

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 3½ 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 9 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.