The telegraphic lines will be distributed into twelve distinct systems or sections, over which the twelve chief directors will preside, so as to inspect, direct, and by communication with the inspectors-general and director-general, to centralize the service.

The hundred inspectors will each be charged with the direction of one or more stations, and will have under their authority deputy station-masters, telegraphists, surveyors, artisans, and laborers, charged with the maintenance of the apparatus, the conducting wires, posts, and all the accessories of the line.

In all chief places, the bureaux will be open night and day. The number of stations open on 1st November, 1853, was 78; in June, 1854, the number was 105. At the close of 1854 all the Prefectures of France will be in electric connection with the capital.

The posts, a large proportion of which had not sufficient magnitude and strength to bear the necessary number of wires, have been everywhere replaced by others of suitable dimensions, and the telegraphists are augmented in number, and measures taken to ensure their efficiency.

It is decided also to give ample trial to the telegraphic instruments of Morse* and Bain, already adopted to a great extent in Germany and in the United States; and if the result of experience on a large scale is favorable to them, they will be adopted either in conjunction with the present telegraphs, or to the exclusion of them according to circumstances. In all, there are manifest signs of activity and of exemption from prejudice, national or personal, which argue favorably for the progress of this great social improvement.

AUSTRO-GERMANIC TELEGRAPHIC UNION.

The electric telegraph had not been long in operation in the German States, before it became apparent that great inconve-

* The Morse system was adopted.—EDITOR.

nience and much obstruction to the progress of correspondence, arose from different states adopting different telegraphic instruments and signals. The difficulties arising from this cause became at length so great as to demand prompt and effectual remedy. A telegraphic congress was accordingly convened at Vienna in October, 1851, at which deputies from all the German States attended; and after a full discussion of the subject, it was resolved to form an Austro-Germanic Telegraphic Union. This union includes all the states of Europe east of the Rhine, and also the Austrian provinces in Northern Italy. It was agreed that a common system of telegraphic instruments and symbols should be adopted throughout all the associated states, and that for the present, Morse's telegraph, with its receiving magnets, registers, and uniform alphabet, should be everywhere used, so that telegraphic communications may at all times be made between any two stations of the Union without the delay and inconvenience of translating dispatches at intermediate stations from one system of telegraphic symbols into another.

Dispatches are transmitted and received at all the stations of the Union, either in German or in French. They are also transmitted and received in English at such of the chief stations as are found by experience to have frequent communication with this country.

Since the convention was concluded, the Germanic lines have received considerable extensions, so that many important stations have been recently established within the telegraphic connection. Thus, a line of telegraphic wires has been laid, extending from Bremen to Gluckstadt, and from Hanover to Lauenburg. Also from Hamburg through Denmark, by Rendsburg, Kiel, Schleswig, to Kiel, across the Little Belt, by Odense, across the Great Belt to Copenhagen and Helsingfors.

Lines are also in operation from Dantzic to Konigsberg, from Troppau to Lemberg, from Vienna, by Pesth, with various branches to Klausenberg, Orsova, Semlin, Peterwardin, and Eszeg.

THE NETHERLANDS TELEGRAPHIC LINES.

Notwithstanding the dense population and active commerce of the kingdom of the Netherlands, its limited territory has rendered a very small telegraphic net-work sufficient for its purposes. Only eight of its chief towns are connected by telegraphic wires. These are:

Amsterdam (*e*), Rotterdam (*e*), the Hague (*e*), Utrecht, Haarlem, Breda, Dordrecht (*e*), and Arnheim.

They are connected at the Hague by seven submarine wires with the English lines, at Antwerp with those of Belgium, and at Arnheim with those of the German Union.

Dispatches are received in German and French at all the stations, and in English at those marked (*e*).

THE SWISS TELEGRAPHS.

The natural difficulties opposed to the construction of railways in Switzerland did not offer such serious impediments to the construction of telegraphic lines, an extensive net-work of which has been constructed and brought into operation. Thus Berne is connected with the French lines by wires to Besancon, and with the German lines at Bale. Lausanne is connected with Besancon by an independent line, and also with Berne on one side and Geneva on the other. Geneva is also connected with the French system at Macon, and with that of Savoy at Aix, from whence a line of wires is carried across Mont Cenis to Turin.

From Lausanne the wires are carried by Vevay and Sion through the Valais to the foot of the St. Gothard, across which they are continued by Bellinzona to Milan.

Another line passes from Bale by Lucerne, Glaris, and Coire, to the Splugen, which it crosses, and is carried to meet the former line at Bellinzona, and thence to Milan.

Another line from Bale passes by Zurich and St. Gal to Innspruck, from whence it passes by Batzen and Trente to Verona, and by Salzburg and Linz to Vienna.

Lines have, however, been since constructed, including some other stations.

ITALIAN TELEGRAPHIC LINES.

Italy is put in electric connection with the more northern countries of Europe at six points, Nice, Mont Cenis, the St. Gothard, the Splugen, the Tyrolese Alps, through Innspruck, and by Trieste.

The French lines are already extended to Nice, and a line between Nice and Turin will probably be completed before these pages come into the hands of the reader. The French and Swiss lines are connected with Turin by the wires over Mont Cenis already mentioned; the Swiss and Rhenish lines with Milan, by the wires over the St. Gothard, and the Splugen, and the Austrian and Bavarian lines by the wires over the Tyrolese Alps, and those from Trieste round the shores of the Gulf to Venice.

From Venice to Milan a line is carried by Verona and Brescia, which is continued to Turin. From this line there are two branches going southwards, one from Verona by Man-

tua, Parma, Modena, Lucca, Leghorn, Florence, Sienna, to Viterbo in the Papal States. This line will speedily be continued to Rome. The other branch goes from Alexandria to Genoa."

Such is the extent of Italian telegraphs completed in 1854.

SWEDISH LINES.

The telegraph is making rapid progress in Sweden and Norway, connecting with the continental lines through Denmark, crossing the sound with a cable, having three electric wires, similar to the Danish cable herein before illustrated.

RUSSIAN LINES.

The telegraph lines in Russia have been extended with remarkable energy. The line from St. Petersburg to Moscow is the oldest, the other routes until late being semiphore. The Moscow line was laid underground, but now it is being placed on substantial poles. In fact, all the lines in Russia are well constructed, and in general, we think them superior to any other lines in the world. The poles are all very large, barked, and charred at lower end. They are well set in the earth, and range with great precision. We have seen many of them, and speak knowingly when we say, that as to permanency they have no equal either in Europe or America.

The principal lines are from St. Petersburg west to Konigsberg, branching from Marianpol, and extending from the same place to Warsaw, and thence to north Austria and to Myslowits.

Another line from St. Petersburg to Twer, Moscow, Kief, Nicholaef, and to Odessa. A branch line runs from Nicholaef to Xerson, Perekop, Simpheropol, and to Sevastopol.

A line extends from St. Petersburg to Wyborg and to Helsingfors.

Another runs to Narva and to Revel.

A branch line runs from Dunabourg to Riga.

There is also a short line from the city to Peterhoff and to Kronstadt.

The Imperial government of Russia is rapidly extending the telegraph throughout its vast empire, and in a few years the system will be more extended there than in any other part of Europe. The Morse system is wholly used.

BLACK SEA LINES.

The Allies have long since been successfully working a submarine line from Turkey in Europe to the Crimea; also, another line from Varna to Constantinople. These lines connect through Vienna to all parts of Europe.

TELEGRAPHS IN TURKEY.

The line from Varna to Constantinople is worked under the direction of the Allies. We understand that there are other short lines, under the Turkish authority, but we have not been fully advised relative to them. We copy the annexed description of the Varna cable as an interesting item of news:

"For months past an electric cable, three hundred and forty miles in length, stretching from Varna to Balaclava, has brought us in a few hours news of the intrepid Argonauts of the Crimea. We venture to quote here the words of a member of the French Academy of Sciences, Marshal Vaillant, Minister of War, when asked for some particulars in reference to this submarine telegraph of the Black Sea, in April last:—"I send my dispatch to General Canrobert, and I have an answer sooner than I should have it by letter from a town half-way to Lyons, to Bordeaux, or Strasbourg, and I have not yet recovered my amazement at this prodigy." The Field Marshal and Academician did not share the general indifference to this marvellous fact.

Although submarine telegraph engineering seemed, by the successful laying of the Varna and Balaclava line, to have been reduced to a certainty, we have recently had to record the signal failure, first, of an attempt to lay a submarine cable from Cape Breton to Newfoundland; and, secondly, the same unfortunate issue of an attempt to complete the telegraphic communication to Algeria by a submarine line, for the Mediterranean Telegraph Company.

In contrast with these mishaps we have this week to record some particulars from an eye-witness of a new triumph of Submarine Telegraph by Messrs. Newall and Co., who, in August last, contracted with her Majesty's Government to establish telegraphic communication between Constantinople and Varna, so as to complete the telegraphic circuit to the seat of the Ottoman Government, by a line of moderate cost, and free from the risks of interruption to which over-ground wires in countries where there is no effective police would be peculiarly exposed, and without facilities of repairing injuries.

For this and another line in the Black Sea, upwards of 200 miles of cable were manufactured, transported 3,000 miles, and successfully laid down in the short space of three months; for on the 5th of October the Varna and Constantinople line was opened for business.

The cable consists of one copper wire, thickly insulated, and covered with iron wires to give it strength and protect it from injury. Its weight is about 200 tons. In this respect it dif-

fers from the Varna and Balaclava line, which, for the greater part of its length, consists of a copper wire one-sixteenth of an inch in diameter, coated with gutta-percha, and altogether a little more than the thickness of a common black-lead pencil! The laying of such a line across the stormy Black Sea may fairly be characterized as the boldest enterprise ever made in electric telegraphing; the risk of doing which was undertaken by Messrs. Newall and Co., who proposed it to the Duke of Newcastle, for the small sum of £22,000.

This marvellous line, which it was predicted by submarine telegraph directors and engineers could not be laid down, and if laid down could not last, has stood all the storms of the Black Sea for six months without the slightest injury or an hour's stoppage. These facts seem to indicate that heavy cables are a useless extravagance, save in very peculiar circumstances of exposure to anchorage. It is evident, also, that the small cable, such as the Varna and Constantinople line, brings within the easy reach of capitalists long lines (such as the Atlantic or Indian) which will pay a handsome dividend on the cost of the cable. We hear that although the single line to the Crimea is occupied in sending long despatches from the French, Sardinian, and Turkish Generals to their Governments, and *vice versa*, yet its capabilities are far from being fully tested.

The operation of laying down the Varna and Constantinople cable was directed by Mr. Newall, and superintended on behalf of her Majesty's Government by Major Biddulph, R. A., Director-General of the Black Sea telegraphs. The cable was shipped from Sunderland on board the screw steamer *Elba*, Martin D. Hammill, commander. Her Majesty's steamer *Terrible*, Captain M'Cleverty, R. N., accompanied the expedition, and went ahead of the *Elba*, pointing out the course to be steered; and right well this important duty was performed.

The operation commenced on Monday afternoon, the 1st of October. The cable was coiled on Mr. Newall's patent paying-out machine, and it was truly interesting to see the snake-like coils rapidly unfold themselves, and glide off as if alive, and endowed with instinct to free itself of kinks, the bane of submarining. In thirty hours the 150 miles were run, an average speed of five miles an hour. Communication was kept up throughout the day and night from a Morse instrument on board with Kilia and Therapia, where Lord Stratford de Redcliffe evinced the greatest interest in learning the progress of the expedition."

Art. VI.—HISTORY OF GUTTA-PERCHA IN AMERICA.

We annex a very interesting article relative to the introduction of gutta-percha in America, believing it to be of interest to our readers. We were surprised to learn, that our country stands foremost in the advancement of gutta-percha in the useful arts. It is too frequently the case, that we award the application of new discoveries to the useful arts, as the property of other nations. Europe enjoys the fruits of the genius of Morse, without rewarding him for the many years of toil. The world is now realizing the blessings from the labors of Americans in the application of gutta-percha as an insulation, and an acknowledgment of merit is smothered by the selfish aims of foreign interests. We can add, from our own knowledge, that the gutta-percha works of America can produce as good a quality of insulated wire as is to be found in the world.

There are some, who are stupid enough to believe, that there are no other works in the world than the London establishment. We know, however, that gutta-percha insulated wire for telegraphic purposes, can be made, not only in London, but also in New-York, Berlin, and St. Petersburg.

In New-York and Berlin there are extensive establishments, and in the former the production of the manufactured article excels in extent and quantity the balance of the world.

HISTORY OF GUTTA-PERCHA IN THE UNITED STATES.

In the year 1846, Samuel T. Armstrong, Esq., of the City of New-York, visited England, for the purpose of learning something of the article of gutta-percha, having had a sample sent him from London, with an invitation to visit that city.

Mr. Armstrong returned to New-York in the fall of 1846, and immediately commenced erecting machinery for the manufacture of gutta-percha goods, having ordered, before he left London, a quantity of the raw material. During the winter of 1847, he formed a connection with W. S. Wetmore, Esq., of New-York, and removed their works to the City of Brooklyn. Up to this time the London and the American Companies had confined themselves, mostly, to the manufacture of water and gas pipes, shoe soles, sheets, machine banding, stamped goods, &c. During the year experiments were made to insulate telegraph wires with India rubber for the purpose of laying under water, but it was unsuccessful. Experiments having been made under Mr. Armstrong's directions to insulate wire with gutta-percha, and having satisfied himself that gutta-percha was a nonconductor of electricity, he procured machinery to

be put up in their factory at Brooklyn for the purpose of covering telegraph wire.

An order was received from Mr. Rogers of Baltimore (then acting as a general agent for the Morse Telegraph Company), for a quantity of No. 9 iron wire to be covered with gutta-percha, for the purpose of passing the electric current across the Hudson River. This order was filled, and the WIRE CABLE laid under water at Fort Lee, under the superintendence of Mr. Rogers. The ends of the wires were attached to the batteries, and the insulation was found to be perfect. A communication was then made to Jersey City Station from the eastern side of the Hudson River by Mr. Rogers, and the cable answered the purposes satisfactorily to the company. This, beyond all question, was the first wire cable insulated with gutta-percha that was ever made or used in the civilized world. About the time this wire cable was being manufactured, at Brooklyn, an Englishman by the name of Naylor came to the factory for employment, and he saw the machine and the mode of coating the cable with gutta-percha. In a few days he left and sailed for his native country. It is said that Naylor introduced the machine and process into England, for which he was well remunerated. It is reported that he received £20,000 for his pretended discovery. The same kind of machinery is used to this day, in England, for manufacturing telegraph cable. They have, as yet, found no pretence to make any improvement on the first Yankee machine. The next person who applied for submarine cables was Col. T. P. Shaffner, President of the St. Louis and New-Orleans Telegraph Company, to lay under the Ohio and Mississippi Rivers; these cables were manufactured for Col. Shaffner, and put into operation by him. Next came Mr. O'Reilly, with his order for submarine cables. After these, different cables were furnished and used by the different companies in America. The discovery of insulating telegraph wire, with gutta-percha, in England, occurred fully one year after it was in successful operation in the United States.

The plan of an ocean telegraph cable was also suggested by Mr. S. T. Armstrong, of New-York, with an estimate of its cost, &c., which was published in the *Journal of Commerce* during the year 1848. He offered to furnish the cable, and lay it down from Newfoundland to the Irish coast, for the sum of $3,500,000. It will be seen, therefore, that John Bull was not the originator of submarine telegraph cables. Mr. Armstrong and his associates are the only persons that have ever manufactured perfect gutta-percha submarine cables in the United States—altho' many have made the attempt without

success. Mr. A. sold out a portion of his business to a large company, and they removed their work from Brooklyn to Raritan, New-Jersey; but questions arose as to the company's title to the lands and water-power, and the company stopped their work. Since which time Mr. S. C. Bishop has taken hold of the business, and is now manufacturing telegraph wires, water pipes, &c. &c., of gutta-percha. Samples of which can always be seen at his warehouse, 181 Broadway, N. Y., and he is also prepared to furnish submarine telegraph cables, and to warrant them equal in quality and beauty to any in the world.

MORSE'S INVENTION OF THE TELEGRAPH.

BY JAMES B. MARSHALL.

"Well, Captain, should you hear of the telegraph one of these days, as the wonder of the world, remember the discovery was made on board the good ship Sully."—*Professor Morse to Capt. Pell, October*, 1832, *on parting after the voyage*.

'Twas in the good ship Sully,
That sail'd in '32,
With Captain Pell for master,
And to Havre bade adieu;
With others, much more noted,
An humble artist came—
His easel and his palette
His means of bread and fame.
For years his Art had lured him,
A patient student, where
The works of the old masters
Repaid his toil and care.
Nor dream'd he, when o'er Rubens,
Or Raphael he bent—
Or Titian's brilliant colors
With Michael's genius blent,
That not from painter's palette
Should spring eternal fame,
Which in the coming future,
Would gild his humble name.

But, in that good ship Sully
This artist had a dream,
That storms nor night could banish,
Nor mid-day's brilliant beam.
It haunted him while sleeping—
Pursued him when awake—
And in upon his musings,
Or converse, even, would break,

And when the glittering sun-ray
Reach'd far across the sea,
Bearing its bright despatches
To bid the darkness flee—
And when the lightning's flashes
Burst fiercely through the cloud,
Illumining what darkness
Did only now enshroud—
He solv'd the haunting vision
That held in spell his brain,
And o'er and o'er revolv'd it,
Till the mystic form was plain.
Upon his mental tablet,
The magic word was writ,
And cheerily and hourly
He proudly cherish'd it.

'Twas in the good ship Sully,
Her master Captain Pell—
Our artist solv'd the problem
That since has work'd so well.
Though winds may fill the canvas
That speeds across the sea,
And steam with locomotives,
More rapidly may flee—
Yet Commerce deem'd them tardy,
And Love, with its desires—
But are content since Morse, now,
Beats Time upon his wires!

Then here's a health to Franklin,
Who drew the lighting-fires,
And made them harmless, and to Morse,
Who sends them, on his wires,
To distant friends with letters
All glowing with their flames,
And be forever honored
Their Time enduring names,
But while we hail the triumph
Of the art that works so well,
Let's not forget the Sully,
And her gallant Captain Pell!

PREAMBLE TO MORSE'S PATENT:

OBJECT OF THE INVENTION.—The original and final object of all telegraphing is, the communication of intelligence at a distance, by signs or signals.

Various modes of telegraphing, or making signs or signals at a distance, have for ages been in use. The signs employed heretofore have had one quality in common. They are evanescent, shown or heard a moment, and leaving no trace of their having existed. The various modes of these evanescent signs have been by beacon-fires of different characters; by flags; by balls; by reports of fire-arms; by bells heard from a distant position; by movable arms from posts, &c. I do not, therefore, claim to be the inventor of telegraphs generally.

The Electric Telegraph is a more recent kind of telegraph, proposed within the last century, but no practical plan was devised until about sixteen years ago. Its distinguishing feature is the employment of electricity, to effect the same general result of communicating intelligence at a distance, by signs or signals. The various modes of accomplishing this end by electricity, have been the employment of common or machine electricity, as early as 1787, to show an evanescent sign by the divergence of pith balls.

The employment of common or machine electricity in 1794, to show an evanescent sign by the electric spark.

The employment of Voltaic electricity in 1809, to show an evanescent sign by the evolution of gas bubbles, decomposed from a solution in a vessel of transparent gas.

The employment of Voltaic electricity, in the production of temporary magnetism in 1820, to show an evanescent sign, by deflecting a magnet, or compass needle. The result contemplated from all these Electric Telegraphs, was the production of evanescent signs or signals only.

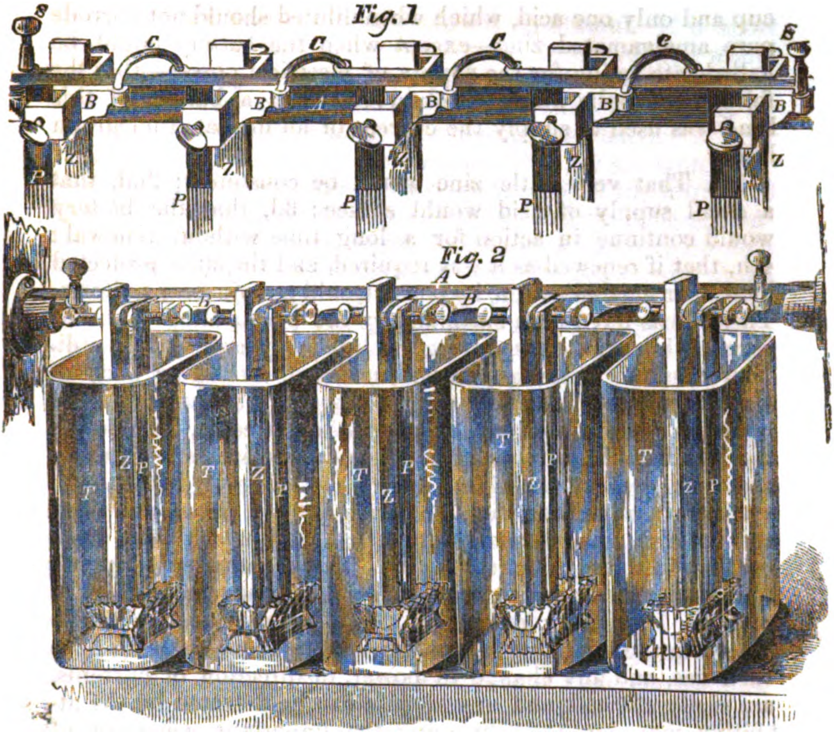
I do not, therefore, claim to have first applied electricity to telegraphing, for the purpose of showing evanescent signs or signals.

The original and final object of my telegraph is, to imprint characters at any distance, as signals for intelligence, its object is to mark or impress them in a permanent manner.

To attain this end, I have applied electricity in two distinct ways.

First. I have applied by a novel process, the motive power of electro-magnetism, or magnetism produced by electricity to operate machinery, for printing signals at any distance.

Second. I have applied the chemical effects of electricity to print signals at any distance.



(A) Insulated wood piece, (B) Brass clamps, (Z) Zinc plates, (P) Platinized plates, (T) Tumblers, in Battery Fig. 1, the wooden pieces rest upon the glasses. In Battery Fig. 2, they rest on iron brackets secured against supports.

Art. VII.—IMPROVED GALVANIC BATTERY.

The Battery represented above, patented to Charles T. Chester, May 15, 1855, was first called into public notice in the pages of this Magazine, in April, 1854. It had then been in use a few months on two telegraph lines leading from New-York. It is designed especially for a Main Battery, and its very general adoption has confirmed the truth of the principles upon which it is constructed, while it has allowed of extensive study of its operations under every variety of test. A comparison was made in the article referred to, of the operations of different batteries. The most important practical deduction from which was, that all diaphragm or porous cell batteries owe their loss of power more to the mutual action of the metals and fluids, than to the decomposition resulting from use in producing the electric current. It was at that time proposed, that if a reasonably intense battery using no porous

cup and only one acid, which when diluted should not corrode pure amalgamated zinc—except when the battery might be called into action for the supply of electrical power—that the following results would be observed, when a battery of this kind was used to supply the current of an insulated telegraph line.

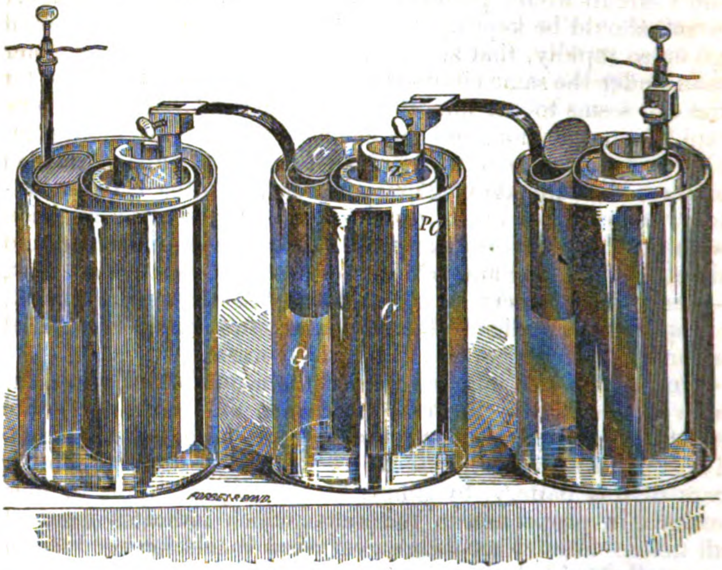
1st. That very little zinc would be consumed; 2nd, that a small supply of acid would suffice: 3d, that the battery would continue in action for a long time without renewal; 4th, that if renewed as it was required, and the zincs protected by proper amalgamation, its power would remain very uniform. These ideas have been sustained by the practical operation of several thousand cups, during the last two years. 1st, in ordinary use, new zincs have been furnished, averaging once in sixteen months; 2nd, acid supplied, liberally amounts to three pounds a year to each cup, at a cost of eight cents. These are the results with ordinary care. Some zincs are now entering their third year of usefulness, a degree of longevity hitherto unattained in other batteries. Their weight is about one third that of the zincs formerly employed, and which have been used up in three or four months. The advantages belonging to a battery dispensing with poisonous fumes have, also, in practice, been fully realized. These batteries are generally placed in the operating rooms, no inconvenience arising from their use, and any change in power, or direction of currents, are easily effected, and any trouble can be detected by the attentive manager, thus bringing the important generator of the very life's blood of this line, under an intelligent supervision.

We add a few words in relation to the principle of its adaptation to the purposes of a main battery, with a view to show where it is most useful, and how it is best kept in good working condition. It furnishes for a great length of time a current of very small *quantity*, but of any required *intensity*, and that is precisely the current required on a well insulated line of telegraph.

In this battery, we have the means of ascertaining the amount of power going from it, and the amount of material consuming. Closely watching the negative plates, small bubbles of gas will be noticed occasionally detaching themselves. On a fine winter day and a well insulated line, the escape of gas is so trifling as to be almost imperceptible; but, form a ground connection at one half the length of the line, and an immediate increase will take place in the escape. Should a ground connection be made ten miles from the battery, its discharge of gas would be very greatly increased, and a very

short circuit would produce a violent ebullition. If a short circuit should be kept up for some time, decomposition would go on so rapidly, that zinc and acid would be destroyed faster than under the same circumstances in porous cell batteries, for the cell seems to act almost as a mechanical barrier to very rapid decomposition, and the chemical changes are more complex in batteries using two fluids—practically if the nitric acid battery, the sulphate of copper battery, and the Chester battery, were all set up in equal force, and a short connection with good conductors arranged for each, the last named would dispose of its zinc and acid earliest, and would give out first, —hence this battery is not well adapted for a local circuit, except in very judicious hands, where a full supply of material is furnished in proportion to the rapid waste.

Nor is it so well adapted to working a number of wires, for here in addition to the multiplied calls on its resources, the effects of cross fire among the wires is, also, to be added. These considerations point to the necessity of taking proper care of this battery, by simply keeping up a supply of new material in proportion to the waste, which indicates itself at all times. Should accident or very bad insulation produce an unusually rapid decomposition, then compensation should be made without delay, and the zinc surfaces examined. If neglected too long, like all other batteries, it proceeds to the work of self-destruction, but very slowly. First, the solution becomes changed from the quick, fierce acid, to the sluggish, dead sulphate. The unprotected zincs corrode, evaporation leaves white crystals of salt upon the plates, and the incrustation running up through itself by capillary attraction, fresh supplies of thick solution continue its encroachments till even the brass connections are attacked. The lifeless sulphate in some cell, weaker than the rest, becomes at length decomposed, and a deposit accumulates upon the negative plate. Thus, from neglect, the work of destruction commences from internal dissension. It would seem useless to caution against such negligence, but some curious instances have fallen under the writer's observation, where batteries set up properly, have been allowed to work five months without any renewal! Some inefficient operators have entertained the idea, that they would never require any further care, but in some mysterious manner supply themselves with acid in the same way that they did with quicksilver. It is desirable to use the best acid in charging. The difference of cost between the best and worst acids being about two cents per cup in a year. It has been very gratifying to witness the success of this battery, where it has been exclusively adopted and cared for in a systematic way.



(Z) Zinc cylinder, (P C) Porous cup, (C) Copper cell with perforated copper chamber attached, (G) Glass.

Art. VIII.—LOCAL BATTERY.

THE engraving represents one of the most popular arrangements for Local Battery now in use. It is known as "Chester's Local," and derives its peculiar construction from a great number of experiments, to secure the least objectionable form for a necessary appendage to the local circuit, and Morse Register. It is, in principle, Daniells' Battery; yet, Daniells' Battery in its highest power and best arrangement, would make a poor Telegraph Local Battery, the objections to it being, First, that the zincs could not be kept amalgamated without pulling the battery to pieces three or four times a day: Secondly, that the deposition of copper is very unequal, the solution of sulphate of copper becoming dense at the bottom, and thin at the top of the glass.

Experience has taught, that for the peculiar demand of a Local Telegraph circuit, if the plates are quite large, a full supply of sulphate of copper kept up, and its solution uniform in density, the zincs will, in some way, take care of themselves with no other excitant than warm water, and that the Battery will give out a steady and a full *quantity* current. It is presumed that just enough sulphuric acid oozes through the porous

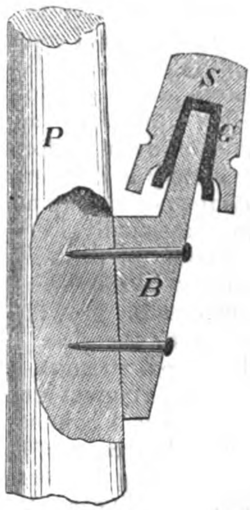
cup to act as a gentle excitant to the zinc. But from whatever source it obtains its energy, the battery is sure to work long and well if these conditions are observed. The quantity of metal surface is secured in construction by the form of the copper and zinc plates—long hollow cylinders. Attached to the copper cell, is a chamber of the same metal, the floor of which is pierced with holes, and its cover is so contrived that it opens when a supply of sulphate of copper is poured in; thus preventing its falling into the porous cell, and attacking the zinc. The holes serve for access to the solution, which dissolves the fresh salt, and this being kept in the upper part of the glass, with a tendency to sink below, a uniformity of strength is secured. But as this battery in its operation deposits a large amount of copper upon the porous cup and copper cell, it is desirable to separate them occasionally, lest they may grow together and prevent circulation of the sulphate solution. The shape of the cell in relation to the glass, is made so that it can be spread out, and altered as the growth upon it increases, and yet be easily removed from the glass. Finally, the glass is made very large, and of great strength. These batteries supply a powerful local current of great quantity, continuing for about two weeks. The renewal consists in a supply of crystals of sulphate copper to the copper box, fresh clean water to the porous cell, and scraping off the thick black oxide that adheres to the zinc. When the zinc is entirely consumed, a fresh one is supplied with great ease, from the fact of requiring no binding screw attachment, the casting being so shaped as to fit easily into the brass clamp termination of the copper arm. The expense of this battery is about the same, or a little less, than other forms of Local Battery. The advantages secured, being, dispensing with poisonous fumes, and the necessity of daily attention.

Art. IX.—IMPROVED INSULATOR.

THE following engraving represents a section of the modern Shield Insulator, now very much used upon telegraph lines, and manufactured by Charles T. and J. N. Chester, of New-York. It consists of the oak bracket (B), spiked to the pole (P). Over the rounded upper part of this bracket fits the glass (G), and this glass is protected by the tight fitting painted wooden shield (S).

The advantages of this insulator are that wood, a partial insulator, is substituted for iron, a conductor, as a bracket. The full benefit of the non-conducting properties of glass is

secured; but the glass surface, well known to collect moisture, is replaced by the painted wooden covering which, at the same time, serves to protect the glass from external violence. This Insulator is believed, by our first telegraph constructors, to be the very best in use.



Art. X.—TELEGRAPH MANUAL.

On many occasions we have been requested to give the details of manipulation practiced in the Morse system. Having our attention especially called to the subject, we insert the following extracts from a circular of the former President of the St. Louis and New-Orleans Line. Nashville and St. Louis were terminating points. The signals are explained under that head, and on reference to them the examples will be understood. It will be observed that the place addressed is first mentioned, to enable the instrument at the destination to be fairly in motion, so that the *place from* be not lost ere the register can indite the first writing.

The check abbreviations indicate the mode of passing messages from one line to another, the accounts of each being separate and distinct.

"In order to have system in all matters concerning this line, I have deemed it necessary to adopt RULES, regulating the manner of transmission and reception of messages between

offices, that there may be no confusion in the discharge of business.

In the promulgation of the codes pertaining to the working of this line, it is anticipated that those in the service will move every nerve to effect their fulfilment; and with zeal and fidelity commensurate with any exigency, promote the weal of the Company.

With the united aid of all, the strength of union will be realized, and glorious success will crown our efforts. Without the co-operation of the officers in command, hope for success will be idle.

The following remarks are given to illustrate the mode of business of the peculiar kind indicated, viz:

St. Louis wants *Nashville*. The former re-adjusts his Magnet carefully, and finding no one writing, he calls Nashville thus,—N N N N N A—observe the space. Call four or five times, then sign the signal of the office. Immediately after the sig. of office, adjust magnet. If no answer, call again, and repeat the call four or five times, pausing a reasonable time between calls for an answer. If St. Louis fails to get Nashville, after a space of a few minutes, the call should be resumed.

When Nashville hears his office called, he must wait for the signature A—then promptly answer thus: I I N St. Louis will then commence and send his message, as illustrated by Example No. 1. If there is more than one message, then as Ex. No. 2.

The 3d and 4th examples illustrate their peculiar object.

If Nashville receives the message, he answers thus: A O K N If Nashville does not, he answers thus: A R R N St. Louis will then repeat the message, until N gives the signals A O K N

After St. Louis sends, and adds as example No. 2, Nashville will then say, A O K G A N St. Louis will then resume sending, and, if the line works well, might send some half dozen or more, without Nashville answering A O K G A N to each message. Too much care cannot be taken in following these rules, to preserve uniformity and correctness in the discharge of business. The office signals of other lines must not be used, but the name in full, thus: G is signal for Louisville. G must not be used, but *Louisville* must be given in full.

EXAMPLES.

EXAMPLE NO. I.

N fm A July 4 for Prof Samuel F. B. Morse Nashville As the inventor of the Electric Telegraph you stand pre-eminent Sig Arago 10 W pd 50 SSS A

EXAMPLE NO. II.

N fm A July 4 for Andrew Jackson New-Orleans Franklin established beyond doubt the identity of lightning and electricity Sig Lardner 10 W pd 160 py 110 Ahr A

EXAMPLE NO. III.

N fm A July 4 for Morse New-Orleans Canst thou send lightning that they may go and say unto thee here we are Sig Job 15 W pd 240 py 165 Ahr A

EXAMPLE NO. IV.

A fm New-Orleans July 4 for Job A Call at any of the offices of the American Electro-Magnetic Telegraph Sig Morse 12 W col 200 SSS N

NUMERALS.

1. Wait a moment.
2. Get answer immediately for———
3. Repeat this name back.
4. What time is it?
5. Have you any thing for me?
9. Deliver immediately.
10. Keep your circuit closed.
12. Write the figures into words.
13. Do you understand my last communication?
17. Can't find———
18. What is the matter?
21. Ans paid here if not paid there.
23. Report is ready. A message for all. Be ready.
25. Write dots.
26. Write the alphabet.
28. Do you get my writing and where shall I go ahead?
31. Don't understand.
33. Ans paid here.
35. How many cups on?
41. Is on short circuit.
44. Answer immediately by telegraph.

64. What is the weather?
73. Best respects.
74. Put this in mail for———
75. This message will be called for.
77. Are you ready to receive my message?
92. Was message received and delivered?
134. Who is writing?

SIGNALS.

I I	I am ready.
O K	All correct.
G A	Go ahead.
S S S	No more–Finish Signal.
R R	Repeat.
G M	Good Morning.
Ahr	Another.
G N	Good Night.
Col	Collect.
Pd	Paid.
Py	Pay.
W	Words.
S F D	Stop for dinner.
S F T	Stop for tea.
S F P	Stop for paper.
D H	Dead Head—free.
R D H	Refunding Dead Head.
Nashville, N.	
St. Louis, A.	

Art XI.—HISTORY OF MORSE'S TELEGRAPH.

THE following laconic statement of the history of the invention, is from the pen of Prof. Morse, and was prepared for the benefit of the United States Court, and was filed as an affidavit. Every word of the statement has been substantiated by incontrovertible testimony, which can be seen on file at Washington, in the office of the Clerk of the Supreme Court of the United States.

The headings to the respective paragraphs are by the editor, and are not in the original, which is filed as aforesaid.

The specimen of writing and its descriptions is also added by the editor. It is taken from a New-York paper of 1837.

The statement and deposition of Capt. Pell, are also added by the editor.

We publish the statement in answer to many inquiries made to us in Europe, relative to the early invention of Morse's Telegraph.

Education.—I was a student in Yale College, in the years 1807, '8, '9, and '10, and in the course of the regular studies of that Institution, I was an attendant on the lectures of Professors Jeremiah Day and Benjamin Silliman. Professor Day delivered lectures upon Natural Philosophy, and treated of the

subject of Electricity, but not Galvanism. Professor Silliman lectured upon Chemistry, and incidentally upon Galvanism.

The title of our text-book with Professor Day was, "Institutes of Natural Philosophy, Theoretical and Practical. By William Endfield, LL. D."

The annexed is a copy of the Proposition XXI., Book V., of said text-book, and of the examples therein contained, for illustration. The illustrations contained in this Proposition were shown to us by Professor Day, and we were made familiar with them.

Proposition XXI., Book V.—"If the circuit be interrupted the fluid will become visible, and when it passes it will leave an impression upon any intermediate body.

Exp. 1.—Let the fluid pass through a chain, or through any metallic bodies placed at a small distance from each other, the fluid in a dark room will be visible between the links of the chain, or between the metallic bodies.

" 2.—If the circuit be interrupted by several folds of paper, a perforation will be made through it, and each of the leaves will be protruded by the stroke from the middle towards the outside leaves.

" 3.—Let a card be placed under the wires which form the circuit, when the circuit is interrupted for the space of an inch, the card will be discolored. If one of the wires be placed under the card and the other above it, the direction of the fluid may be seen.

" 4.—Spirits of wine or gunpowder, being made part of the circuit, may be fired.

" 5.—Inflammable air may be fired by an electric gun."

Professor Silliman performed the usual class experiments and illustrations of the time; several of the salts were decomposed by Professor Silliman by means of galvanic electricity, separating them into their elementary parts: separating the acids from their bases, and precipitating the metals from their combinations; for example, acetate of lead, separating the acetic acid from the lead.

I attended the course of lectures delivered by Professor Dana, in the years 1826 and 1827. He gave a very full exposition of the science of electro-magnetism, so far as its progress was then advanced. He explained it by many experiments and illustrations. I was on terms of great intimacy with Professor Dana. As he was a colleague lecturer with me, in those days, at the New-York Athenæum, I had frequent opportunities of conversing with him on the subject of his lectures, which I attended. He visited me frequently at my studio, and the favorite topic of conversation between us was electro-magnetism,

a science in which he was an enthusiast. The electro-magnet which he exhibited at those lectures, and the first electro-magnet I ever saw, was in my possession, being a gift from Professor Torrey, the successor of Professor Dana, who purchased it, with other apparatus, upon Professor Dana's decease. It was required in evidence in a suit in Kentucky, some three or four years since, and is annexed to depositions on file in the Circuit Court of the United States for the Kentucky District, at Frankfort, Kentucky.

Painter by Profession.—I was a historical painter. I visited Europe in the latter part of 1829, for the purpose of studying my profession in England, France, Italy and Switzerland.

Return to America, 1832.—I returned in October, 1832, in the packet ship Sully, Captain William W. Pell. I do not remember all the passengers, but I can name the Honorable William C. Rives and family, Mrs. Temple, Mr. Palmer and family, J. F. Fisher, Esq., Doctor Hazlett, Lewis Rogers, Esq., Mr. W. Post, Dr. Charles T. Jackson, and William Constable, Esq.

The Telegraph Invented.—Shortly after the commencement of my return voyage from Europe, in the autumn of '32, before referred to, the then recent experiments and discoveries in relation to electro-magnetism, and the affinity of electricity to magnetism or their probable identity, became the subject of conversation.

The special subject of conversation was the obtaining the electric spark from the magnet. In the course of the discussion, it occurred to me that by means of electricity, signs representing figures, letters or words, might be *legibly written down* at any distance.

At this time the idea of telegraphing in any way by electricity, was new to me, and so far as I could judge, to every one on board the ship. So far as my knowledge then extended, I was ignorant that any one had previously entertained even the idea of an electric telegraph. Subsequent investigation has, however, shown me, that the first *idea* of telegraphing by electricity does not belong to me, and I therefore disclaim it; but in the modes proposed by me, I *do* claim to have invented an entirely novel and useful mode and art of telegraphing.

All previously known modes of telegraphing were by evanescent signs. Had my invention rested merely in the idea, it would have been comparatively valueless; but at the same time I conceived a practical mode of carrying into effect my original idea. I claim then to have invented a new *art. The art of imprinting characters at a distance for telegraphing purposes,*

and the mode and means of performing the same are set forth in my several letters patent. And I also claim the use of sounds for telegraphing as are set forth in my letters-patent.

The idea thus conceived of an electric telegraph took full possession of my mind, and during the residue of the voyage, I occupied myself, in a great measure, by devising means of giving it practical effect. Before I landed in the United States, I had conceived and drawn out in my sketch-book the form of an instrument for an electro-magnetic telegraph, and had arranged and noted down a system of signs, composed of a combination of dots and spaces, which were to represent figures or numerals, and these were to indicate words, to which they were to be prefixed in a telegraphic dictionary, where each word was to have its own number. I had also conceived and drawn out a mode of applying the electric or galvanic current, so as to make these signs by its chemical effects in the decomposition of salts; and so also, to make sounds for telegraphing. Immediately after my landing in the United States, I communicated my invention to a number of my friends, and employed myself in preparations to prove its practicability and value by actual experiments.

To that end, before the commencement of the year 1833, being at the house of my brother, in New-York, I made a mould, and cast a set of type representing dots and spaces intended to be used for the purpose of closing and breaking the circuit in my contemplated experiments.

Want of Means.—But for the want of pecuniary means, I found myself unable to purchase materials for an instrument and the galvanic battery and wire, and was compelled, for the means of subsistence, to betake myself to my pencil.

Painting for a Livelihood.—From the year 1832 to the latter part of 1835, my profession led me from place to place, affording me little or no time to experiment upon my conception of an electro-magnetic telegraph, although I never lost faith in its practicability nor abandoned the intention of testing it as soon as I could command the means.

Professor of N. Y. University.—In the year 1835, I was appointed a Professor in the New-York City University, and about the month of November of that year, I occupied rooms in the University buildings.

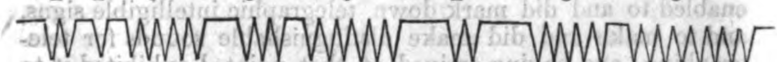
He Makes a Model Telegraph.—There I immediately commenced, with very limited means, to experiment upon my invention. My first instrument was made up of an old picture or canvas frame fastened to a table; the wheels of an old

wooden clock moved by a weight to carry the paper forward; three wooden drums, upon one of which the paper was wound and passed over the other two; a wooden pendulum suspended to the top piece of the picture or stretching frame, and vibrating across the paper as it passes over the centre wooden drum; a pencil at the lower end of the pendulum, in contact with the paper; an electro-magnet fastened to a shelf across the picture or stretching frame, opposite to an armature made fast to the pendulum; a type rule and type for breaking the circuit, resting on an endless band, composed of carpet binding, which passed over two wooden rollers, moved by a wooden crank, and carried forward by points projecting from the bottom of the rule downwards, into the carpet-binding; a lever with a small weight on the upper side, and a tooth projecting downward at one end, operated on by the type, and a metallic fork also projecting downward over two mercury cups, and a short circuit of wire, embracing the helices of the electro-magnet connected with the positive and negative poles of the battery, and terminating in the mercury cups. When the instrument was at rest, the circuit was broken at the mercury cups; as soon as the first type in the type-rule (put in motion by turning the wooden crank) came in contact with the tooth *on the lever*, it raised that end of the lever and depressed the other, bringing the prongs of the fork down into the mercury, thus closing the circuit—the current passing through the helices, of the electro-magnet, caused the pendulum to move and the pencil to make an oblique mark upon the paper, which, in the mean time, had been put in motion over the wooden drum. The tooth in the lever falling into the two first cogs of the types, the circuit was broken when the pendulum returned to its former position, the pencil making another mark as it returned across the paper. Thus, as the lever was alternately raised and depressed by the points of the type, the pencil passed to and fro across the slip of paper passing under it, making a mark resembling a succession of V's. The spaces between the types caused the pencil to mark horizontal lines, long or short, in proportion to the length of the spaces.

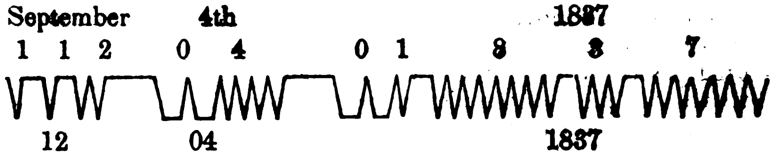
Specimen of Telegraphic Writing made by means of electricity at the distance of one-third of a mile.

Successful experiment with telegraph.

2 1 5 3 6 2 5 8



215 36 2 58



The *words* in the diagram were the intelligence transmitted.

The *numbers* (in this instance arbitrary) are the number of the words in a telegraphic dictionary.

The *points* are the markings of the register, each point being marked every time the electric fluid passes.

The register marks but one kind of mark, to wit, (V). This can be varied two ways. By intervals, thus, (V VV VVV,) signifying one, two, three, &c., and by reversing, thus, (Λ.) Examples of both these varieties are seen in the diagram. The single numbers are separated by *short*, and the whole numbers by *long intervals*.

To illustrate by the diagram: the word "successful" is first found in the dictionary, and its telegraphic number, 215, is set up in a species of type prepared for the purpose, and so of the other words. The type then operate upon the machinery, and serve to regulate the times and intervals of the passage of electricity. Each passage of the fluid causes a pencil at the extremity of the wire to mark the points as in the diagram.

To read the marks, count the points at the bottom of each line. It will be perceived that two points come first, separated by a *short* interval, from the next point. Set 2 beneath it. Then comes one point, likewise separated by a short interval. Set 1 beneath it. Then come five points. Set 5 beneath them. But the interval in this case is a *long* interval: consequently, the three numbers comprise the whole number, 215.

So proceed with the rest, until the numbers are all set down. Then, by referring to the telegraphic dictionary, the words corresponding to the numbers are found, and the communication read. Thus it will be seen that, by means of the changes upon *ten* characters, all words can be transmitted. But there are *two points* reversed in the lower line. These are the *eleventh* character, placed before a number, to signify that it is to be read as a *number*, and not as the representative of a word.

Telegraph Apparatus Complete.—With this apparatus, rude as it was, and completed before the first of the year 1836, I was enabled to and did mark down telegraphic intelligible signs, and to make and did make distinguishable sounds for telegraphing; and having arrived at that point, I exhibited it to some of my friends early in that year, and among others, to

Professor Leonard D. Gale, who was a colleague professor in the University.

Chemical Telegraph.—I also experimented with the chemical power of the electric current in 1836, and succeeded in marking my telegraphic signs upon paper dipped in turmeric and a solution of the sulphate of soda, (as well as other salts), by passing the current through it. I was soon satisfied, however, that the electro-magnetic power was more available for telegraphic purposes and possessed many advantages over any other, and I turned my thoughts in that direction.

Combining Circuits.—Early in 1836, I procured 40 feet of wire, and putting it in the circuit, I found that my battery of one cup was not sufficient to work my instrument. This result suggested to me the probability that the magnetism to be obtained from the electric current would diminish in proportion as the circuit was lengthened, so as to be insufficient for any practical purposes at great distances; and to remove that probable obstacle to my success, I conceived the idea of combining two or more circuits together in the manner described in my first patent, each with an independent battery, making use of the magnetism of the current on the first to close and break the second; the second, the third, and so on. This contrivance is fully set forth in my patents.

My chief concern, therefore, in my subsequent patents, was to ascertain to what distance from the battery sufficient magnetism could be obtained to vibrate a piece of metal, knowing that if I could obtain the least motion at the distance of eight or ten miles, the ultimate object was within my grasp. A practical mode of communicating the impulse of one circuit to another, such as that described in my patent of 1840, was matured as early as the spring of 1837, and exhibited then to Professor Gale, my confidential friend.

Circumstances of Morse, 1837.—Up to the autumn of 1837, my telegraphic apparatus existed in so rude a form, that I felt a reluctance to have it seen.

My means were very limited—so limited as to preclude the possibility of constructing an apparatus of such mechanical finish as to warrant my success in venturing upon its public exhibition. I had no wish to expose to ridicule the representative of so many hours of laborious thought. Prior to the summer of 1837, at which time Mr. Vail's attention became attracted to my telegraph, I depended upon my pencil for subsistence. Indeed, so straitened were my circumstances, that in order to save time to carry out my invention and to economise my scanty means, I had for many months, lodged and

eaten in my studio, procuring my food in small quantities from some grocery, and preparing it myself. To conceal from my friends the stinted manner in which I lived, I was in the habit of bringing my food to my room in the evenings, and this was my mode of life for several years.

More Improvements.—In 1836, and the early part of 1837, I directed my experiments mainly to modifications of the marking apparatus, contrivances for using fountain pens, marking with a hard point through pentagraphic or blackened paper, varying in the modes of using and moving the paper, at one time on a revolving disc spirally from the centre, at another on a cylinder, by which means a large, ordinary sheet of paper might be so written upon that it could be read as a common-place book and bound for reference in volumes, and devising modes of marking upon chemically prepared paper. As my means and the duties of my profession would admit, the spring and autumn of 1837 were employed in improving the instrument, varying the mode of writing, experimenting with plumbago and various kinds of ink or coloring matter, substituting a pen for a pencil, and devising a mode of writing on a whole sheet of paper instead of on a strip or ribband; and in the latter part of August or the beginning of September of that year, the instrument was shown in the Cabinet of the University to numerous visitors, operating through a circuit of 1700 feet of wire running back and forth in that room.

Government Proposing for a Telegraph.—On the 27th of September, 1837, I addressed a letter to the Hon. Levi Woodbury, then Secretary of the Treasury of the United States, in reply to a circular from the Treasury Department, upon the subject of Telegraphs, giving him an account of my invention, and of my successful experiments thus far; and on the 28th day of November, I reported to him my further progress in another letter. Copies of these letters, believed by me to be true, may be found in Mr. Vail's work upon the electro-magnetic telegraph, pages 69 to 74, inclusive.

Published in 1837.—In Silliman's Journal, for October, 1837, some of the results of my experiments were announced, and that article was copied into the Journal of the Franklin Institute for November, 1837, and into the London Mechanics' Magazine for February, 1838.

Machinery completed, 1837.—In the latter part of the year 1837, the new instrument intended for exhibition in Washington was completed, and about ten miles of wire procured, all insulated and wound upon two reels.

Exhibited to Franklin Institute.—The instrument was exhibited in the Hall of the Franklin Institute, at Philadelphia, on its way to Washington, operating with perfect success through ten miles of insulated wire. A committee was appointed to examine it, a copy of whose report may be found, in part, in Vail's book, before referred to, pages 79 and 80, inclusive.

Exhibited to Congress.—Thence the instrument was removed to Washington, where it was exhibited in successful operation to a multitude of persons, among whom were the President, the Cabinet, and members of the Senate and House of Representatives. It was exhibited in the room of the Committee of Commerce of the House, until near the end of the session. That Committee made a favorable report of the invention upon the 5th of April, 1838, recommending immediate steps to test its utility.

Caveat filed for a Patent.—As early as the 4th of October, 1837, I sent a caveat to the patent office, for the purpose of securing the invention, and on or about the 7th of April, 1838, filed my specification, and made the application for a patent complete. At my own request, however, the issue of the patent was subsequently suspended, lest my application for patents in the countries of Europe might be defeated by my invention becoming known.

Morse went to Europe.—In the month of May, 1838, in company with the Hon. F. O. J. Smith, who had become so well convinced and satisfied of the practicability and value of the invention that he abandoned his seat in Congress, and took an interest in it, I embarked for Europe.

Patent granted in France.—In France I procured a patent, which, however, has proved to be of no value to me, partly because of my inability to command the means to bring the invention into public use in that country within two years (as required by the French Law,) after the date of the patent; but chiefly because of the refusal of the French government to allow the telegraph to be erected on the St. Germain railroad, as would have been in accordance with the wishes and petition of the Railroad Company.

Received with Honor.—In both England and France, but particularly in France, I was received with great attention by distinguished and scientific men, and my telegraph was generally admitted to be superior to any other invented.

Exhibited to French Academy of Science.—I communicated an abridged description of my invention, and exhibited the instru-

ment in operation to the French Academy of Sciences at their session of the 10th of September, 1838, and it was published in the Weekly Journal of the Academy, called the "Comptes Rendus," a few days after. That description, however, did not include the Local Circuit or Receiving Magnet.

M. Arago.—M. Arago, the celebrated *savan*, took a peculiar interest in my invention. In March, 1839, I returned to the United States, having derived no pecuniary benefit whatever from my visit to Europe.

Morse follows Daguerreotyping.—General pecuniary embarrassment in the United States at that time, rendered hopeless any attempt to bring my telegraph into use, and in order to procure the means of subsistence, I was obliged to resume my pencil, in conjunction with the practice of the Daguerreotype.

First patent issued.—In June, 1840, I took out my first patent, based on the specification filed by me in April, 1838, having found no other resources for bringing my invention into public use, on account of the heavy outlay of capital required, and the impossibility of inspiring confidence in results so extraordinary as were promised. I petitioned Congress for aid to bring out my invention at the December session of 1842, supported by the strongest testimonials of many scientific men.

Congressional Committee Report for an appropriation.—Before the end of December a strong report was made by the Committee of Commerce in favor of the measure, accompanied by a bill appropriating $30,000 for the purpose of testing the practicability and utility of the system.

First line completed, 1844.—The appropriation was made, and after encountering and overcoming many difficulties, I had the satisfaction to witness the successful operation of my system of telegraphing, on a line of forty miles, from Washington City to Baltimore in June, 1844, nearly twelve years from the date of my invention.

Improvements.—I further state, that the combination of machinery in constructing my telegraph as put in operation in 1844, was different from that originally contemplated and described in my first patent in the following respects, viz:—The combined circuits of my first patent, were the combination of two or more circuits as links in a main line for the purpose of renewing the power and propelling forward, indefinitely, the electric current, in such volume as to render the power more available at the distant point, and to charge an electro-magnet with sufficient magnetic force to work a register or move the

lever of a re-lay magnet, suggested by the probability indicated by my own experiments and the experiments of scientific men, that sufficient magnetic power could not be obtained from the electric current through a very long circuit to make a mark of any sort. This difficulty the undersigned proposed to obviate by means of two or more circuits, each with a battery, coupled together, and broken and closed by means of the same principles as the receiving magnet now used; these links of one main line are to be made so short as to secure the necessary magnetic power.

The register was to be placed, not in a short circuit, as now arranged, but on a link in the main line. But this arrangement was liable to the practical inconvenience, that it would always require two lines of wire, both always in order; because the receiving magnet would work only in one direction. While preparing to build the line from Washington to Baltimore, I ascertained, by experiment on 160 miles of insulated wire, and, some time previously, upon 33 miles of wire, that magnetic power sufficient to move a metallic lever could be obtained from the electric current of a circuit of indefinite length, and that there was no necessity for combining two or more circuits together *for the purpose of renewing the power at short intervals on the main line.*

Relay-Magnet applied.—I then devised the present combination, which enables me to work the same wire both ways, dispensing with one of the two wires originally supposed to be necessary under all circumstances. This combination consists of one main circuit, connected by the receiving magnet with as many short office-circuits as may be desired, upon which respectively are the requisite registers, and not upon the lines of the main line, as originally contemplated. Any of these office-circuits may be separated from the main line without affecting its efficiency; whereas the breaking of a link in the chain of circuits originally contemplated would interrupt all communication. In that combination the battery at each station was to perform the double purpose of working the register and breaking and closing the next circuit in the main line.

In the present combination, the purpose of the battery on the main line is to close and break the short independent office-circuit, which works the register. This new combination of parts was a most valuable improvement upon my first plan. A part of this improvement was used on the experimental line between Washington and Baltimore, for the first time, in May, 1844, and the whole of the improvements in the

year 1846, on lines in the course of construction, in which I was interested as a joint owner.

The combination of circuits mentioned in my French patent of October, 1838, is the same as that mentioned in my American patent of 1840, and not that described in my American patent of April 11th, 1846.

Congress Fails to Adopt a Telegraph.—After the successful result of the line from Washington to Baltimore, I did not doubt that Congress, at its next session, would adopt the telegraph as public property, and make provision for its extension. In this expectation I was disappointed—no means looking to the adoption of the telegraph having been proposed, and a bill providing for its extension to New-York having been left among the unfinished business, not having passed either House.

Private Enterprise—N. Y. Line Built.—About five years of the patent had now expired, and it was deemed proper to look to private enterprise, as the only certain means of making it valuable. With much difficulty, a company was organized in May, 1845, to build a line from New-York to Washington, with a subscription of $15,000, which was applied to the construction of so much thereof as lies between New-York and Philadelphia.

N. Y. and Buffalo Line.—Soon after, a company was organized, and funds subscribed to build a line from New-York through Albany to Buffalo, although the companies encountered many difficulties and losses. Having learned by experience that copper wire, though the best conductor, cannot be relied on for strength, and being obliged to exchange it for iron, the public confidence in the utility and value of the telegraph increased as it progressed, and little difficulty was experienced in procuring funds to build lines on routes of any considerable importance, on terms of an equal partnership between the owners of the patent and the subscribers of funds—the patent privileges being considered equal in value to the cost of construction.

Morse the First Inventor.—I further state, that I believe myself to be the first original inventor of the American electro-magnetic telegraph, as described in my first patent, bearing date the 20th day of June, 1840—re-issued on the 13th day of January, 1846—again reissued on the 13th day of June, 1848; and my second patent, bearing date the 11th day of April, 1846, and re-issued on the 13th day of June, 1848; and also of an improvement in electric telegraphs, as claimed in

my letters patent, bearing date May 1st, 1849; and that the re-issues are for the same invention as described in the original patents respectively, of which they were re-issues.

Mystery of Electricity.—I would further state, that from the mysterious nature of the power, which is efficient in producing the great result, that power may be exhibited in an almost infinite variety of forms, and sometimes in so intricate and complicated a manner, as not to be traced without much study and patience. This very peculiarity renders it, therefore, comparatively easy to mystify its action by complicated contrivances, and also to conceal, in a great degree, the actual similarity and dissimilarity of power, process and results, under a seeming, and only seeming, difference.

The Recording Telegraph.—The great end to be attained in the invention of the undersigned, as is clearly set forth in his letters patent, is the recording or imprinting of characters, as signs of intelligence at a distance. The power employed is that of galvanism, in any of its known modes of production. The power, therefore, is this form of electricity. The result or end is the recording or imprinting of characters at a distance in a permanent manner, and by representing them by sounds. The manner in which I use this power to produce this result is exhibited in my machinery and in my mode of operation. In its present practical form it consists of the following parts: A main or long circuit of wire, which is extended between any two or more distant places, and through which main circuit the electric current from any battery or generator of electricity is made to act at pleasure, through two helices, around two cores of soft iron, making an electro-magnet, which attracting an armature attached to a lever or its equivalent, produces motion in such lever or its equivalent, either to act directly in marking upon paper or other suitable material at practical distances, or indirectly by touching off, so to speak, a second or short circuit, and as many local circuits along the line as may be desired, each containing a battery, which imparts power sufficient to accomplish the great result, to wit: to mark or imprint characters at a distance, and to do this at as many places along the line, at the same time, as may be desired.

The resistance to be overcome is the slight *vis inertiæ* of a delicate armature upon a balanced lever and a delicate spring. The lever breaks and closes by the power thus exerted by the secondary or short circuit. The short circuit operates directly upon the register, which is an instrument of clock-work for carrying paper, so that the paper while in motion is marked

on by a pen or stile in contact with it, and thus forming on it the dots and lines specially and peculiarly adapted and applied to the purpose.

Plan of Invention on Ship Sully, 1832.—And I further say, that during my passage in the ship Sully in the year 1832, I conceived and proposed at least three ways to make my said signs for telegraphing. First: by passing an electric spark through dry paper and thereby puncturing it, in which case the broken parts of the circuit were not to come in contact with the paper. Second: By electro-chemical decomposition, which was to have the paper moistened with a solution of salt easily decomposable by electricity, and the broken parts of the circuit of conductors to come in contact with the paper. Third: By the motive power of electro-magnetism. By reflection and study on the first mode, I came to the opinion that it would not answer.

I then turned my mind to the second mode, which, by the use of moist paper afforded a partial conductor to obviate the anticipated difficulty in the first, and it occurred to me that even the interposition of the moistened paper might be avoided by barely bringing the paper in contact with the conducting wire. This latter idea, to wit: By electro-chemical decomposition, was the most favorite one with me on board the ship, and for some time after; for I had at that time an indefinite recollection, from recurring to my college studies, that there was a class of salts easily decomposable by a current of electricity; and on learning that the sulphate of soda belonged to that class, I proposed to use that salt in the following manner, to wit: Paper colored with turmeric was to be moistened in a solution of Glauber salts (sulph-soda)—the paper thus prepared was to be made to pass by clock-work in contact with the conducting wire of a circuit. I was under the idea at that time that the simple contact with the wire through which the electricity was passing, might so affect the salt as to discolor the paper. This was my first idea. My second was to make the paper chemically prepared to pass between and in contact with two divided parts or points of a circuit connecting the two poles of a galvanic battery or other generator of electricity. Then if at any other point of the circuit there was another broken or divided part, I assume the following operation would take place.

When the prepared paper was made to move slowly in contact with the wire, or between the two first mentioned divided parts of a circuit, I presume that while the other divided points were open, the paper would pass without a change of color; but when they were closed, and a current of electricity

was passing, I presumed the salt would be decomposed, and a reddish brown mark would be made upon the paper. This was wholly conceived and proposed by me on said passage. These modes were to be tested by experiments, after landing, as I had no means of experimenting on board the ship. It was not until 1834, however, that I had the opportunity of testing these modes, and of ascertaining the result by actutual experiment. In the year 1834, I found by experiment, that *simple contact* between the conducting wire, of an unbroken closed circuit and the chemically prepared paper, was not sufficient to color the paper, while by the interposition of the paper between the two broken parts of a closed circuit, so that the electricity having been made to pass through the prepared paper, the colored marks necessary for the purpose of marking by telegraphic signs were successfully accomplished in a rude manner.

Experiments in 1835.—In the latter part of the year 1835, soon after occupying my rooms in New-York City University, I repeated this experiment, among others, and with success; and, by the use of my telegraphic apparatus then constructed, I made and showed my telegraphic characters, distinctly marked by electro-chemical decomposition upon paper. But at this time, I had matured in my mind the electro-magnetic mode of marking, and laid aside the electro-chemical mode, which, although I had put in operation and proved practicable, was deemed by me far less eligible than the electro-magnetic mode.

Chemical Telegraph Patented.—In 1846, finding that attempts were rife to start some telegraph under pretence of its being different from mine, which was in successful operation in various parts of the country, I returned to my electro-chemical mode; and, although I considered it less eligible, it being still practicable, and unless secured to me, as I considered of right it should be, since I was its first inventor, I reproduced, in the spring and summer of 1846, the same result as in the years 1834 and 1835, and entered a caveat at the patent-office for the same in January, 1847, and completed my application for a patent in January, 1848.

CAPTAIN PELL'S LETTER, 1837.

NEW-YORK, September 27th, 1837.

SAMUEL F. B. MORSE, Esq.:

Dear Sir,—On my arrival here I received your letter calling on my recollection for what was said on the subject of the electric telegraph, during the passage from Havre, on board of the ship Sully, in October, 1832. I am happy to say, I have a distinct remembrance of your suggesting, as a thought newly occurred to you, the possibility of a telegraphic communication being effected by electric wires. As the passage progressed, and your idea developed itself, it became frequently a subject of conversation. Difficulty after difficulty was suggested as obstacles to its operation, which your ingenuity still labored to remove, until your invention, passing from its first crude state through different grades of perfectionment, was, in seeming, matured to an available instrument, wanting only patronage to perfect it, and call it into reality. And I sincerely trust that circumstances may not deprive you of the reward due to the invention, which, whatever be its source in Europe, is with you, at least, I am convinced, original.

To your question of my having spoken on subsequent passages, to others, of your invention, I might say, you could well anticipate the reply; as you enjoined no secrecy on me, it was natural I should mention a subject so interesting to me, and have a remembrance of so doing in several instances, but to whom, I cannot recollect. When you observed to me, a few days before leaving the ship, "Well, Captain, when you hear of the telegraph, one of these days, the wonder of the world, remember the discovery was made on board the ship Sully," I then little thought I should ever be called upon to throw into the scale my mite of testimony in support of your claims to priority of invention, for what seemed so startling a novelty.

With my respects and best wishes,

I subscribe myself,

WILLIAM W. PELL.

DEPOSITION OF WILLIAM W. PELL.

I, William W. Pell, of Hackensack, in the State of New-Jersey, aged 49 years, on oath depose and say, that I am by profession a mariner.

I am personally acquainted with Prof. Samuel F. B. Morse. In the month of October, 1832, said Morse made a passage

from Havre, in France, to New-York, in the packet-ship Sully, of which I was then commander. After many days of the passage had passed, said Morse first made mention, in the presence of myself and others seated with him at the breakfast table, of the idea of an electric telegraph, as having occurred to him during the passage; and he entered into some explanations of the means by which he thought such an instrument could be realized. Throughout the subsequent portion of the passage, his mind was busied in bringing it to maturity; and all his improvements upon it, from its first vague form through all its progressing grades of perfection, much to its present condition, were, as he successively reached them, named in the presence of myself and others, until he had presented to our minds, before the passage ended, his instrument essentially the same as his present one, and as the one I saw in operation at the University after that voyage, both in its principles and mechanism, its numeral dots, (diagram omitted,) and its typhal form, thus: (diagram omitted,) most of which are still fresh in my recollection, as he explained them, as are also the words he addressed to me a few days before leaving the ship, "Well, Captain, should you hear of the telegraph one of these days, as the wonder of the world, remember the discovery was made on board the good ship Sully."

His plan of communicating intelligence at a distance, was by imprinting signs at a distance. While on board the ship, he described his use of a galvanic trough, the circuit from which was to be broken and closed, by means of a lever acted upon by the tooth types, which were to be moved by a crank.

At the other extremity of the circuit was an artificial horse-shoe magnet, with a movable armature, holding a pencil or pen, and carrying it by the movement communicated by the closing and breaking of the circuit, over a papered-cylinder, on which it traced a succession of toothed marks. This was in the month of October, 1832. On that passage, Prof. Morse also showed me a sketch-book, in which were contained drawings of some of said telegraphic apparatus.

The said sketch-book was shown to me last spring, and I recognized it as the same sketch-book shown to me, in the possession of said Morse during said voyage of 1832. When it was so shown to me last spring, I wrote my name upon it, and the date of my said signature.

I distinctly recollect that the said sketch-book, at the time that I saw it on board the packet-ship Sully, had in it certain drawings which I recognized when I wrote my name upon said leaf, as before stated; and also on another page, other

drawings of the part of the apparatus and machines described by Professor Morse for his telegraph, which I also recollected having seen in said book during the voyage aforesaid, and I recognized them when so shown to me last spring, and then wrote my name upon the page containing them.

When said Morse showed me an apparatus and machine in operation at the University, in the city of New-York, I recognized the instrument the moment I saw it, as being constructed upon the same general principles of the telegraphic instrument described by Prof. Morse, on board the ship Sully, on his passage from Havre, in 1832.

* * * * *

WM. W. PELL.

Sworn to and subscribed before me, at New-Barbadoes, this 5th day of June, 1840.

JOHN N. ACKERMAN,
Justice of the Peace.

Art. XII.—THE MORSE TELEGRAPH ALPHABET.

AMERICAN, AUSTRO-GERMANIC, RUSSIAN.

THE alphabet of the Morse Telegraph is composed of dots, dashes, and spaces, methodically arranged, so as to give facility and celerity in manipulation, perfectly in accordance with their use in the language. In the formation of the letters, Professor Morse had in view the arrangement of a font of type, and those letters used most, as in the system of types, he made the most easy for rapid manipulation. Thus, the letter e is made the quickest of all the signs, being a single dot. In the telegraph writing five e's can be made as soon as one can be made in chirography. Most of the letters can be made quicker; hence, an expert telegrapher, by the Morse system, can write by the key much faster than the most expert penman can indite with a pen. The advantages of celerity of the Morse telegraph, is owing, very much, to the beautiful arrangement adopted by the inventor, in the combination of his alphabet. There are some faults, however, in the American alphabet. In the formation of letters by the use of spaces, such as in the letters c, o, r, y, z, and &, sad mistakes sometimes occur by bad telegraphers; and as an example, we refer to a single case which has occurred, viz.: a merchant in New-Orleans telegraphed to his correspondent in New-York to protect a certain draft. The message was received, protest the draft. The only difference between the spelling of the two words, is in the use of the *c* and the *s*. These letters differ, telegraphically, only in the space between the last two dots, as will be seen on reference to the alphabet. Here was a very sad error, and arising from a very slight difference. The fault, therefore, in the American formation is in the spaced letters, which is quite a grievous one occasionally. In Europe, a different combination has been adopted; and, although not so rapid in communication, yet more free from liability of error. There are no spaced letters. The American alphabet, as presented here, is made from the dots and dashes of an ordinary font of type, and are not quite bold enough in face to exactly illustrate the indentation made by the ordinary pen of the machine; yet, many telegraphers adjust their pens to make marks equally as delicate as those given below; and, in fact, many experts write much finer. The length of the dashes and the length of a given letter, wholly depends upon the will of the writer. Some will make a t as long as the l, as given below; and then, again, others will make an l as short as the t, repre-

sented below, and the t proportionably shorter. As it is with the pen, some persons will write a very fine and delicate hand, while others, like John Hancock for instance, will write a bold and large hand. We also give the figures of the system, which follow the letters. The punctuations in America are only the period, interrogation, and the indication of a paragraph. Others were recommended, but never practically adopted; and many telegraphers only use the period.

AMERICAN MORSE ALPHABET.

A .-	O . .
B -...	P .....
C .. .	Q ..-.
D -..	R . ..
E .	S ...
F .-.	T -
G --.	U ..-
H	V ...-
I ..	W .--
J -.-.	X .-..
K -.-	Y .. ..
L —	Z ... .
M --	& . ...
N -.	

NUMERALS.

1 .--.	6 ......
2 ..-..	7 --..
3 ...-.	8 -....
4 ....-	9 -..-
5 ---	0 —

(.) ..--..
(?) -..-.
(¶) ----

We next give the Austro-Germanic Alphabet for the Morse system, which is in service nearly all over Europe where the Latin letter is used—embracing all Germany, Denmark, Norway, Sweden, France, England, Italian States, and wherever the French, German, and English languages are read:—

AUSTRO-GERMANIC MORSE ALPHABET.

A	• —	O	— — —
Ä	• — • —	Ö	— — — •
B	— • • •	P	• — — •
C	— • — •	Q	— — • —
D	— • •	R	• — •
E	•	S	• • •
F	• • — •	T	—
G	— — •	U	• • —
H	• • • •	Ü	• • — —
I	• •	V	• • • —
J	• — — —	W	• — —
K	— • —	X	— • • —
L	• — • •	Y	— • — —
M	— —	Z	— — • •
N	— •	Ch	— — — —

NUMERALS.

1	• — — — —	6	— • • • •
2	• • — — —	7	— — • • •
3	• • • — —	8	— — — • •
4	• • • • —	9	— — — — •
5	• • • • •	0	— — — — —

PUNCTUATION.

!	— — · · — —	.	· · · · · ·
=	— · · · · —	;	— · — · — ·
'	· — — — — ·	,	· — · — · —
/	— — — — — —	:	— — — · · ·
		?	· · — — · ·

We next append the Russian-Morse Alphabet, arranged for the lesser alphabet in that language, being six less than the full Russian. The figures and punctuations are the same as the German. Messages can be sent in either Russian, German, or French languages, with equal facility. Some of the letters in the Germanic and Russian formations are the same as those in the American, especially letters of equivalent sounds. We have had them engraved for the purpose of general information, and we trust we shall not fail in accomplishing the object.

We would add, further, that the letters, as engraved, are much larger than those made by the machine. The pen-point of the Morse instruments in Europe are precisely the same as those in America. The registers, magnets, and keys are generally very much the same in form; and those made by Messrs. Leiman & Halskie, of Berlin, Prussia, are equal, if not superior, to any others made in the world. They are expert mechanics, and hold to the useful.

RUSSIAN-MORSE ALPHABET.

А	· —	Ф	— — — ·
Б	· — · —	Х	· — — —
В	— ·	Ц	— — —
Г	— · — ·	Ч	— · —
Д	— —	Ш	— · · —
Е	· ·	Щ	— — — —
Ж	— — · ·	Ь	· · · ·
З	· · — —	Ы	— · — —
И	· · ·	Ю	· · · —
И	— — · —	Я	· — — ·
К	· · — ·	П	· — ·
Л	· — · ·	Р	· · —
М	— · · ·	С	— · ·
Н	—	Т	— — ·
О	·	У	· — —

Editorial.

VALEDICTORY.—We have finished our work, and now present our farewell respects to our friends—the patrons of the *Companion.*

Our publication has been honored in both hemispheres by the telegrapher, and the devotee of science. We feel grateful for such elevated consideration.

We now cease the publication of our Journal, and, also, any further connection with the management of the telegraph in America.

It is now more than ten years since we first became charmed by the electric telegraph. We were then a young practitioner at law, and, with considerable energy at an early day, embarked in the new enterprise. Owing to the unfortunate patent difficulties, suits, controversies, and rivalry, it soon became evident that the field of usefulness was surrounded with very great barriers. There was no retreat for us. With a consciousness that Morse was a wronged man, that his many years of toil was scoffed at unjustly, and that he was entitled to the credit he claimed, we with a warm devotion defended and advocated his rights over all others. There was a time when our future welfare would have been financially benefited, by assuming a different attitude. We never wish for gain by the outrage of others' rights. The continuation and multiplicity of suits and controversies, made it apparent that there was no possibility of ultimate success. We have passed through the ordeal, in all the elements of administration, and find ourselves a few thousand dollars worse off than when we began, that is, so far as our account current of loss and gain pertains to the telegraph. We still hold a very large amount of unproductive stock, and we must confess, that we are likely to continue to hold it.

As to the *Companion*, it was started by our own inclination, and at our own expense. It has been supposed by some, that it was mantained at the expense of the patentees; such was not the case, either direct or indirect. What we have said, in behalf of Professor Morse, or of any other gentleman, was original with us. The whole management of the *Companion* has been exercised by our own independent will.

Our attention, for the future, will be divided between the two hemispheres, and, perhaps, the patrons of the telegraph will hear from us again, in the final accomplishment of our cherished wishes, to see the earth girdled with one continuous electric and intelligible flame, diffusing light, knowledge, and peace among nations.

ould be returne
r before the last

ents a day is incu
eyond the spec

tly.