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Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 149.

For the Week ending November 9, 1878.

Price 10 cents. For sale by all newsdealers.

Depth of Nevada Gold and Silver Mines.

The Sierra Nevada mine is at a depth of 2,200 feet; Ophir, 108 feet on stope below 2,100 feet; Consolidated Virginia and California are 2,050 each; Gould & Curry, 1,900; Savage, 2,300; Hale & Norcross, 2,300; Chollar Potosi, 1,850; Imperial, 2,400; Consolidated, 2,400; Bullion, 2,200; Yellow Jacket, 2,400; Crown Point, 2,360; Belcher, 2,360; Julia, 2,100; North Consolidated, 1,425. Levels in North Consolidated are 1,100 and 1,425 feet from the surface.

THE EAST RIVER BRIDGE.

[Continued from first page.]

At the outset the estimated cost of the bridge, exclusive of the land, was $7,000,000. When at the death of his father, Colonel Roebling, the present engineer in chief, Mr. W. A. Roebling, took charge of the work in 1872, he raised the estimate of cost to from $8,000,000 to $9,500,000. In 1875 the directors asked and obtained an appropriation raising the expected outlay to $13,500,000. Even this vast sum is now found to be insufficient; and the probability is that the amount needed will not be less than the estimate made by the SCIENTIFIC AMERICAN, some five years ago, namely, $20,000,000, a sum nearly double what would be needed—as was shown in this paper February 3, 1877—to provide at least fourteen tunnels crossing under the East River at as many principal streets.

Already the limit fixed by the Legislature has been passed, and yet the work is far from completion. As a natural consequence the undertaking has aroused the strenuous opposition of influential parties, who insist that no more of the city's money should be expended on account of the bridge until the courts decide that it must be paid. Prominent in this connection is the New York Council of Reform, whose president, Mr. William H. Webb, the eminent ship builder, has lately given an elaborate statement of the grounds on which their opposition to the bridge has been based. A summary of his argument will be given below. How far the charges against the bridge—on the score of its injury to commerce, its incapacity to meet the needs of the two great cities which it is to unite, and its inability to withstand the force of storms such as that which has just made such havoc along our coast and in neighboring cities—how far these charges are true, how far exaggerations of fact, we shall not now attempt to discuss. We give them as an essential element in the history of the great bridge.

Under the head of injury to commerce, Mr. Webb asserts that two thirds of the 19,534 sea-going vessels that came into this harbor in 1876 had to pass the towers of this bridge, some of them several times, in the process of loading, unloading, and repairing; and that the masts of a large majority of these vessels were found to be too high to pass under the flooring of the bridge under all conditions of weather and the crowded occupation of the river.

The cost and delay of taking down and replacing the top masts, and the frequency of the collisions of ship masts with the cables of the bridge, are said to be so great that it has already become the practice to insert in the charters of vessels coming to this port the conditions that they shall not pass this bridge, or, if compelled to do so, shall receive extra allowance. Since the commerce of this city is its life, and has a State and national importance, no such injury to it can be tolerated.

In view of the circumstance that the United States Government, in the interests of the whole country, is spending many millions in removing the natural obstructions to commerce at Hell Gate (the eastern entrance to New York harbor, on the same channel the bridge is to open), the Council insist that it is not to be supposed that it will neutralize these improvements by imposing a still greater obstruction in the same river by this bridge, especially when such obstructions are expressly prohibited by the laws of this State; and that with so strong a presumption that the bridge will be judiciously condemned, it is a criminal waste to spend any more of the public money upon it, at least until a final decision of this question has been rendered.

Under the head of excessive cost it is urged that, since the act of the Legislature authorized only the construction of such "a bridge as should render the travel of the people of this district certain and safe at all times, and whose cost should not exceed $8,000,000 when completed and open to the public, with all its debts and liabilities paid;" and since the Engineer's estimates show that the bridge cannot be completed for less than double the sum allowed, any further work upon the bridge is unauthorized and illegal, and the further issue of city bonds on account of the bridge should be stayed until some competent judicial authority shall decide that they must be issued.

Touching the incapacity of the bridge to facilitate either passenger or business traffic across the East River, Mr. Webb claims that the bridge will sustain per hour the weight of only 250 passengers in cars and 10,000 moving on foot at the usual rate; while at the busy periods of the day, morning and evening, Fulton Ferry alone carries 20,000 an hour. Seeing that 190,000 passengers are daily carried both ways by all the ferries between New York and Brooklyn, it is claimed that the bridge will not begin to meet the demands that may be made upon it, in case the ferries are suspended by ice or otherwise.

Still more serious is the charge that the bridge will not be secure. Mr. Webb says: "This is wholly an experimental bridge. It is the highest and longest in the world, and probably the only one entirely unsupported by any form of stays. The history of suspension bridges in this country and in Europe shows their most dangerous exposure to be that to storms, producing oscillations and ruptures. Five of the largest suspension bridges in this country, and several in Europe, have been destroyed within a few years after their erection in this manner, although all of them were substantially stayed. The Engineer-in-Chief of this bridge, in his report of March last, asserts: 'During the severe northeast gale of January 31 last it would have been extremely dangerous to have sent trains across on narrow gauge.' This storm, which was not at all exceptional for its violence, Mr. Roebling estimates at 21 pounds per square foot pressure, which is 1-6th greater than the sustaining power of the bridge, and expresses the opinion in this report that a train of cars on either a 4-foot 8-inch track, or 6-foot track, would be upset by a wind pressure 17 per cent less than this, and asks: 'Who can guarantee that the wind will never blow with stronger force?' He instances a recorded case of the velocity of the wind during the last year at 186 miles an hour, or about 170 pounds pressure per square foot. If, then, railroad cars, with their low iron wheels and heavy structure, are liable to be overturned by frequent storms, what must be the liability of top-carriages and business vehicles, with their high wheels, lighter structure, and narrower gauge? What is the liability of foot passengers? What of the bridge itself, with its 130,000 square feet of flooring, and the 17 per cent storm resistance of its trusses? If an eddy of air were to strike the bridge from beneath with greater force than its own weight it would be lifted, to crash back again with its destructive momentum of thousands of tons."

Another source of peril lies in the circumstance that while the bridge will provide space for 5,000 passengers in the car-division and twice as many more on foot, it will bear the weight of only 2,400 at one time, and these equally distributed.

"How are these conditions to be secured in a public bridge 'at all times' when there are at least six hours each day during which, if the ferries are stopped, there will be a pressure for freight and passengers at least ten times greater than the bridge can sustain?"

Again, Mr. Webb urges, the weight and working of the endless rope for propelling the cars is likely to prove a fatal strain upon the bridge. "The iron cable, more than two and one-fourth miles in length, must be of sufficient strength to overcome the friction of the wheels upon which it rests, to carry its own weight, and the car attached to it, at a speed of 15 miles an hour up and down a grade of 100 feet, revolving around drums 6,000 feet apart, and frequently stopping and starting. As this cable is held by drums at each terminus of the bridge, 100 feet lower than it is at the center, when the horizontal power is applied to revolve the cable, it must bear down the center with a crushing perpendicular force."

The feasibility of the method of moving the cars is doubted, Mr. Webb says, by all the best engineers the Council have consulted, while the Engineer-in-Chief of the bridge has condemned the only other method, the use of locomotives, for the reason that the structure has neither been designed nor built to bear such heavy concentrated loads.

In view of these strongly put if not inherently strong objections, Mr. Webb insists that it would be foolish, if not wicked, to spend more money on "a bridge that is not called for, cannot be made to answer the purposes for which it was professedly built, very seriously damages a large part of the commerce of this harbor, taxes the financial ability of these two cities to their utmost, and cannot fail either to be taken down by the mandate of the courts or demolished by the winds."

PROFESSOR MORTON ON THE ELECTRIC LIGHT.

In a lecture before a meeting of the American Gas Light Association, at Stevens Institute, Hoboken, October 17, Professor Morton reviewed the progress made in producing light by electricity, and discussed at some length the question of competition between electricity and gas. In tracing the history of the electric light he said that it is, as applied to practical purposes, essentially a phenomenon of magneto-electricity, or the mechanical production of electricity, because electricity produced by the battery is only used as a matter of scientific interest. In this sense the possibilities of the usefulness of the electric light originated with Faraday's discovery of magneto-electricity in 1831, as everybody knows. This was followed within a year or two by the invention and construction of magneto-electric machines by Saxton, Clark, and others, and these were developed in size and power by Holmes, and by the various inventors whose work is embodied in the machine known as that of the Alliance Company, in Paris, a machine capable of producing a very brilliant electric light, but very bulky and very expensive, requiring immense power to drive it. Its use was consequently limited to the Falmouth lighthouse, in England, and to some French lighthouses and works of construction like the Cherbourg docks.

The first decided improvement upon this machine was made by Siemens, who devised a peculiar form of armature. The next step forward was made by Mr. Wild, of England, who made the remarkable discovery that if a current from a small magneto-electrical machine was made to pass around the coils of a large magnet, the attractive power of that magnet would be immensely greater than the force of the magnets in a small machine. Thus by working a small machine, passing the currents through electro-magnets of a large one, and then taking from the armature of the large machine the current to be used, he obtained great electric power in a small compass. Almost at the same time Wheatstone and Siemens made similar improvements, and a machine, between them and Ladd, of London, received another development by having this curious combination introduced. A single set of electro-magnets were employed, with an armature between the poles wound with two coils, one coil being so connected as to pass the current through the electro-magnet itself, and the other supplying a current for exterior use. In this way the machine, as it were, excited itself, and then yielded a powerful current for exterior work.

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In all the machines used, up to this time, the armature had its magnetism reversed as it rotated, and this involved a great loss and waste of power. The French cabinetmaker, Gramme, conceived the idea of using a ring and rotating this ring between the poles of a magnet in such a way that there should be no reversal of poles, but merely the traveling of the poles around in the ring. This ring was surrounded with poles from which the induced current was taken. The idea here involved was so unpromising that several electricians wrote very decidedly concerning it, opposing and ridiculing it. Nevertheless it produced in practice a machine which possessed a remarkable merit in yielding a large quantity of electricity with a very small expenditure of power. In this country, Mr. Palmer, of Boston, Mr. Wallace, of Ansonia, Mr. Brush, of Cincinnati, Mr. Weston, of Newark, and Mr. Hockhausen, of New York, have all developed machines which involve some of the general principles contained in the earlier productions, and all of which are excellent in their way. By one or other of these machines we are now enabled to produce light by an expenditure of power so small as to render its production cheap; probably not far from a fair average is that of 1,000 candles per horse power. Consequently this light has opened to it a wide field of usefulness and practical application which did not exist when it was more expensive.

Touching the practical uses of the electric light, Professor Morton said that the illuminating of large workshops, of public buildings, places of amusement, gardens, and the like, is undoubtedly an accomplished fact, and this use of the electric light, we feel confident, will largely extend. But it has been suggested that more than this will soon be reached, and that the electric light will take the place of other sources of illumination, gas, for example, in private houses. It would be very foolish for any one to attempt to predict what may or may not be accomplished in the future, but in such a case as this we may at least look back at the past and see what has been the history of the same thing, and judge something of future probabilities from past experiences.

Thereupon the speaker described at length the unfulfilled promises of Mr. Jobart's method of dividing the electric light, which twenty years ago was thought to have solved the great problem of electric lighting. He would by no means have it inferred that better success could never be attained. On the contrary, there are several very promising directions for experiment, on one of which, no doubt, Mr. Edison is at present embarked; but the difference between a promising line of experiment and a successful result all the world's history teaches us is often a distance of many years, to say the least.

The method of producing light by heating a platinum wire by the electric current was then exhibited and explained, and its difficulties enlarged upon. Also the production of light in Geissler tubes, and by the extra current as employed by Professors Houston and Thomson, of Philadelphia, in which direction he thought something might be attained. Of the speedy substitution of the electric light for the gas light, Professor Morton was very skeptical; no such radical change as many expect need be expected this century.

An interesting feature of this lecture was the exhibition of an improved gas burner giving a light of 250 candles with the consumption of forty cubic feet of gas an hour.

THE ELECTRICAL DEPARTMENT IN THE MECHANICS' FAIR, BOSTON, MASS.

At the Mechanics' Fair held four years ago in Boston there were nine entries classed under the head of electrical inventions; to-day there are eighteen. This increase marks the great advance we are making in the application of electricity to the useful arts.

Even in the approach to the exhibition building, which is opposite the Boston and Providence depot, corner of Columbus avenue and Pleasant street, one face is illuminated at night by an electric light, which simulates the white gleam of moonlight, throwing dark shadows and enabling one to see to pick up a pin on the sidewalk with perfect ease.

The illumination of the main building by electricity is the most important feature of the exhibition. One side of the large hall is lighted by five lamps which are run by the Wallace Farmer machine, and the opposite side is lit by four lamps run by the Brush machine. The Wallace Farmer lights are provided with plate carbons two inches by five or six in area. The voltaic arc plays across the smaller side. From three to five lamps are run upon one circuit by the Wallace Farmer machine. If one light should happen to go out, the others in the circuit are not extinguished, for the plate carbons close together and the light is relit. These lights necessarily flicker to a certain extent; they are, however, steadier than would be imagined when the great play of the voltaic arcs in each lamp is considered. It has been demonstrated at the fair that five lights at least can be furnished on one circuit by the Wallace Farmer method. This in itself is a decided achievement.

The Brush lamp makes use of what may be called the pencil carbon points in contradistinction to the Wallace Farmer carbon plates. Each of the Brush machines furnishes four lights, which are fed by four different currents running on two conductors to each lamp. The Brush lights appear to be steadier than the Wallace Farmer lights, but not so powerful. The question of the amount of power used by both machines and the resistances of the circuits of both machines enter, however, in the question of the amount of current generated which produces the lights. The Brush lamp is c rtainly very steady in its action. The Wallace Farmer lamp and the Brush lamp do not differ in principle with the exception of the use of broad plates by the one and pencils by the other. The carbons of the Brush light are electroplated with copper, which, it is claimed, prevents the heating of the carbon below the point of burning and regulates the consumption at the points.

We have said that both lamps do not differ in principle. In the Brush lamp the upper carbon is lifted by the movable core of a straight electro-magnet; in the Wallace Farmer by the armature of a horseshoe magnet; and practically the same mechanical device is used in both lamps to prevent the upper carbon from falling when the circuit is made. In the Art Gallery the two rival lamps confront each other, and one can judge better there of the relative brilliancy of the two. The details of the pictures are clearly seen in the brilliant lights, which are softened by heavy ground glass or opal shades. Great interest is manifested in these lights, which seem to be the prominent ones before the American public.

No less than twenty different electrical lamps were exhibited this summer at the Paris Exhibition; and three hundred lamps were lit during the nights of the past summer in the French capital. The Jablochkoff candle has not made its way to this side of the water, and American makers of dynamo-electric machines are attacking the problem of electric lighting by means totally different from those used in France. While we use the continuous current machines the French makers are altering their machines into alternate current machines, so as to obviate the unequal wearing away of the positive and negative carbons. The Jablochkoff candle dispenses with a regulator and thus enables more than one light to be produced by the same alternating current. The American regulators exhibited at the Mechanics' Fair would not work with an alternating machine.

The subject of electric illumination is evidently in its in fancy; four years ago, however, the Mechanics' Fair could not have been so satisfactorily lighted as it is every night at the present time by the Brush machines and the Wallace Farmer machines.

The next important invention, and by some considered the most important, is the telephone. Both the Bell telephone and the telephones of the Western Union and Gold and Stock Company are placed on exhibition. The forms of the Bell telephone are well known; both the hand and the box instrument are at the fair, and are connected with the various telephone dispatch companies in and out of Boston, so that one can converse about the fair with one's distant friends. It appears from various trials that a message can be heard better from Cambridge than from a neighboring room in the exhibition building; there is a certain condition of outside resistance beyond the mere resistance of the circuit which seems to give the best effect. In the Gold and Stock Company exhibit can be seen and heard the various forms of Phelps' telephones and also Edison's carbon transmitter. The latter, in combination with a Bell or Phelps telephone, gives the best effect of any telephones or telephonic combinations. It is claimed that the New England Telephone Company (Bell's patent) have succeeded in improving their methods of communication in cities and towns. The same company also exhibit a new and very sensitive call. It is marvelous how quickly a new industry has sprung up with the introduction of the telephone! New forms of flexible telephone cords, provided with binding ends, which obviate the expensive terminals now in use, are exhibited by Mr. Hale, and are practical improvements. Redding & Co. also exhibit enamel covered wire for telephones and electro-magnets in general. Copper wire is coated with a very thin black insulating preparation which is said to stand heat and moisture remarkably well. More turns of this wire can thus be wound upon a given bobbin or magnet than of silk or cotton covered wire.

Edison's electric pen, which is well known to readers of this journal, has a liberal space devoted to it in the exhibition. Many specimens of its work are given, including some fine writing by Edison himself.

An apparatus for lighting street lamps and gas jets in fire engine houses is shown by Mr. Stevens; it seems to be a very practical device, and superior to that which has lately attracted much attention in London. Mr. Stevens makes use of the direct current to turn on the gas, and of the spark produced by the extra current to light it. Many forms of hotel electric annunciators and burglar alarms are exhibited. The exhibition building is protected from fire by the automatic electric fire signal company. The principle of their device consists in the use of a small coil which expands by heat and completes an electric circuit, which thereupon gives an alarm. If electricity could be used to heat the buildings, it could be said to afford in itself both the means of preservation and destruction of the fair.

THE FRENCH INDUSTRIAL EXHIBITION OF 1878.

While the Philadelphia Exhibition was still in progress in the summer of 1876, the French Legislature passed an act providing for the holding of an International Exhibition in Paris in 1878, to continue from May to October.

The preparation of the requisite buildings in the Champ de Mars and on the Trocadero was taken in hand energetically; and notwithstanding the ominous war cloud that seemed to be settling over all Europe, the work of making ready for the Exhibition was pushed forward with commendable dispatch.

A characteristic feature of the scheme was the appropriation of $300,000 for the payment of an International Jury, to consist of 650 members—350 French and 300 foreigners—aided by a Supplementary Jury of 350 members, 150 of whom were to be French.

It was not until the close of last year that the participation of the United States was insured by the passage of a bill appropriating $150,000 for that purpose. At that late date nearly all the space had been allotted, there remaining for the United States only 400 x 100 feet. Fully five times this amount was immediately asked for by our would-be exhibitors, but the vast majority had to be refused.

The Exhibition was formally opened May 1, 1878, though, with the exception of England, few of the exhibits were well advanced toward readiness. Relatively the American space was about one sixth that of Great Britain, one half that taken by Belgium, two thirds that of Austria, a little less than half that of China and Japan, a little more than that of the Netherlands, and about the same as was severally occupied by Russia, Italy, and Switzerland. Germany did not compete.

In view of these facts, the correspondent of the *Tribune* complainingly remarked that he was almost tempted to say that we had better not have come at all than to have come with such a meager display, especially as we might have had as much space as Great Britain if we had asked for it in time.

Thanks, however, to our most efficient and honorable Commissioner in Chief, an admirable selection of exhibits was made; and, as the result shows, the United States partially, at least, made up in quality what we lacked in quantity. In one other respect the Paris Exhibition has been peculiarly gratifying to all Americans: not a question has been raised as to the capacity, energy, and integrity of our official representative.

No official report has reached us with regard to the aggregate attendance upon the Exhibition; we believe, however, that it has been equal to, if it did not exceed, the attendance upon the Centennial Exhibition of 1876.

AWARDS AND HONORS AT PARIS.

The last great official act in connection with the Exhibition of 1878 was the distribution of prizes and honors, which took place Oct. 21, in the Palais de l'Industrie, in the presence of an immense and brilliant audience.

The complete list of the prizes awarded to American exhibitors appears in the SCIENTIFIC SUPPLEMENT of this week; it is happily far too long for insertion here.

The following named Americans received decorations of the Legion of Honor:

Commissioner-General Richard C. McCormick, who is made Commander; Professor F. A. P. Barnard and William W. Story, who were made Officers. Auguste H. Girard, secretary to the Commissioner General; Henry Pettit, Engineer and Architect of the Commissioner-General's staff; Thomas R. Pickering, Superintendent of the Machinery Section; Lieutenant Benjamin H. Buckingham, U.S.N., Naval Attaché; John D. Philbrick, Superintendent of the Educational Section; D. Maitland Armstrong, Superintendent of the Fine Arts Section; Professor Andrew D. White, LL.D., juror; Professor William P. Blake, juror, and Professor Edward H. Knight, LL.D., juror, were made Chevaliers. Cyrus H. McCormick and Walter A. Wood, who were in 1867 made Chevaliers, have been raised to Officers.

Several exhibitors were made Chevaliers, namely:

Charles Tiffany, silverware; Thomas A. Edison, phonograph; Elisha Gray, telephone; James Brewster, carriages, and F. A. Bridgman, the artist.

It is worthy of note that the men thus selected by the French Government for special distinction are all honored at home as hard working, capable, and useful men—heads of colleges, mechanics, artisans, manufacturers, inventors, artists, scientists, and civil and mechanical engineers.

Though our action was long delayed - indeed, until most foreign competitors had their goods prepared or on the way to Paris—and our exhibitors were far too few in number to adequately represent American industry, yet it is gratifying to note that a larger proportion were prize winners than fell to the share of any other country.

WHO WILL INVENT A SATISFACTORY MILKING MACHINE?

Noting some recent experiments with milking machines, the *Western Rural* remarks that it is safe to say that the milking machines now before the world are not what is needed. They will milk, but not so well as can be done by hand; and failing to get all the milk they tend to dry up the cows. The problem is a difficult one, yet the demand is urgent and the profit assured for any one who will solve it successfully. The *Rural* says:

"No time need be spent in endeavoring to demonstrate the desirability or the necessity of such an invention. This, therefore, existing, we cannot secure the machine too soon. Any opposition to such a contrivance as is needed, which comes of prejudice, should be immediately overcome within ourselves and by ourselves, that no unnecessary impediment shall be placed in the way of success. No stubbornness or 'old fogyism' should prevent us from making a careful examination of existing machines, that their merits or defects may be fully demonstrated, and genius thus shown what has been done and what needs to be done. It would be well if our agricultural societies would hold out large inducements to inventors to enter this field, and it is certainly the duty of dairy associations to do it."

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