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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 688.

For the Week Ending March 9, 1889.

Price 10 cents. For sale by all newsdealers.

MEETING OF THE NATIONAL ELECTRIC LIGHTING ASSOCIATION.

Nearly 400 men connected with electrical lighting and kindred industries met recently in Chicago, at the convention of the National Electric Lighting Association, to listen to papers prepared by experts in their several fields, and to discuss the best means of advancing their work. Among the many interesting and timely subjects brought to the attention of this meeting, that of underground service was the most absorbing, because, just now, the most urgent. Long ago the law was invoked to force the wires underground, at least in the large cities, and now that means have been found which, by many informed persons, are thought to be adequate for its proper fulfillment, the public is grown impatient and will not brook further delay. A committee was appointed by the convention that met last August to inquire with careful particularity into, and report upon, the various systems of "underground conduits, with underground conductors and conduits now in operation, and the number of wires actually in use in these conduits." Letters asking for information were sent out to 1,066 local companies; 104 replying, though only seven were actual users. In only one of these cases, as reported by the committee, the user expressed satisfaction with the underground system for currents of high potential. Here are some of the objections taken from a mass of testimony: "The cause of failure has been mainly defective insulation. Even if this question of insulation should be settled, the cost will make it commercially impracticable." "I know of no system to-day which, at any expense, has proved satisfactory, except a system of subways built large enough for men to walk through their entire length." Here are two conflicting opinions; one user says: "Defective mechanical construction, defects in laying, defective conduits, injury to cables in laying, or defective joints have caused very little trouble, the main cause of trouble being defective insulation and deterioration, owing to the presence of gas, water, and steam." Another user says: "My objections to the underground system, as I have used it, are chiefly commercial, partly electrical, and partly mechanical." The seventh man tried, tested his cables under water, but says they did not work satisfactorily, lasting from three months to one and one-half years, the cause being, in his opinion, the effect of the water on the cables and the insulation of the wires.

In summing up, the committee say: "Only in one instance have the experiments or practical workings proved satisfactory, the only other case that was not reported adversely being where the wires had been in operation only 40 days. The average voltage that we used on all the circuits tested was 1,893 volts, the current was 10 amperes, the average thickness of insulation over wires was $\frac{9}{32}$ of an inch, and the average length of cables tested in each case was about 4,600 feet." As to the conduits themselves, there seems to be a decided objection to the use of creosoted wood, most users preferring to bury their wires in the ground itself or in water, and in favor of single conductors. As to whether or no cables should be covered with lead, opinion is divided.

The scene that followed this finding of the committee was in some ways a remarkable one; there being those present who had operated underground conduits for some years, and found them altogether practicable and satisfactory. City Electrician John P. Barrett, of Chicago, said: "We have been using underground electric lighting service here for the last six years. The municipality of Chicago purposes to extend it indefinitely so far as the limits of Chicago are concerned. I was in hopes when I came here to receive some information from other committees. Now it is a singular thing to me to see in this convention men who are prepared to present conduits, prepared to guarantee to construct them and maintain them in any form that you require, and right alongside of them men prepared to furnish conductors that will carry anything you want—in face of that fact, I find it stated by this report that it is an impracticability. We think pretty well of it here, and we have got plenty of it in service. I would be glad to offer any assistance I can to demonstrate that fact."

A well known conduit man said: "I am another aggrieved party. I did not receive a circular. I have been in the electric light business underground for five or six years; operating a plant in Philadelphia during that entire time with perfect and uniform success. We have constructed a plant in New York for the same purpose at a very great expense. The reason they [the committee] say the conduits are not practicable is that they have not seen them. They would not look at them. They have been invited time and again to come and see the practical operation of the conduits, the conductors carrying a voltage which they say is impracticable. In 1883 we laid two miles of conduits in Philadelphia. At the time the state of the manufacture of the insulation was in somewhat primitive condition. To-day they have advanced so that they are willing to offer us wires with a guarantee of three or five years' duration of any insulation that we require. Even with that very weak insulation which we had in 1883, which was made of pure rubber—and they did not understand that a conductor lying in that soft rubber would naturally thin the lower portion out and crowd it up on the top—even with that, some of these conductors, in a year or eighteen months, were working straight along with a Hockhausen machine, and you all know what that machine is.

"It was openly charged, and not denied, though the other side was present, that this Philadelphia underground electrical lighting system was bought out at an enormous advance on its cost by those interested in the overhead system; and though it was working smoothly and paying handsomely, it was utilized for an incandescence circuit, the announcement being made public that arc lighting was not practicable underground."

The defense made by the committee, or rather that made by those of the convention believing in the justness of their finding, was very strong. It having been long since conceded that arc light circuits of 1,000 volts and less may readily be operated underground, the committee had bent their efforts toward learning of successful systems using higher voltage, for by far the major and most important part of the arc light business has this characteristic, and so a committee thus appointed would scarcely have warrant to recommend as already practicable what really was suited to the purposes only of the few—at least as yet.

In the discussion that followed, some very important evidence in surrebuttal was brought out. Here are the vital points of it: The use of high tension currents underground (1,000 volts and over) has up to the present time proved unsatisfactory and impracticable, if not from a scientific standpoint, at least from an economical one; the only circuit of such character now and for some time in successful use being that in Chicago, with a record, so far, of only one year; its projectors having a preponderating advantage over all private companies or individuals in the fact that the municipality of Chicago pays the bills. The following dialogue between two well-informed men on their respective sides, the one interested in conduits and cables, the other a purveyor of light, will serve to give a fair idea of the gist of this matter as represented to the convention:

Mr. Johnstone: . . . "Mr. Cooper's prophecy that Prof. Barrett's expenditure for arc light underground circuits in Chicago will be useless. Pray, how is it that he knows this? He has had no experience with underground circuits."

Mr. Cooper: "Past experience. Mr. President, I should like to ask Mr. Johnstone one question. Can you tell me of any underground wire, either the Johnstone system or any other system, using an arc light circuit of 2,000 or 2,200 volts, that has been in successful operation, not three years, but three months?"

Mr. Johnstone: "The Harlem River Electric Light Company, of New York——"

Mr. Cooper: "I ask you if you have got any such thing in operation?"

Mr. Johnstone: "Not now. We are putting up in 51st Street, New York, something that will show and develop this thing in one month, so that there will be no further questions about it."

Mr. Cooper: "We will wait until the end of the month."

As a result of the discussion, the report was recommitted to the committee, which after being re-enforced was instructed to continue its investigations.

Disruptive Discharges in Lead Cables.—Under this head, C. H. Rudd described some experiments he has been making in the line suggested, at the last meeting of the Association, by A. G. Acheson—experiments which by no means support the theories entertained by that industrious investigator. Mr. Rudd says that the static charge in an ordinary cable is a negligible quantity when compared with the regular current flowing, and the E. M. F. of said charge cannot be greater than the E. M. F. of the current from which it was derived. Hence, in considering the character and thickness of insulation, we have nothing to take account of but the primary pressure which bears upon insulation. Mr. Acheson's second conclusion, viz., that a static charge will not pass an arc, virtually declares an arc circuit to exist as a number of sections in a sense insulated from each other, and in that connection the statement is made that each separate section comes under separate strain every time that the circuit is shut down. We may hold our own ideas concerning the E. M. F. of a static charge, therefore we need not fear that an imprisoned charge would do any more harm than the current did from which it came. If we charge an ordinary condenser from a battery, and the condenser does not break down, we do not fear that it will break down when we disconnect the battery. There is in the minds of some people an idea that static electricity when it begins to move produces a current possessing different properties from currents formed by other electricity under the same conditions. If disruptive discharges occur in properly insulated cables, we must look for the cause in those sources of high pressure which exist in nature. I do not believe that burn-outs can be ascribed to any one

cause, but that each individual case has its own individual cause.

In practice, we must provide insulation strong enough to meet the daily strain and suitable devices to prevent the accumulation of charge from outside sources of greater pressure than the insulation will bear. As yet we have no proof that high pressure protectors are required anywhere outside of the station from which the wires start. Mr. Acheson says that the greater number of grounds or burn-outs occurring in arc light circuits are at the terminals of the lead, or at the joints, and says that such a state of things would be naturally caused by the greater density of the static charges at these points. Mr. Rudd thinks this to be a singular carrying over of ideas obtained in laboratory work with purely static electricity, and arbitrarily applying them to entirely different conditions. The natural static charge in a cable, due to the distribution of the working E. M. F. of the current in the cable, must necessarily be produced in its distribution by the force from which it originated. The shape of the conductor cannot act in the matter of this kind of static distribution as the shape of an insulated conductor would act upon a purely static charge. As regards burn-outs that occur at terminals and joints, great care is required to make these points equal to the rest of the cable in matters of insulation.

Fuel oil, a subject just now attracting a very general attention among electrical lighting men, was discussed at great length. Three papers were read, the writers describing their experiences as actual users, and presenting many facts showing the advantages of the system, which they had gathered during the course of their studies.

S. S. Leonard told of an unfortunate experience his company had had while trying to use oil fuel without altering the furnaces that had been used by his company for coal fuel. They covered the grate bars with fire brick, so the heat would not injure them, put in the burner, and turned on the oil. As a result, the oil was not all burned, and ran down into the ash pits, where it gave no end of trouble. Now, with proper furnaces, they are finding oil fuel offers great advantages. They have been using it now eighteen months. During the first part of the night seven boilers are in use, the engines being 1,100 H. P. The steam pressure is easily maintained at any desired point. He finds that one man can attend to from seven to ten 150 H. P. boilers. One fireman at night and one during the day they have now, against three by night and three or four by day as formerly. As to whether or no oil is cheaper than coal, it depends on the relative difference in cost of the two, and hence to the locality. In Minneapolis, where his plant is, Illinois lump coal costs from $3.25 to $3.60 per ton, while Eastern coals are worth from $4.50 to $5.50 per ton (bituminous). The oil costs at present 2½ cents a gallon, delivered.

In comparing tests with oil and coal, he finds that 2½ barrels, or 104 gallons, costing $2.60, will evaporate as much water as one ton of coal, costing $3.15, a saving of about 21 per cent in favor of oil. With one pound of coal he evaporated 5·38 lb. of water. One ton of coal would, therefore, evaporate 10,760 lb. water. With oil, 14·8 lb. of water were evaporated per pound of oil. Oil weighs about 7 lb. to the gallon. One gallon oil would, therefore, evaporate 103·6 lb. water. With oil at 2½ cents a gallon, it would take 126 gallons to cost the same as one ton of coal, viz., $3 15; 126 gallons oil would evaporate 13,053 lb. water, while one ton of coal evaporates 10,760 lb. water, being a difference of 2,293 lb. in favor of the oil, or a saving of 21 per cent. He believes that he is saving at least 15 per cent, and perhaps 20 in fuel alone.

M. J. Francisco said one pound of coal contains 12,000 heat units, while 1 lb. of petroleum furnishes 20,000. Engineers of experience, familiar with the practical workings of coal, know that under the most favorable conditions not more than 10 lb. water can be vaporized per pound of coal, while petroleum shows a vaporization of 18 lb. water for every pound of oil consumed, estimating in both experiments the feed water at 212° F. The heat in coal transferable to water is about 70 per cent, while the heat in petroleum transferable to water is about 80 per cent. Therefore with coal 70 per cent of 12,000 units gives 8,400, and for petroleum 80 per cent of 20,000 is 16,000—a gain of 7,600 heat units in each pound.

This is on the basis of pure coal, but when we consider the waste, amounting in some cases to 25 per cent—and the master mechanic of one of the largest railroads in the country claims 55 per cent found in nearly all coal—such as sulphur, slate, and earthy substances, which, being incombustible, retard instead of generating heat, the difference in the per cent obtained in actual practice is far greater than shown by the above comparison. On this basis the only question to be considered is the cost of power furnished by each at the dynamo. Three and one-half barrels or 955 lb. of oil equal 2,240 lb. of pure coal, therefore, with oil at $1 per barrel and coal $3.50 per ton, or oil at $1.50 per barrel and coal $4.50, the difference in cost would not be marked if there were no other factor to be considered. When, however, we calculate the great saving in stoking, removing cinders and ashes, cleaning flues and benefit to boiler, besides securing a steady heat, combined with quickness and ease in starting and shutting down, we have an argument in favor of oil that stockholders that care for dividends can appreciate. Oil can be delivered at Rutland, Vt., for $1.50 per barrel, while soft coal costs $4.40, and hard $6 per ton. On this basis, allowing five pounds of coal per hour, twelve hours per day, 1,000 H. P. requiring 803 tons per month, at $4.50 would cost $3,613.50; two firemen to feed same, $100; man cleaning flues, etc., $45; carting ashes and cinders, $100; making total cost for thirty days, $3,858.50 with coal. Same number H. P. and same length of time, allowing three and one-half barrels for each ton of coal, would require 2,810 barrels of oil at $1.05 = $2,950.50. Wages of one man in boiler room, $50; making total of cost of 1,000 H. P. one month, with oil, $3,000.50, showing a saving of $858 per month, besides the advantages, where oil is used, of steady flow of steam and regularity of speed.

Mr. Francisco has gathered these facts: The Boston and Albany Railroad Company, after a careful test, made in their shops by a Lehigh University professor, say that the cost of fuel is about the same; though they buy their coal in large quantities at one time, and secure low rates, they prefer liquid fuel, because it is clean and requires no fireman, and gives a better supply of steam.

Day, Cordage & Co., of Boston, claim that, with Cumberland coal at $4.50 per ton and liquid fuel at $1.15 per barrel, they save fifteen cents per 100 H. P. per hour, and the oil is preferable.

The Fairbanks Scale Co., of Vermont, report that they find it a great saving over coal, while the boilers are heated evenly the entire length. The manager of the Toledo, Columbus, and Southern Railway reports a saving of 33 per cent of the price of coal by using liquid fuel, and that two barrels of oil equal one ton of soft coal, while manufacturers on his road find it only costs one-half as much as coal for their stationary boilers. The rolling mill works of Chicago use it under a battery of fourteen boilers, and say that 3 6/10 barrels oil does the work of one ton of coal. Formerly, when using coal, twenty-five men were needed to work this battery of boilers for twenty-four hours; now, with liquid fuel, four men do the work, the efficiency of the boilers is increased, cost of repairs lessened, and the flame less severe on boilers.

A paper on municipal lighting was read by F. H. Whipple, and on municipal ownership of commercial monopolies, by A. R. Foote.

POSITION OF THE PLANETS IN MARCH.

VENUS

is evening star. Her period of greatest brilliancy occurs on the 25th, when, as well as during this whole month, she shines like a young moon, casts a shadow, and is visible at noonday in the presence of the sun himself. After that time her light grows dim, as she rapidly approaches the sun and draws near the close of her career as evening star. Her movement northward will increase the length of her stay above the horizon, and place her under most favorable conditions for observation. Venus sets on the 1st at 9 h. 42 m. P. M. On the 31st she sets at 9 h. 38 m P. M. Her diameter on the 1st is 27″.8, and she is in the constellation Pisces.

SATURN

is evening star. He is easily found in the northeast, as soon as the stars come out, from his vicinity to Regulus. A quadrilateral may be traced, formed by Saturn, Regulus, and two other stars belonging to the Sickle, Gamma and Epsilon Leonis. Saturn sets on the 1st at 5 h. 30 m. A. M. On the 31st he sets at 3 h. 28 m. A. M. His diameter on the 1st is 19″, and he is in the constellation Leo.

JUPITER

is morning star. He is fair to behold as he looms above the southeastern horizon on the 1st, more than three hours before sunrise. He is in quadrature with the sun on the 27th, and is then 90° west of the sun. Jupiter rises on the 1st at 2 h. 59 m. On the 31st he rises at 1 h. 15 m. A. M. His diameter is 33″.6, and he is in the constellation Sagittarius.

URANUS

is morning star. He is now near enough to the earth to be visible to the naked eye, and, rising on the 1st about 9 h. P. M., may be found about 2° north of Spica, as a small star of the sixth magnitude. Uranus rises on the 1st at 9 h. 3 m. P. M. On the 31st he rises at 7 h. P. M. His diameter is 3″.8, and he is in the constellation Virgo.

MERCURY

is morning star. He reaches his greatest western elongation on the 13th, and is then visible in the east as morning star before sunrise. He is, however, too far south of the sun to be seen under favorable conditions. Mercury rises on the 1st at 5 h. 25 m. A. M. On the 31st he rises at 5 h. 7 m. A. M. His diameter is 8″.6, and he is in the constellation Aquarius.

MARS

is evening star. Our interesting neighbor increases his distance from the earth, but is still visible as a ruddy star, setting on the 1st about two hours after the sun. Mars sets on the 1st at 8 h. 4 m. P. M. On the 31st he sets at 8 h. P. M. His diameter is 4″.6, and he is in the constellation Pisces.

NEPTUNE

is evening star. He sets on the 1st at 0 h. 15 m. A. M. On the 31st he sets at 10 h. 20 m. P. M. His diameter is 2″.6, and he is in the constellation Taurus.

Saturn, Neptune, Venus, and Mars are evening stars at the close of the month. Uranus, Jupiter, and Mercury are morning stars.

PROPOSED VISIT OF THE AMERICAN ENGINEERING SOCIETIES TO EUROPE.

The American Society of Civil Engineers, with the Society of Mechanical Engineers and the Institute of Mining Engineers, are organizing a trip to Europe to visit the Paris exposition and such other objects of interest as may prove practicable. The proposed excursion has attained already such dimensions, as indicated by the responses of members, that it is believed that two steamers will be required to accommodate the travelers. The civil engineers alone will fill one vessel. It is proposed, therefore, to charter one or two vessels of the Inman line, and perhaps to reserve all the first cabin accommodations on the Egypt or Spain of the National line. The maximum fare for the ocean voyage and return will be $110. The magnitude of the delegation indicates well the immense growth of the engineering profession in the United States, and it is gratifying to feel that America is to be so well represented at the exposition. Her position at all previous exhibitions, from the standpoint of inventiveness and ingenuity displayed by the exhibits, has been very high, and will be so in 1889. The engineering societies will give a personal aspect of American professional life that we are confident will make itself felt in scientific circles there.

Burglarizing Bank Safes.

A startling article appeared in the daily papers last week, giving an account of what purported to be the blowing open of one of Marvin's bank safes by two "reformed burglars" (?) connected with the Star Theater company.

We thought the statements were worth investigating for our readers and the many bankers and business men using safes, not only in this city, but throughout the country; for if safes can be broken open in a few moments, it is time users of them knew it. We are glad to say that after fully investigating the facts, we find the whole matter was merely an advertising scheme to puff a cheap play at the expense of a reputable business. The real truth of the matter is that these people bought a little second-hand safe for about twenty dollars of some dealer, to exhibit it in their show and make a pretense of blowing it open during the progress of the play. It is an outrage that such a misstatement should have appeared in the daily papers as would tend to create a feeling of distrust in bank safes.

The Marvin Safe Company has been manufacturing safes for half a century, and no name in the trade stands higher than theirs, and they now have under way for various banks safes that look as though it would take a month to force open.—*The Financier.*

More Industrial Schools.

Mr. Jacob Tome, a wealthy banker of Port Deposit, Md., who some time ago set aside a half million dollars to found a practical training school in the mechanic arts and trades, to be located at Port Deposit, Md., has now increased the gift to two and a half million dollars. With this liberal endowment, and the carrying out of Mr. Tome's wishes, who has himself risen from the ranks of labor and fully understands the difficulties now besetting the youth of our country in obtaining a practical knowledge of the mechanic arts, this school is designed to be one of the most complete and extensive in all branches of trade practice of any similar institution in the world. The scheme of free trade teaching inaugurated by Peter Cooper has at last taken a deep root in the minds of able men, followed by the success of the New York Trade Schools and the Pratt Institute in Brooklyn, N. Y.

The munificent gifts of Mr. Williamson, of Philadelphia, and Mr. Tome, of Port Deposit, Md., are destined to bring out the latent genius and energy of our youth in a practical apprenticeship, free from the depressing influence and obstruction now thrown in the way of the apprentice by the discouraging influence attempted and partially enforced through the perverted dogmas and actions of labor organizations.

THE direct use of electricity as a labor-saving machine has been applied at the great steel works, Cleveland, Ohio, where a large electro-magnet is used, suspended from a crane, to pick up steel bars and billets. It will pick up 800 lb. billets and drop them where wanted by the touch of a key, the movement of the crane being done by steam.