A. Helland adduces a large amount of evidence to show that the fjords in Norway have been formed by glacial action.—H. C. Vogel describes some careful experiments on the spectrum of aurora, which he compared with the spectra of various gases in Geissler tubes. He regards it as a modification of the air spectrum; one line of the former, at least, corresponding with the maximum brightness of the latter, while the remaining lines probably appear in the spectra of atmospheric gases under certain conditions of temperature and pressure.—A new mode of measuring rate of rotation is proposed by A. Schuller. The principle is briefly this: A disc divided into three sectors (black, red, and green), rotates on a horizontal axis; a seconds pendulum fitted with a screen, in which is a vertical slit, oscillates at the back of it, and a ray of light passes through the slit and disc to a telescope through which the observer looks. The recurrence of particular colours observed gives a means of estimating the speed of rotation.—Among the remaining papers are one on a block of lava from the recent eruption of Vesuvius, one on compounds of thallium, and one on a new form of the Noë thermopile.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, Nov. 14.—Mr. W. Spottiswoode, F.R.S., President, in the chair.—The following gentlemen were elected as officers and members of council for the ensuing session:—President, Dr. Hirst, F.R.S.; Vice-Presidents, Prof. Crofton, Mr. S. Roberts, and Mr. Spottiswoode; Treasurer, Mr. S. Roberts; Secretaries, Mr. M. Jenkins, Mr. R. Tucker; other members, Prof Cayley, Prof. W. K. Clifford, Mr. T. Cotterill, Mr. J. W. L. Glaisher, Rev R. Harley, Prof. Henrici, Mr. C. W. Merrifield, Prof. H. J. S. Smith, Mr. J. Stirling, and Mr. J. J. Walker. Messrs. Glaisher and Harley were elected in the room of Dr. Sylvester and the Hon. J. W. Strutt. The new president having taken the chair, alluded in feeling terms to the loss the mathematical world and the Society had just experienced by the death of Dr. Clebsch, of Göttingen, who had been elected a foreign member in December last. Mr. Spottiswoode then read his paper, "Remarks on some recent Generalisations of Algebra." It gave an analysis of methods used by Prof. Peirce, of Harvard, in his "Linear Associative Algebra," and by Dr. Hermann Hankel in his "Vorlesungen über die complexen Zahlen und ihre functionen," Part i. Prof. Henrici exhibited a series of models of cubic surfaces, and pointed out the several singularities, and explained how the models were constructed. Prof. Clifford next read a paper "On a theorem relating to polyhedra analogous to Mr. Cotterill's theorem on plane polygons," and exhibited several illustrative models. The plane theorem is "for every plane polygon of n vertices there is a curve of class $n-3$ touching all the diagonals; the number of diagonals is such as to exactly determine this curve and no more; and when the curve touches the line at infinity the area of the polygon is zero." The analogous theorem in space should therefore apply in the first instance to those solids whose volume can be expressed as the sum of tetrahedra, having one vertex at an arbitrary point of space, and the other three at three vertices of the figure; that is to say, it should apply to solids having triangular faces. For such solids the author finds that the analogy is very complete and exact. Defining the plane which contains three vertices and which is not a face, as a diagonal plane and a line joining two vertices, but not being an edge as a diagonal line, he proves the following theorems:—"For every polyhedron of n summits having only triangular faces (Δ faced n-acron, Cayley) there is a surface of class $n-4$, touching all the diagonal planes. This surface contains all the diagonal lines. The diagonal planes and lines are so situated, however, that the conditions of touching the planes and containing the lines are precisely sufficient to determine a surface of class $n-4$. When this surface touches the plane at infinity, the volume of the solid is zero." Prof. Clifford then proceeded to apply these propositions to polyhedra having other than triangular faces.—A paper by the Hon. J. W. Strutt was, in his absence, taken as read. Its title was "Investigation of the disturbance produced by a spherical obstacle on the waves of sound." The problem to which chief attention is given in the paper is that of a rigid spherical obstacle, which is either fixed, or (more generally) so supported that, when disturbed from the position of equilibrium, it is urged back by a force proportional to the displacement. The mathematical solution is worked out without any limitation as to the size of the sphere; but in drawing conclusions from it, attention is confined for the most part to the case when the diameter of the sphere is small compared to the length of the sound waves. Mr. Strutt then considers the problem of a fluid spherical obstacle, working it out in full for a very small sphere; and afterwards he investigates anew the same problem by a very different analysis, not restricted to the case of a sphere or an abrupt variation of mechanical properties on the one hand, but on the other less general in requiring the variation and the region over which it occurs to be small. In conclusion he indicates the solution of the problem when the source of sound is at a finite distance from the obstacle, the primary waves being accordingly spherical instead of plane.—The following abstract of M. Hermite's paper "sur l'intégration des fonctions circulaires," was furnished by Prof. Cayley. M. Hermite's paper relates to the integral

$$\int f(\sin x, \cos x)\, dx$$

where f is any rational function of $\sin x$, $\cos x$. The substitution of $e^{xc}=z$, where $c=\sqrt{-1}$, converts this into an integral of the form $\int \frac{F_1(z)}{F(z)}dz$, where $\frac{F_1 z}{F z}$ is a rational function of z, viz. $F_1 z$ and Fz are each of them a rational and integral function of z. The last mentioned integral is treated by the ordinary method of the decomposition of rational fractions; and the gist of the paper is in the transformation of the resulting expressions back from the new variable z to the original variable x, so as to obtain the required integral $\int f(\sin x, \cos x)\, dx$, in terms of the circular functions of x. It is shown that the process leads to an equation of the form $\int (\sin x, \cos x) = \Pi x + \Phi x$, where Πx is a rational and integral function of z, $\sin x$, $\cos x$: and Φx is of the form

$$\phi x = C + a \cot\frac{x-\alpha}{2} + a_1\frac{d}{dx}\cot\frac{x-\alpha}{2} +, \text{ \&c.}$$
$$+ b \cot\frac{x-\beta}{2} + b_1\frac{d}{dx}\cot\frac{x-\beta}{2} +, \text{ \&c.}$$
$$+ \text{ \&c.}$$

each series, and also the number of the different series, being finite: so that the integration is made to depend upon the integrals

$$\int \Pi\, x dx \text{ and } \int \cot\frac{x-\alpha}{2}\, dx = 2 \log \sin\frac{x-a}{2}$$

The paper contains processes for the complete determination of the coefficients, C, a, a_1, &c. and other interesting matter.

Meteorological Society, Nov. 20.—Dr. Tripe, president, in the chair.—On the storms experienced by the Submarine Cable Expedition in the Persian Gulf on November 1 and 2, 1869, by Mr. Latimer Clark. The first storm occurred at 9 o'clock at night, when the vessels of the expedition were about 130 miles from Bushire, and burst upon them without any preliminary warning, lowering the temperature by nearly 30° in a few minutes. It was accompanied by heavy rain and much lightning and thunder, and progressed from N.W. to S.E. After the tempest had lasted for two hours the wind changed to a gale from S.E., and subsequently fell calm as before The next day the cable was spliced up, and paying out had scarcely re-commenced, with a strong south-east wind, when notice was received that another violent storm from the north-west had passed Bushire, and was on its way down the Gulf. At 3 o'clock black clouds were seen rising, and at 3.52 the storm burst forth with the same suddenness and fury that characterised the previous one. Being daylight many phenomena were observed which were missed the night before. As the clouds approached they gathered into a peculiar form, resembling the cap of a large mushroom, extending across the heavens from one horizon to the other. The lower edge had a rounded and wrinkled margin, but was very sharply defined; the surface was composed of innumerable similar strata, as if melted pitch had been poured out and allowed to solidify in numerous cakes, each rather smaller than the one below.* Suddenly there came a profound calm,

* This is the form of cloud mentioned by M. Poey in NATURE, Vol. iv. No. 103.

and a few hundred yards ahead the squall was seen approaching. The sea was elsewhere covered with full-sized waves, but under the influence of the hurricane it became one dead-level of creamy foam, the top of every wave being swept off into spray as soon as it arose. When the squall struck the vessels the thermometer fell at once from 81° to 53°; torrents of rain swept the decks, accompanied with continuous thunder and lightning. After two hours the wind changed into a gale from the south-east, followed by a calm. It was noticed that the barometer was unaffected till the last moment, but as soon as the storm arrived it rose two-tenths of an inch, and fell again as it passed over. The electrical instruments, although of the most sensitive character, were not at all affected during the storm. The other papers read were "On the Meteorology of Southland, New Zealand, in 1871," by Mr. C. R. Martin, and "On a Self-registering Tide-gauge and Electrical Barograph," by Mr. H. C. Russell, B.A., Government Astronomer, Sydney.

PARIS

Academy of Sciences, Nov. 18.—M. Faye, president, in the chair.—The meeting commenced with another instalment of the ferment controversy, M. Pasteur rising and objecting to M. Fremy's remarks as reported in the *Comptes Rendus* of the last meeting. M. Bouillaud followed, expressing his regrets that M. Pasteur's proposition with regard to the experiments had not been acceded to. M. A. Trécul then rose, and regretted that certain words which had appeared in the same number had not been uttered at the meeting. He then read a note criticising M. Pasteur's remarks at that meeting. The discussion then dropped, and M. Tresca read a note on the best form for the international standard meters. He proposes a section like the letters H or X. —M. Bouillaud then read a paper on the theory of the production of animal heat.—M. F. Perrier read a paper on the prolongation of the French meridian into the Sahara by means of the trigonometrical junction of Algiers with Spain.—The next paper was by M. Jeannel on the natural production of nitrates and nitrites. Among other conclusions the author arrives at this, that "calcareous humus" in drying determines the combination of the elements of the air.—M. Max Marie presented the concluding paper of his series on the elementary theory of integrals of any order and their periods, after which followed a paper on a new method of analysis founded on the use of imaginary co-ordinates, by M. F. Lucas.—M. C. Dareste presented his fifth paper on the osteological types of osseous fishes.—"Studies on the ventilation of transports" was a paper by. M. E. Bertin, giving the results of some experiments on ventilation made on board the *Calvados* and *Garonne*, transports. The apparatus used, worked by the waste heat of the furnaces, evacuated 35,000 cubic metres of air per hour from the lower decks.—Notes on the *Phylloxera* were received from M. Saint-Pierre and M. Loarer. The former has found the insects on the wild vines of Vaucluse known as *lambrusques*, and hence considers that the general opinion that this disease is the result of cultivation is erroneous. Both letters were sent to the *Phylloxera* Commission, and notes from M. F. Barilla on a remedy for cholera, and M. G. Fabretti on the transmission of infectious miasmata were sent to that appointed to administer the Bréant legacy.—A note from M. Curral on the realisation of perpetual motion in the planetary system was submitted to the examination of M. Phillips, while a note from M. Andru on the quadrature of the circle was, in accordance with a very old rule of the Academy, considered as not received.—M. Serret then presented a note on the planetoid 116 Sirona, by M. F. Tisserand.—M. J. Bourget's Memoir on the Mathematical Theory of Kundt's acoustic experiments followed, after which came a note on "Magnetic Energy" by M. A. Cazin.—M. E. Becquerel next presented a note on the multiplicity of images, and the theory of accommodation, a paper on optical physiology, by M. F. P. Le Roux.—M. Sainte-Claire Deville then communicated an account of M. Cailletet's researches on liquid carbonic anhydride and M. F. Pisani's description and analyses of a new silver amalgam from Konsberg in Norway.—M. Becquerel presented M. Aug Guerout's researches on the action of sulphurous anhydride on recently precipitated insoluble sulphides. The author finds that a hyposulphite is the result of the reaction which takes place in three successive stages, these are the formation of a sulphite and hydrosulphuric acid, the decomposition of the latter, and of the sulphurous anhydride into sulphur and water, and the combination of this sulphur, whilst in the nascent state, with the sulphite formed at first.—A note on the geographical distribution of the *Percina* by M. Léon Vaillant came next; and then M. A. Gaudry's note on a tooth of *Elephas primigenius* from Alaska. The tooth contained as much as 23·97 per cent. of organic matter.—Next came M. A. Laboulbène's paper on the elevation of central temperature in cases of acute pleurisy, on the abstraction of the liquid from the pleura, the temperature rose from 0°·2 to 0°·3 C. after the operation.—M. Béchamp followed with observations on M. Pasteur's paper, in which he stated that the wine ferment came from the grape skin.

BOOKS RECEIVED.

ENGLISH.—How I found Livingstone in Central Africa: H. M. Stanley (Sampson Low and Co.)—A Report on the Expedition to Western Yunan, *viâ* Bhamô: Dr. Anderson, Calcutta.—Mineral Phosphates and Pure Fertilisers: C. Morfit (Trübner)—The Physiology of Man; Nervous System: A. Flint (Appleton and Co).—Elements of Zoology: Andrew Wilson (A and C. Black).—Small Pox and Vaccination: Dr. C. Both (Trübner).

FOREIGN.—Beiträge zur Biologie der Pflanzen: Dr. F. Cohn, Heft II.

DIARY

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 8.30.—On the Colouring Matters derived from Aromatic Azodiamines. 2. Safranine: Dr. Hofmann, F.R.S, and Dr. Geyger.—Synthesis of Aromatic Monamines, by intra-molecular atomic interchange: Dr. Hofmann, F.R.S.—Investigation of the Attraction of a Galvanic Coil on a small Magnetic Mass: J. Stuart.

SOCIETY OF ANTIQUARIES, at 8.30—On Certain Prevailing Errors respecting French Chambered Barrows: Rev. W. C. Lukis, M.A.

LINNEAN SOCIETY, at 8.—On the Skeleton of the *Apteryx*: Thomas S. Allis.—On New and Rare British Spiders: Rev. O. P. Cambridge, M.A.

CHEMICAL SOCIETY, at 8.—On the Reducing Power of Phosphorous and Hypophosphorous Acids and their Salts: Prof. C. Rammelsberg.—On Hypophosphites: Prof. C. Rammelsberg.—On New Analyses of some Mineral Arseniates and Phosphates: Prof. A. H. Church.

FRIDAY, DECEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—On Coal Seams in the Permian at Ifton, Shropshire, with Remarks on the Supposed Glacial Climate of the Permian Period: D. C. Davies.—Note on a Well Section at Finchley: Caleb Evans.

SUNDAY, DECEMBER 8.

SUNDAY LECTURE SOCIETY, at 4.—On Arctic Experience; with a description of the Esquimaux; John Rae, M.D.

MONDAY, DECEMBER 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, DECEMBER 10.

LONDON INSTITUTION, at 4.—On Elementary Physiology: Prof. Rutherford.

PHOTOGRAPHIC SOCIETY OF LONDON, at 8.—Landscape Photography: F. C. Earl.—A New Actinometer: J. R. Johnson.

WEDNESDAY, DECEMBER 11.

SOCIETY OF ARTS, at 8.—On Galvanic Batteries: Rev. H. Highton.

THURSDAY, DECEMBER 12.

ROYAL SOCIETY, at 8.30.

SOCIETY OF ANTIQUARIES, at 8.30.

LONDON MATHEMATICAL SOCIETY, at 8.—On Geodesic Lines, especially those of a Quadric Surface; and on the Mechanical Description of certain Quartic Curves by a modified Oval Chuck: Prof. Cayley.—Note on the breaking up of the Inharmonic-ratio Sextic: J. J. Walker.

CONTENTS

ERRATA.—No. 157, p. 540, 2nd col, l. 15: For "2328·3 = 2,250,821,000," read "2328·3 × 2,250,821,000;" p 541, 1st col, l 14 from bottom: for "absolute certainty" read "supposed absolute certainty." No. 160, p. 47, 1st col., l. 14: for "water-fall" read "water falling."