

**ELECTRICAL AIDS TO THE DRAMA.**

The moon in nature borrows her light from the invisible sun, but the moon at the Metropolitan Opera House gets his from an electric lighting station in 25th Street, nearly a mile away; the energy coming along the overhead wires, up Broadway, piercing the stage door, thence through the wings and up in the mimic sky over the stage. So, when the Fair Marguerite, in the IV. act of the opera "Faust," thrusts her hand out of the window of the garden pavilion and exclaims,

"How sweet the notes of yon nightingale,  
How soft this moonlight!"

she not only compliments the excellent imitation of that bird, as given by Herr Hans Hochschlagen, crouching in the wings, but pays a deserved tribute as well to the stoker, engine driver, and dynamo man in the distant lighting station.

The designer and operator of the moon—we refer, of course, to the terrestrial one—is Mr. James Stewart, a clever mechanical and electrical engineer. When he was asked last week as to its mechanism, he led the way behind the scenes, through mimic rocks and boulders, pictured mountains, tropical forests, and Scandinavian wastes, with here a ferocious dragon blocking the way and there an uncanny-looking gnome peeping out from a cave. A flight of narrow stone steps led upward from the darkness, and a crooked passageway ended at a room where, upon a high shelf, the sun and the moon were resting snugly, besides some evening and morning stars and a few other planets.

"Hermann!" he called to a man preparing a ripple-effect for the river Rhine in "Rhinégold," "Hermann, just take the ladder and go up there and bring the moon down."

This moon (Figs. 4 and 5) is about 18 inches in diameter, of porcelain or milk glass, and oval in form. Within are six incandescence lamps of the ordinary type, three red, three white, each of 16 candle power, connected with the street circuit and also with a resistance coil. In "Tannhaeuser" the knight and minstrel of that name, tiring of the refuge he has found from the griefs of earth in the hill of Venus (the Hörselberg in Thuringia), regains his liberty, and, traveling through the country, finds himself in a valley between the Wartberg and the Hörselberg. Here he pauses to be charmed by the beauties of that nature he has been hiding from. The current in the electrical moon is switched into the three red-globed lamps, the white cut off. It rises between the hills, a great fiery red globe, as we often see the heavenly orb on a clear evening when at its full. The hills are in a glow, there is a shimmer among the tree tops, the red growing fainter and fainter as it mounts, from the lowering of the intensity of the current, till finally the red lamps are cut off, the white ones turned on; the hills and trees are silvered, the little lake becomes a mirror, the bordering trees projecting their shadows athwart it.

The moon is moved by means of a "batten," a thin piece of wood let down from above, the course being marked for the operator by the apparent though ex-

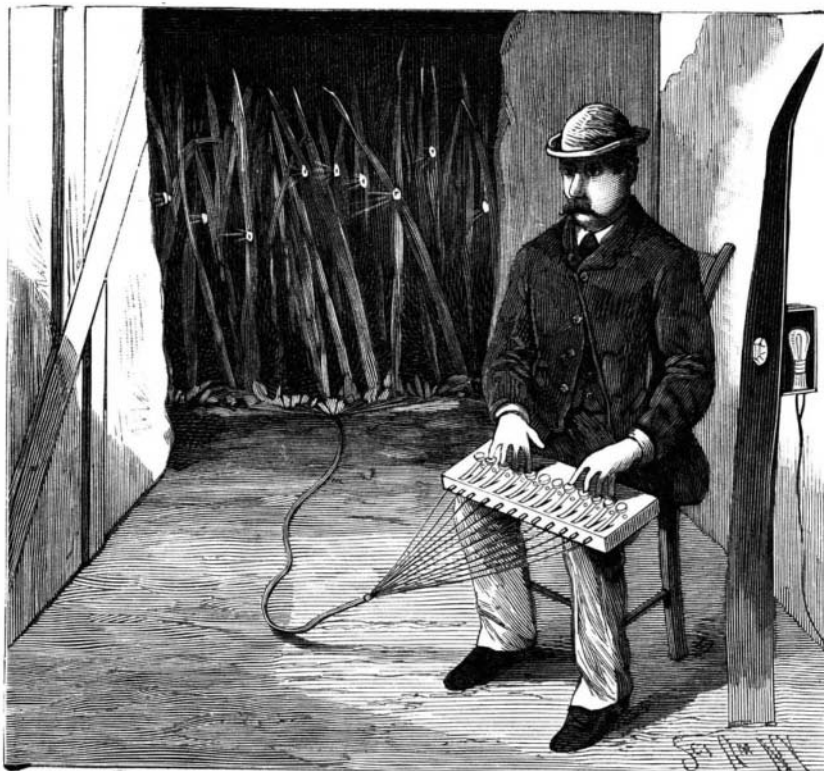


Fig. 10.—ELECTRIC FIREFLIES.

aggerated movements of the moon as we see them in an orrery. The mimic sun moves behind the "drop" (the short curtain in the background), but the moon moves before it, and hence, to keep up the illusion, the wire or electrical main it drags after it must be colored as is



Fig. 9.—RAINBOW EFFECT.

this "drop." This is called "masking in." The edges are carefully pared off around the disk and the muslin serving perforated, else it would cast a shadow backward and show the sky to be only a curtain.

The electrical sun is a big ground glass disk, with a voltaic arc lamp behind it of about 2,000 candle power, connected with the street circuit. It shows through a hole cut into a drop curtain, and is set firmly in a frame covered with colored gauze to represent the various hues with which it tinctures the atmosphere and the

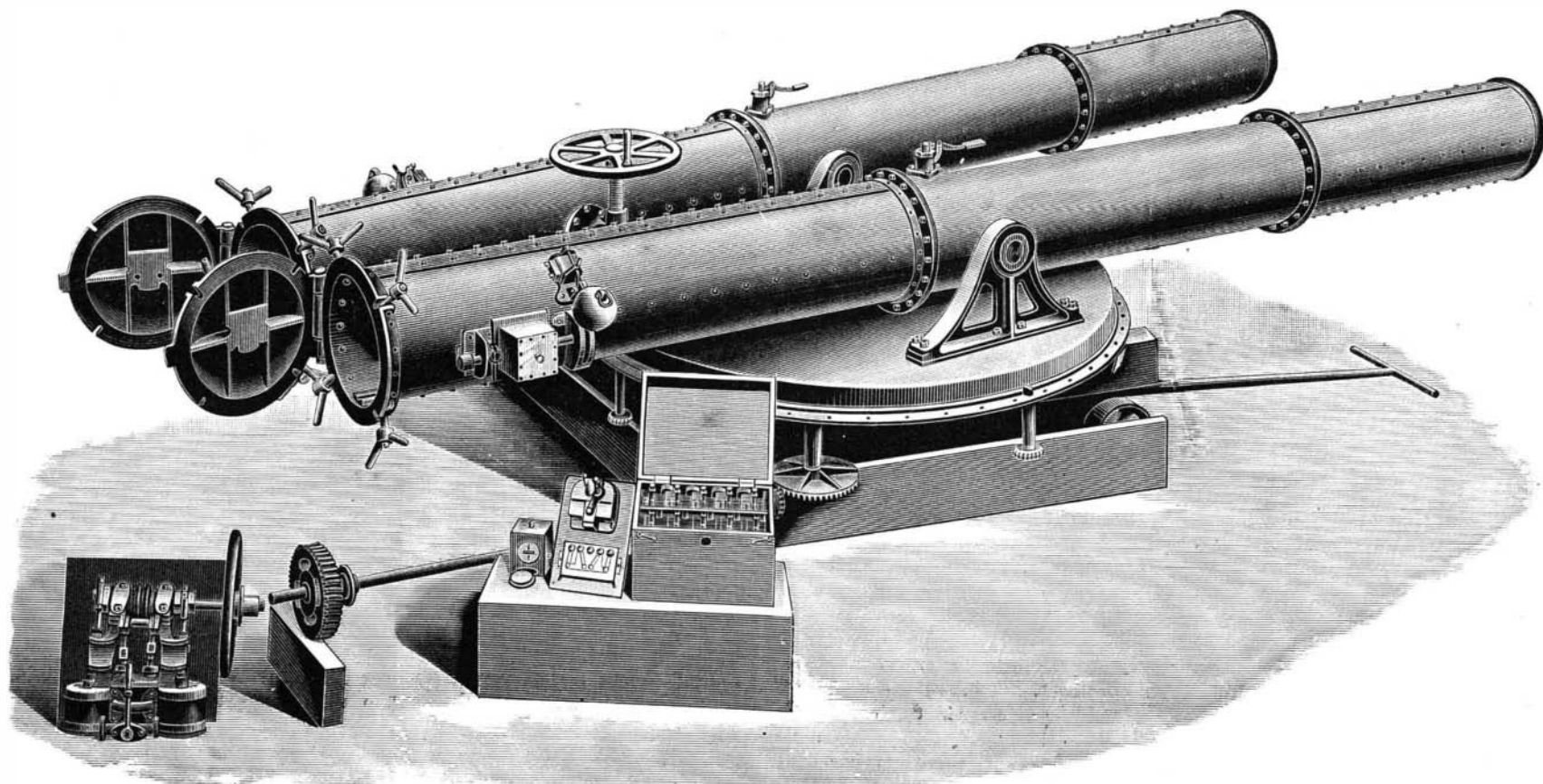
colors it projects upon the clouds during ascension and declination. One of the best effects yet had with this artificial sun is in Myerbeer's "The Prophet," act III., scene 1. The Anabaptists are encamped in a Westphalian forest near by a frozen lake that loses itself in the mist gathered at the horizon (also an electrical effect). The day is going down in the west with the sun. The fierce arc lights are moderated through golden gauze, then softened by the ground glass outside.

As the sun is let down behind the paper mountains, the purple and red gauze is pushed up over his face, and the lower clouds, now changed from cumulus to stratus, take on those horizontal lines of color we know so well. "Tannhaeuser," act III., scene 2, shows the mellow glowing of twilight, the masterful incandescence light, hooded in pale yellow, controlling the haze so well that in the expanse of mimic sky there is not a tint to dispel the illusion. The evening star in the southwest twinkles clearly like the ruby Mars. Wolfram, the minstrel knight, seems justified in his apostrophe:

"I look on thee, O star in heaven the fairest,  
Thy clear-cut beam thro' trackless space thou bearest,  
The hour of darkness is by thee made bright,  
Thou lead'st us upward with kindly light."

This star (see Fig. 2) consists of a single 16 candle power incandescence light connected with the street circuit and affixed to a metal frame set in the drop curtain; only the star itself, with a covering of red gelatine tinctured with blue, showing through. In the duel scene in Gounod's "Faust," act IV., scene 7, will be found a striking electrical effect. As will be remembered, the soldier Valentine, brother to Marguerite, fights with Faust, the student and Marguerite's lover. As he is unfamiliar with the use of the sword, the Devil in the guise of Mephistopheles stands by, sword drawn, to aid him (see Fig. 1), interposing the weapon when Valentine makes too fiercely at the student. Heretofore, though there was a clash of swords, there was not here anything to indicate the possession of supernatural powers by Mephistopheles. The electric wires are connected with Valentine and Faust. The poles of the battery are connected under the stage with copper plates sunk into the flooring where the duel takes place. Copper nails driven, one into a shoe of Valentine, the other in that of Faust, connect up with the floor plates whenever they respectively stand upon them, and wires running up the legs and body of each and then down their several sleeves end in a small plug. So, when they draw their swords, they have but to insert these plugs into the holes sunk into their hilts and they are connected up with the electrical storage battery in the wings; Valentine representing the positive pole, and Faust the negative.

Every time Mephistopheles interposes his sword and strikes up the contending weapons, which are then brought in contact, the sparks fly furiously, and there are those weird, crackling, sizzling sounds heard in the lightning as well. When Valentine gets his death wound, he throws out the plug connecting his sword with the battery, by a simple turn of the thumb, and,



IMPROVED DIVERGING TORPEDO GUNS.—[For description see page 392.]

as he falls, his sword flies from his hand with nothing to show the presence of any electrical connection.

Every one familiar with the charming music drama of Wagner's, the "Ring of the Nibelung," will recall that impressive scene in the first act of Siegfried where the stout lad Siegfried welds together the broken pieces of his dead father's sword which have been left him by his mother Sieglinda (see Fig. 6). The scene represents a cave in the rocks with openings into the forest. It is a smithy's forge, with fire, chimney, and bellows. The point of this scene lies in the prodigious strength of the lad Siegfried, who, because of it, succeeds where Mime, the smithy, has failed, and welds the terrible sword that is to kill the dragon who guards the treasure. The anvil upon which the lad strikes is connected by concealed wires with the storage battery, the positive plate being a corrugated piece of cast iron  $6\frac{1}{2}$  inches by 12, the negative pieces of iron wire three-sixteenths inch diameter and 12 long, bowed upward at their center and placed above and free of the corrugations below them. The current required being of 15 amperes, if the negative wires should rest upon the positive plate, a dead short circuit would be formed and all metal connection with the battery would be fused; but bowed as they are, there is but a momentary short circuit at each stroke of the hammer, when the springy wires are forced down upon the under plate, producing only a shower of sparks, as if from the great force of the blows struck. At last, when the sword is completed and a firm handle upon the hilt, he determines to test its temper, and raising it aloft brings it down with what seems a tremendous blow upon the anvil, which falls into two parts (see Fig. 7), as if cleft in twain, the sparks following the sword down to the ground. In reality, he strikes a spring which lets one-half the anvil fall, its under and outer side, as will be seen, having the corner cut off for the purpose and causing momentary short-circuiting.

A very pretty electrical effect is had in the garden scene in "Faust," act III., scene 6. Siebel, the would-be lover of Marguerite, advances to a bed of tulips (see Fig. 3), some red, some white, and some gold, to pluck a nosegay that he would leave upon her window to speak for him. Concealed in the corolla of each flower, or, rather, disguised as stamens and anthers, are two tiny incandescence lamps (15 volts each), the whorl of petals fresh and sparkling as when we see them fed with sunlight. Now, the demon Mephistopheles had long before warned Siebel:

"Every flower that you touch  
Shall rot and shall wither."

Unheeding, Siebel picks a golden tulip which shines yet as he lifts it up to him (the fine wire carrying the electrical current that keeps the bulbs in the flower aglow, trailing after it, unseen amid the foliage). No sooner does he examine it, when, lo! Mephistopheles, partly concealed, raises his hand, the current from that single flame is cut off, and it grows dull and withers perceptibly. Siebel says:

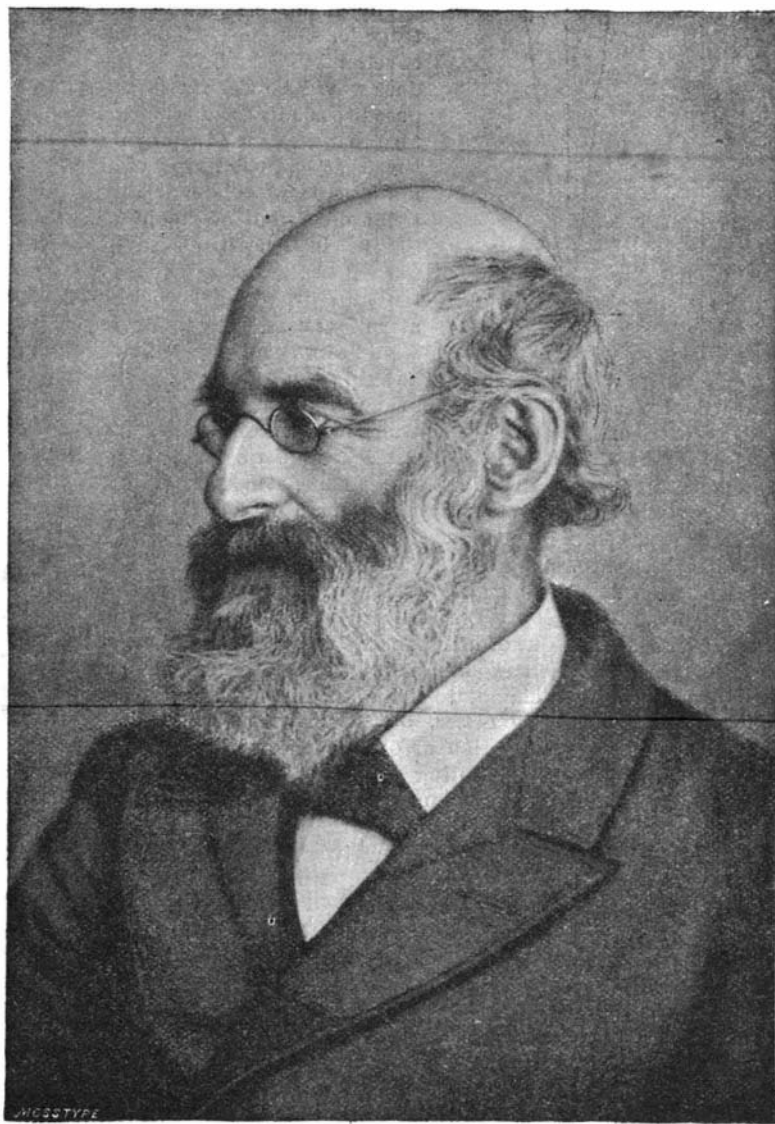
"What, faded! Ah me!  
Thus the Sorcerer foretold at the fair:  
That, should I touch a blooming flower,  
It shall wither.  
But my hand in holy water I'll bathe—  
See, now, will they wither?"

Here he plucks a red tulip, a white and a golden one, holding them up triumphantly, a rich, mellow glow in each (the electrical current following upward along the fine wire and the little bulbs yet lighted), for Mephistopheles may not raise his hand against the power of what's been blessed. Then he changes hands, and, like a flash, they fade; beaming with light again when he, remembering it was the other hand that touched the holy water, hands them back. (The operator, watching the scene, turning the electrical switch on or off as required.)

In the last act of Siegfried, the wanderer (Wotan) is standing at the foot of a high cliff, with a deal of thunder and lightning overhead. He is armed with a great spear, steel-tipped and pronged, with the wood of it studded with steel. It is supposed to contain the sacred though unseen fire, and heretofore, until the present application of electricity, there was no evidence of it, save Wotan's word. He, as guardian of the rocks, is pacing up and down, with the spear in his hand. Siegfried comes seeking Brynhilda's rock. As Siegfried approaches he draws his sword, dealing a heavy blow against the spear of Wotan, while, at the same moment, a man in the wings turns an electric switch. The spear parts, and from its shattered ends flames, like forked tongues, leap out. A lamp of 30

volts intensity is hidden in the spear; the core wrapped with heavy brown paper for insulation, with a mass of secondary cotton stuffed about the carbons at the point where the spear is to part. Then come thunder and lightning and black, rolling clouds, the last two projected upon the mimic sky by a stereopticon in the wings. The lightning and the clouds are scratched and painted on small bits of glass; before projection being greatly magnified by lensing, with a powerful voltaic arc electric light behind the condenser throwing them with wonderful precision and naturalness: the clouds rolling across an apparently immense expanse of sky, as the operator revolves the disks one over the other (see Fig. 8), and the forked lightning seeming to shoot across the heavens.

The realistic fire clouds and flames in the last act of the Prophet, where the latter, learning he is betrayed, orders the firing of the Palace of Munster, are done by concentrating the arc light upon colored gelatine; using first yellow for fumes, then yellow and white, then yellow and red, red and white, red and black. The snowstorm in the Prophet is made by forcing the light through white scratches on black glass. The sand-storm in last act of the Queen of Sheba is done with



ROYAL E. HOUSE, THE ELECTRICIAN.

yellow and black and pink gelatine before the light, and the rain by parallel scratches on a black surface; the arc light being dimmed and set aglow alternately, and the glass turned this way and that, so that the parallelism of the drops shall follow a supposititious changing of the direction of the wind.

The firefly (Fig. 10) is another fine effect, devised by the same hand as the others, and recently used at the Broadway Theater, in the play of the Kaffir Diamond. Tiny 15-volt incandescence bulbs were affixed to the weeds and rushes in a swamp, each bulb getting its life from a fine wire connected to an electrical accumulator in the wings. The operator in his hiding place, by pressing upon the knobs of his key board alternately, lighting up one and then another, could make a single firefly appear to be darting hither and thither, then there would be two of them, a half dozen, a score, or, pressing upon all, twenty-eight.

The artificial rainbow (Fig. 9) is made by the interposition of two triangular glass prisms, one elevated slightly over the other, before an electrical reflector, the bases and faces and lateral edges carefully adjusted with regard, the one prism to the other. The electrical sun, set opposite to the point where the rainbow is to appear, is made, the better to aid the illusion, to shine into a mass of cloud, the rainbow being seemingly only the reflection, refraction, and disintegration of sun rays into the various colors of the prismatic spectrum, the influence of the rain drops. So ingenious is the work, that there is made to appear, as in nature, two arches, the primary with its inter circle of red, and the secondary with red along the inner.

In the Valkyr, an incandescence light is thrust into a knot in the tree and, shining upon the hilt of the sword, discovers it to Siegmund.

#### ROYAL E. HOUSE, THE ELECTRICIAN.

BY H. C. HOVEY.

In a pleasant home in the city of Bridgeport lives a veteran inventor, whose name has long been associated with the honored names of Henry, Morse, Vail, and other pioneers of telegraphy, and which has lately gained new publicity from the fact that he contests with Professor Bell the priority as inventor of the telephone. Keenly watchful of passing events, he has hitherto been unwilling to allow any sketch of his life and services or any portrait of himself to be published; and it is only at the urgent request of his friends that he permits the printing of this communication.

Royal Earle House was born in Rockingham, Vt., September 9, 1814. In 1840, he invented and put in operation a water wheel that would work under water, and not freeze in winter, and yet do the work of a gravity wheel with its gearing. This he accomplished by using a spiral conduit, with cover, inclosing a vertical wheel with two sets of buckets; one set arranged around its side, to have motion from the inflowing water, the other arranged to cover the bottom, each bucket having a suitable angle to utilize the centrifugal force of the whirling water, and its weight, by causing the water between the vertical buckets to move backward and be discharged in a direction nearly opposite to that of the water in the spiral conduit, when, relatively, the outflowing water is in a state of rest. The principle of the turbine wheel had long been known abroad; but House's invention lay in such a combination of the impulse and discharge as should make the wheel of practical value, and his ingenious contrivance is now extensively used in various forms and known by different names.

In 1842 he resolved to devote his life to the study of electricity, and to give popular lectures, with accompanying experiments. After a brief career in the lecture field, he decided, however, to limit his attention to the more promising arena of invention. A brilliant galaxy had already preceded him. Morse had taken out his earlier patents, but had not yet built the first electro-magnetic line—from Washington to Baltimore—when House conceived the idea of his printing-telegraph. He made his first instrument of the kind in 1844, and exhibited it before the Mechanics' Institute, in New York City. It received a gold medal from the American Institute in 1848, with a special compliment on its being "an invention of great ingenuity." The committee of award were Professors Agassiz, Chilton, and Renwick. Morse's telegraph conveyed intelligence by preconcerted signals, dots and lines made by breaking and closing the circuit. House's telegraph printed its messages in Roman letters. The component parts were type wheels, platens, a keyboard like that of a piano, and a single line of telegraph.

The type wheels moved synchronously by a step-by-step motion, arrested at will by pressure on a key, causing its representative letter to be printed. The actual speed attained was at the rate of fifty words a minute, or equal to the average speed of the modern typewriter. This was more rapidly than work could be done by the Morse instrument; but the printing-telegraph required more power to move the type wheels, etc., which became an objectionable feature when stations came to be multiplied.

Professor House removed with his family to New York City, in 1844, and sold a half interest in his invention to Mr. William Ballard, who was financially associated with him in making instruments and laying lines. Hon. Samuel Selden and Mr. Hiram Sibley, of Rochester, were also interested. Mr. Henry O'Reilly made an agreement for the use of the printing-telegraph throughout the West. He located the first telegraph line of any sort between Pittsburg and Cincinnati. Afterward he located an instrument at New Albany, Ind.

Capital was subscribed for building a line from New York to Philadelphia. This line crossed the North River at Fort Lee. On the east side was a mast 300 feet high, and on the Palisades, on the west side, one 200 feet high, making an eminence 400 feet in height. The contractors had faith in a small wire cable of seven twisted strands. But in practice this gave much trouble, and a solid wire had to be substituted. The right to use the printing-telegraph between New York and Philadelphia was sold for \$25,000 in stock, and for \$30,000 the right from New York to Boston.