North Staffordshire, where a large area of coal and blackband ironstone is being opened up, under the auspices of his Grace the Duke of Sutherland, by our member, Mr. Homer.

Dr. Siemens then spoke of Anthracite and the large extent to which it was used in America, of Lignite and Peat, which may be looked on as coal in formation. After referring to natural gaseous fuel he went on to say :—

Although the use of natural gas is not likely to assume very large proportions owing to its rare occurrence, its application at Pittsburg has forcibly reminded me of a project I had occasion to put forward a good many years ago, namely to erect gas producers at the bottom of coal mines, and by the conversion of sclid into gaseous fuel, to save entirely the labour of raising and carrying the latter to its destination. The gaseous fuel, in ascending from the bottom of the mine to the bank, would acquire in its ascent (owing to its temperature and low specific gravity), an onward pressure sufficient to propel it through pipes or culverts to a considerable distance, and it would be possible in this way to supply townships with heating gas, not only for use in factories, but, to a great extent, for domestic purposes also. In 1869, a company, in which I took a leading interest, was formed at Birmingham, under the sanction of the Town Council, to supply the town of Birmingham with heating gas at the rate of 6*d*. per 1,000 cubic feet, but their object was defeated by the existing gas companies, who opposed their bill in Parliament upon the ground that it would interfere with vested interests. I am still satisfied, however, that such a plan could be carried out with great advantage to the public ; and although I am no longer specifically interested in the matter, I would gladly lend my aid to those who might be willing to realise the same.

With reference to water power, Dr. Siemens said :—The advantage of utilising water power applies chiefly to continental countries, with large elevated plateaus, such as Sweden and the United States of North America, and it is interesting to contemplate the magnitude of power which is now for the most part lost, but which may be, sooner or later, called into requisition.

Take the Falls of Niagara as a familiar example. The amount of water passing over this fall has been estimated at 100 millions of tons per hour, and its perpendicular descent may be taken at 150 feet, without counting the rapids, which represent a further fall of 150 feet, making a total of 300 feet between lake and lake. But the force represented by the principal fall alone amounts to 16,800,000 horse-power, an amount which, if it had to be produced by steam, would necessitate an expenditure of not less than 266,000,000 tons of coal per annum, taking the consumption of coal at 4 lbs. per horse-power per hour. In other words, all the coal raised throughout the world would barely suffice to produce the amount of power that continually runs to waste at this one great fall. It would not be difficult, indeed, to realise a large proportion of the power so wasted, by means of turbines and water-wheels erected on the shores of the deep river below the falls, supplying them from canals cut along the edges. But it would be impossible to utilise the power on the spot, the district being devoid of mineral wealth, or other natural inducements for the establishment of factories. In order practically to render available the force of falling water at this and the thousands of other places under analogous conditions, we must devise a practicable means of carrying the power to a distance. Sir William Armstrong has taught us how to carry and utilise water power at a distance, if conveyed through high-pressure mains, and at Schaffhausen, in Switzerland, as well as at some other places on the Continent, it is conveyed by means of quick-working steel ropes passing over large pulleys. By these means, power may be carried to a distance of one or two miles without difficulty. Time will probably reveal to us effectual means of carrying power to great distances, but I cannot refrain from alluding to one which is, in my opinion, worthy of consideration, namely, the electrical conductor. Suppose water power to be employed to give motion to a dynamo-electrical machine—a very powerful electrical current is the result. This may be carried to a great distance, through a large metallic conductor, and there be made to impart motion to electro-magnetic engines to ignite the carbon points of electric lamps, or to effect the separation of metals from their combinations. A copper rod of 3 in. in diameter would be capable of transmitting 1,000 horse-power a distance of say 30 miles, an amount sufficient to supply one quarter of a million candle power which would suffice to illuminate a moderately sized town.

The use of electrical power has sometimes been suggested as a substitute for steam power, but it should be borne in mind that so long as the electric power depends upon a galvanic battery, it must be much more costly than steam power, inasmuch as the combustible consumed in the battery is zinc, a substance necessarily much more expensive than coal ; but this question assumes a totally different aspect if in the production of the electric current a natural force is used which could not otherwise be rendered available.

Dr. Siemens then went on to speak of the processes of manufacture, sketching briefly the history of the improvements in these processes, and concluded by referring to the various applications of steel. Speaking of the means of preserving iron and steel from rust, he referred to Prof. Barff's recently discovered process. This consists in exposing the metallic surfaces, while heated to redness, to the action of superheated steam, thus producing upon their surface the magnetic oxide of iron, which, unlike common rust, possesses the characteristic of permanency, and adheres closely to the metallic surface below. In this respect it is analogous to zinc oxide adhering to and protecting metallic zinc, with this further advantage in its favour, that the magnetic oxide is practically insoluble in sea water and other weak saline solutions.

Dr. Siemens concluded his valuable address by urging upon the Institute, now that it has attained to such importance, to obtain recognition in official quarters and to become possessed of a habitation in a central position, and in such a building as would serve the societies devoted to applied science in the same way that Burlington House does those devoted to pure science.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, March 8.—Mr. C. W. Merrifield, F.R.S., vice-president, in the chair.—The following communications were made :—On a new view of the Pascal hexagram, by Mr. T. Cotterill. In a system of co-planar points, the number of intersections of two chords is a multiple of 3. In the case of the hexagram the forty-five points thus derived are divided into four sets of triangles—(1) The three intersections of the chords joining four points form a triad self-conjugate to the conics through the four points. (2) Any three non-conterminous chords intersect in three points, forming a diagonal triangle. In each of these two cases, a derived point determines uniquely its corresponding triad, the number of triads being fifteen. (3) An inscribed triangle determines an opposite inscribed triangle ; the three intersections of the pairs of sides supposed to correspond form a triangle, the intersections of two inscribed triangles, the nine intersections of the two triangles forming an ennead. (4) The three intersections of the opposite sides of a hexagon of the system form a Pascal triangle. The number of triangles in each of the two last cases is sixty ; to each triangle of one set corresponding a triangle of the other, as well as a triad of the second set, the nine points forming three triads of the first set. Denoting, then, the primitive points by italics and fifteen of the derived points (no two of which are conjugate) by Greek letters, we obtain all the derived points by accenting once and twice the Greek letters to form self-conjugate triads. Tables are then formed in matrices of the nine chords joining the vertices of two opposite triangles and their eighteen intersections, found to consist of six triangles of each of the second and fourth sets. To these corresponds a matrix containing the nine intersections of the two triangles. In the case of a conic hexagram, the properties of the sixty points of intersection of chords with the tangents at the conic points are then examined.—On a class of integers expressible as the sum of two integral squares, by Mr. T. Muir. [The class of integers considered included those whose square root, when expressed as a continued fraction, has two middle terms in the cycle of partial denominators. A general expression was given for all such integers, and an equivalent expression in the form of the sum of two squares.]—Some properties of the double-theta functions, by Prof. Cayley, F.R.S. (founded on papers by Goepel and Rosenhain).—A property of an envelope, by Mr. J. J. Walker.

Chemical Society, March 15.—Prof. Abel, F.R.S., president, in the chair.—The secretary read a paper by Dr. W. A. Tilden and Mr. W. A. Shenstone, on isomeric nitroso terpenes, being a further contribution to Dr. Tilden's previous researches on these compounds. This was followed by a communication entitled "Preparation of Copper-zinc Couples," by Dr. J. H. Gladstone, and Mr. A. Tribe, which was experimentally illustrated; it gave the details of the experiments made to ascertain the conditions for the preparation of a couple of maximum activity. The other papers were on chromium pig-iron, by Mr. E. Riley; a note on gardenin, by Dr. J. Stenhouse and Mr. C. E. Groves; two papers by Mr. M. M. P. Muir entitled "Additional Note on a process for estimating Bismuth volumetrically," and "On certain Bismuth Compounds," Part IV.; and a note by Dr. M. Simpson and Mr. C. O. Keeffe, on the determination of urea by means of hypobromite.

Victoria (Philosophical) Institute, February 5.—Dr. C. Brooke, F.R.S., in the chair.—A paper was read by Prof. Birks, of Cambridge, on "The Bible and Modern Astronomy."

Geneva

Physical and Natural History Society, January 18.—M. Ernest Favre read a paper on the question of the origin of the gravels which are found in the portion of the Alps under the glacial soil, and which are known as the old alluvium. This is formed in the vicinity of the ancient glaciers, as is proved by the following facts: (1) The presence of glacial soil in two localities in the neighbourhood of Geneva, in the very interior of the alluvium, at several metres under the great glacial sheet; (2) the very different heights at which the alluvium is deposited in the interior of the same basin; (3) the fact that it is formed of the same elements, large pebbles and fossil sand at whatever distance it is observed from the foot of the Alps; the disappearance of these depôts begins the limit of the ancient glaciers.—M. Philippe Plantamour has undertaken observations on the variations of the level of the Lake of Geneva, similar to those of Prof. F. A. Forel at Morges. They confirm the theory of the perpetual oscillation to which the surface of the water is subject, as shown by Dr. Forel, and which lasts about an hour and a quarter in the longitudinal direction. The variations of level, or *seiches*, are much greater in the neigbourhood of Geneva, at the western extremity of the lake than at Morges, a little beyond the middle of its length towards the east, and they are in the opposite direction. A registering limnimetre, which is to be erected by M. Th. Plantamour, will permit of following with a new facility the phases of the phenomenon, and of comparing them with those which occur at Morges.

Paris

Academy of Sciences, March 12.—M. Peligot in the chair.—The following papers were read:—Theorems relative to series of isoperimetric triangles which have one side of constant size, and satisfy three other diverse conditions, by M. Chasles.—Influence of pressure on chemical phenomena, by M. Berthelot. He cites an experiment of Quincke's showing that the liberation of hydrogen from zinc and sulphuric acid is not stopped by pressure of the gas, but only retarded. It goes on so long as there is acid to saturate or zinc to dissolve.—On a metallic iron found at Santa Catarina (Brazil), by M. Damour. This is supposed of meteoric origin. The small quantities of carbon (0·0020) and silicium (0·0001) in it are like those of the best qualities of iron obtained in industry, while the proportion of nickel (0·3397) considerably exceeds that of meteoric irons hitherto known. To this latter is doubtless due its resistance to oxidation in moist air and to the action of dilute sulphuric and hydrochloric acids. M. Boussingault stated he had had cast in his laboratory 62 per cent. steel and 38 nickel. A polished face of the alloy did not rust in contact with air and water. Of the filings two or three grains took rust, merely showing the alloy was not entirely homogeneous. Alloys with 5, 10, or 15 per cent. nickel oxidised rapidly.—Observations on the native iron of Santa Catarina and on the pyrrhotine and magnetite associated with it, by M. Daubrée. The masses, when at a high temperature, seem to have been subjected to oxidising action of air or water, which action penetrated into the interior by very fine fissures.—On the maintenance of constant temperatures; second note by M. D'Arsonval. He heats the apparatus by means of a thermo-siphon, and the *rôle* of the regulator is to proportion the activity of the circulation to the causes of loss. Thus the fire may be of any strength; it gives its heat to a liquid which distributes it as the regulator allows.—On the annual aberration and annual parallax of stars, by M. Kericuff. He corrects some mistakes in the formulæ made for these.—Applications of a theorem comprising the two principles of the mechanical theory of heat, by M. Levy.—On the periodicity of solar spots, by M. Wolf. In a *brochure* he gives not only all the epochs of maxima and minima since the discovery of the spots, but, for a century and a quarter, by means of a relative number, the monthly energy of the phenomenon. He shows by curves the average course of the phenomena and anomalies; also the indices of a great period embracing sixteen small periods of eleven and a half years, or nearly 168 years.—Measurements of the calorific intensity of the solar radiations received at the surface of the ground, by M. Crova. He calculates that on January 4, 1876, the heat received on a square centimetre at right angles to the direction of the sun's rays from sunrise to sunset, would be 535·0 cal., that on the surface of the ground 161·2 cal.; for July 11, 1876, the corresponding numbers are 876·4 cal. and 574·1 cal. The heat received at right angles on January 4 is 0·610 of that on July 11; the heat received on the surface of the ground on January 4 is 0·281 of that on July 11.—Metals which accompany iron, by M. Terreil. Their proportions are small, they rarely amount to five thousandths; whereas, in native or meteoric iron, they may be ten per cent. They are chiefly manganese, nickel, cobalt, and chromium; while copper, vanadium, titanium and tungsten occur accidentally.—Chemical study of mistletoe, (*Viscum album*, L), by MM. Grandeau and Bouton. *Inter alia*, the composition of the stem is very near that of the leaves, and the composition of the mistletoes of different species is widely different. As to nutritive value, the mistletoe of the oak takes rank with meadow grass of good quality or red clover, the leaves of the mistletoe of the cornelian and pear trees have equal value with good hay or aftermath; while their branches may be compared to the straw of leguminous plants, or the husks of cereals.—On the electrotonic state in the case of unipolar excitation of the nerves, by MM. Morat and Toussaint. When the positive pole is applied to the nerve, the current is divergent, from the middle of the nerve it goes towards the two extremities; it is thus in the two ends contrary to the proper current of the nerve; hence the negative phase of the electrotonic state. If the negative pole is applied, the battery current converges towards the middle, and is in the same direction with the proper current, which it increases (positive phase of the electrotonic state).—Acute poisoning by acetate of copper, by MM. Feltz and Ritter. It is more active than sulphate. The disorders are more intense and long in fasting animals. One could not swallow the substance in food or drink without perceiving the taste.—On the value of certain arguments of transformism, taken from the evolution of the dental follicles in ruminants, by M. Pietkiewicz. In these animals there is nothing at all like germs of canines and incisors, as Goodsir affirmed.—On the unity of the forces in geology, by M. Hermite.—On the crevasses of the cretaceous system, by M. Robert.

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