of the lacustrine stations in Switzerland. M. Vouga calculates that the layer of mud that overlies the bronze bed to the thickness of about 0·12 m. has required 3000 years for its accumulation, that the deposition of the bronze bed itself occupied one or more centuries, a layer of lacustrine mud between the bronze bed and the stone bed (0·12m. thick) took another 3000 years to accumulate, and that the stone bed probably took twice as long in its formation as the bronze bed did. The stations have been suddenly abandoned, with all the personal property of the inhabitants, several times, and completely deserted: once by the men of the pure stone age—the stone of the country; a second time perhaps, but very probably, by other men who possessed nephrite and jade implements, axes and polished hammers, and articles of copper; lastly, by the men of the bronze age. No satisfactory explanation of these facts has yet been offered, but perhaps the frequent change of level of the lake waters may be to some extent responsible for them.

## *SOCIETIES AND ACADEMIES.*

### LONDON.

Royal Society, April 26.—"On the Specific Heats of Gases at Constant Volume. Part II. Carbon Dioxide." By Dr. J. Joly, F.R.S.

In the former experiments on this gas, recorded in the first part of this research,[1] the highest absolute density at which the specific heat was determined was 0·0378. In the present observations the determinations of specific heat have been carried to densities at which the substance was partly in the liquid state at the lower limit of temperature of the experiments. Observations dealing with true specific heat, uncomplicated by the presence of thermal effects due to the presence of liquid, are limited by the density 0·1444. At this density the mean specific heat over the range, 12° C. to 100° C., is 0·2035.

These observations, combined with those contained in Part I. (*loc. cit.*), afford a well defined line, which rises slowly at the higher densities, turning away from the axis of density.

According to an empirical equation to this line, the specific heat of carbon dioxide at constant volume is given in terms of its variation with density $\rho$, as follows:

$$Cv = 0{\cdot}1650 + 0{\cdot}2125\rho + 0{\cdot}3400\rho^2$$

"On the Specific Heats of Gases at Constant Volume. Part III. The Specific Heat of Carbon Dioxide as a Function of Temperature." By Dr. J. Joly, F.R.S.

In order to investigate the question of the variation of the specific heat of carbon dioxide with temperature, a steam calorimeter was constructed having double walls of thin brass, between which the vapour of a liquid boiling under atmospheric pressure could be circulated. The vessels used in the experiments were hung in the closed inner chamber. Into this chamber steam could be admitted after the temperature had become stationary and the same as that of the jacketting vapour. In this way the initial temperature could be varied.

Experiments at various densities and over four intervals of temperature were carried out. The densities chosen were 0·0456: 0·0800; 0·1240; 0·1800, and 0·1973. The intervals of temperature over which the gas at each density was investigated were: air temperature to 100°; 35° C. (boiling point of ether) to 100°; 56° (boiling point of acetone) to 100°, and 78° (boiling point of ethyl alcohol) to 100°.

The results are plotted on 5 equi-density lines, in which the precipitation due to the calorific capacity of the gas between $t_1$, and 100° is plotted against the initial temperature $t_1$ in each case. If the specific heat is invariable these are right lines. This proves to be sensibly the case for the lines $\rho=0{\cdot}0456$ and $\rho=0{\cdot}0800$; those of lowest density.

The next line, 0·124, is nearly rectilinear over the higher ranges, but pursued in the direction of decreasing temperature it rises markedly, thus indicating that the specific heat at constant volume falls in value with increasing temperature. The line $\rho=0{\cdot}1800$ and the one close above it, $\rho=0{\cdot}1973$, show this variation very markedly. Their variation below the critical temperature is complicated by the presence of liquid.

[1] "On the Specific Heats of Gases at Constant Volume," Part I. *Phil. Trans.* vol. clxxxii. 1891, pp. 73-117.

The following empirical equation expresses the line $\rho=0{\cdot}124$ calculated into a line of variation of specific heat with temperature:—

$$Cv = a\,(100-t) + b\,(100-t)^2 + c\,(100-t)^3,$$

where $t$ is the initial temperature of the experiment in centigrade degrees;

$$a = 0{\cdot}19020000,$$
$$b = -0{\cdot}00006750,$$
$$c = 0{\cdot}00000182.$$

Geological Society, May 9.—Dr. Henry Woodward, F.R.S., President, in the chair. The following communications were read:—Carrock Fell: a Study in the Variation of Igneous Rock-masses. Part I. The Gabbro. By Mr. Alfred Harker. The author opened with an account of the general relations of the intrusive rock-masses of the district, and proceeded to deal more particularly with the gabbro, which forms the earliest intrusion. A petrological description of the Carrock Fell gabbro followed a study of the variations observed in different parts of the mass. The rock becomes progressively more basic from the centre to the margin, passing from a quartz-gabbro with as much as 59½ per cent. of silica to an ultrabasic type with as little as 32½. The latter in extreme cases contains nearly 25 per cent. of iron-ores, partly titaniferous. This was compared with the igneous iron-ores described by Vogt in Scandinavia, &c., and the probable physical cause of the remarkable variation in the gabbro was discussed. Other modifications of the gabbro were briefly noticed, due on the one hand to metamorphism of the rock by a somewhat later intrusion of granophyre, on the other hand to the gabbro-magma having enclosed considerable masses of the basic lavas of the district, which are themselves highly metamorphosed. The paper was commented upon by Mr. Marr, Prof. Judd, Prof. Cole, and Mr. Rutley.—The Geology of Monte Chaberton, by Mr. A. M. Davies and Dr. J. W. Gregory. The importance of the Chaberton district, as affording a key to the general geology of the Cottians, was explained, and the opinions of previous observers referred to. The mountain was examined from three sides—that of the Grand Vallon; the approach from Mont Genèvre by the Col de Chaberton; and that of the Clos des Morts Valley. The following are the conclusions arrived at:—(1) The well-known Chaberton serpentine is intrusive into the calc-schists, and yields fragments to the *cargneules* of the Trias: it is therefore a *pre-Triassic* intrusion. (2) There are on the mountain other fairly basic schistose rocks (quartz-chlorite-schists) which cut the Trias, and are therefore *post-Triassic*. (3) The contorted beds in the Clos des Morts Valley are fossiliferous limestones, and it is from them that the fallen blocks previously recorded were derived. The only recognisable fossil is *Calamophyllia fenestrata*, Reuss, a characteristic coral of the Gosau Beds. In spite, therefore, of the doubts of Kilian and Diener, the opinion expressed by Neumayr as to the existence of Cretaceous rocks in this part of the Alps is confirmed. (4) The earth-movements of the mountain are described: they include ordinary folds, inversions, faults, and an important thrust-plane. (5) It is suggested that in addition to the two series of intrusive rocks above mentioned as pre- and post-Triassic, a third series of late Cretaceous or Tertiary date may be represented in the Mont Genèvre and Rocciavré masses.—Cone in Cone. How it occurs in the Devonian (?) Series in Pennsylvania, U.S.A., with further details of its structure, varieties, &c., by Mr. W. S. Gresley. The author described cone-in-cone structure occurring in the Portage Shales of Pennsylvania, and gave details concerning the nature of the structure as seen in these shales. He criticised the explanation of Mr. J. Young as to the origin of the structure, and concurred in a great measure with the views of those who have suggested that the formation was due to pressure acting on concretions.

Mathematical Society, May 10.—Prof. Greenhill, F.R.S., Vice-President, in the chair.—The following communications were made: On the kinematical discrimination of Euclidean and non-Euclidean geometries, by Mr. A. E. H. Love. The problem of Helmholtz, to lay down axioms concerning motion, by which the Euclidean, elliptic, and hyperbolic geometries shall be distinguished from all other imaginable geometries, has been recently solved by Sophus Lie in the third part of his "Theorie der Transformations-gruppen" (1893), and he adds the remark that the group of the Euclidean motions is distinguished from the two groups of non-Euclidean motions by the possession of a real invariant sub-group. This remark obviously refers to translations, and in fact it appears to have been previously noticed that in the elliptic and hyperbolic geometries, the transformations that correspond to translations do not form a group. In the present communication a number of representations of elliptic and hyperbolic geometry are described and illustrated with the object of making this kinematical distinction between the Euclidean and the other geometries intuitively obvious.—Permutations on a regular polygon, by Major P. A. MacMahon, F.R.S.—The stability of a tube, by Prof. Greenhill (Dr. J. Larmor, F.R.S., *pro tem.* in the chair). The difficulties of constructing a theory for the stability of a tube, subject to external pressure and end thrust, have been discussed by Mr. A. B. Basset in the *Phil. Mag.* September 1892. Similar investigations have been undertaken by Mr. Love and Mr. Bryan in the *Proceedings* of the London Math. Society. The analytical difficulties due to the difference of pressure on the two sides of the plate, have not yet been overcome, so that the investigation of the present paper must be taken as provisional, as it proceeds on the old theory, as laid down in Thomson and Tait's "Natural Philosophy." The chief object is to determine the number of segments or waves into which the cross section of the tube will tend to break, as the supporting influence of the ends is made to operate at sections which are brought closer and closer together; the influence of the end thrust is also taken into account. A differential equation is obtained for $w$, the infinitesimal normal displacement of the tube, of the form

$$\mathrm{A}\left(\frac{d^4w}{dx^4}+2\frac{d^2w}{dx^2dy^2}+\frac{d^4w}{dy^4}+2\frac{d^2w}{a^2dx^2}+\frac{w}{a^4}\right)$$
$$+\mathrm{A}\sigma\frac{d^2w}{dx^2}+\mathrm{X}\frac{d^2w}{dx^2}+\mathrm{Z}a\left(\frac{d^2w}{dy^2}+\frac{w}{a^2}\right)=0\ldots(\mathrm{A})$$

where $x$ is measured parallel to the axis of the tube, and $y$ circumferentially; $a$ denotes the radius of the tube, $b$ its thickness, A the flexural rigidity, $\sigma$ Poisson's ratio, X the longitudinal thrust in the tube per unit length of cross section, and Z the external applied pressure; the inch and pound are taken as units of length, so that the theoretical results may be compared immediately with experimental values; to do this it is assumed provisionally that we may put $\mathrm{A} = \frac{1}{12}\mathrm{M}b^3/(1-\sigma^2)$, where M denotes Young's modules of elasticity. If the tube breaks circumferentially into $n$ waves, we put

$$\frac{d^2w}{dy^2}=-\frac{n^2w}{a^2},\ \frac{d^4w}{dy^4}=\frac{n^4w}{a^4};$$

and equation (A) becomes

$$\frac{d^4w}{dx^4}-2n^2\frac{d^2w}{a^2dx^2}+(n^2-1)^2\frac{w}{a^4}$$
$$+\left(\sigma+\frac{\mathrm{X}a^2}{\mathrm{A}}\right)\frac{d^2w}{a^2dx^2}-(n^2-1)\frac{\mathrm{Z}a^3}{\mathrm{A}}\frac{w}{a^4}=0\ldots(\mathrm{B})$$

For cylindrical collapse, when the supporting influence of the ends is left out of account, $\frac{d^2w}{dx^2}$ is zero, and therefore

$$\frac{\mathrm{Z}a^3}{\mathrm{A}}=n^2-1,\ n\mathrm{Z}=\frac{n^2-1}{12}\frac{\mathrm{M}}{1-\sigma^2}\left(\frac{b}{a}\right)^3.$$

But if the ends of the tube are supported or strengthened, the collapsing pressure is obviously increased, so that

$$\frac{\mathrm{Z}a^3}{\mathrm{A}}-(n^2-1)$$

is positive. If the supporting influence is due to a series of equidistant strengthening rings, as is a caisson, $l$ inches apart, preserving accurately the circular form at the corresponding section, while permitting slight changes of direction in the longitudinal seams, we put

$$\frac{d^2w}{dx^2}=-\frac{\pi^2w}{l^2},\ \frac{d^4w}{dx^4}=\frac{\pi^4w}{\mathrm{L}^4};$$

so that (B) becomes

$$\left(\frac{\pi a}{\mathrm{L}}\right)^4+\left(2n^2-\sigma-\frac{\mathrm{X}a^2}{\mathrm{A}}\right)\left(\frac{\pi a}{\mathrm{L}}\right)^2$$
$$+(n^2-1)^2-(n^2-1)\frac{\mathrm{Z}a^3}{\mathrm{A}}=0\ldots\quad(\mathrm{C})$$

In practice X is proportional to Z, when it is not zero; and to determine the number $n$ of segments into which the tube collapses, we may put $\mathrm{Z}a^3/\mathrm{A}=y$, and $(\pi a/l)^2=x$, and draw the hyperbolas represented by (C) for values of $n = 1, 2, 3, \ldots$; and the points of crossing of these hyperbolas will represent the separating states when an integral change in $n$ is about to take place. The case of $n = 1$ would only occur when the tube was used as a long cylindrical column, on the point of buckling sideways, without crippling; we now find that the formula assigns a critical thrust which is only $\frac{2}{3}(b/a)^2$ of that given by the usual theory, due to Euler.—Researches in the calculus of variations, Part v., the discrimination of maxima and minima values of integrals with arbitrary values of the limiting variations; Part vi., the theory of discontinuous or compounded solutions, by Mr. E. P. Culverwell.

**Physical Society**, May 11.—Walter Baily, Vice-President, in the chair.—A mathematical communication on electromagnetic induction in plane, cylindrical, and spherical current sheets and its representation by moving trails of images, by G. H. Bryan (part 1, general equations), was read by Dr. C. V. Burton, who also explained some of the parts in greater detail. After mentioning that the magnetic field due to induced currents in thin conducting sheets placed near moving magnetic poles could be represented by moving trails of images of those poles, the author goes on to say that in the paper, the surface-conditions which hold at the surfaces of the sheets are deduced directly from the fundamental laws of electromagnetic induction. (1) The total current across any enclosed portion of a surface which always contains the same particles is equal to $1/4\pi$ of the line-integral of the magnetic force round the curve bounding the surface; and (2) the rate of decrease of the surface integral of magnetic induction across any enclosed surface which always contains the same particles to equal to the line-integral of electromotive force round the curve bounding the surface. By working with the scalar magnetic potential instead of vector-potential, the investigation is simplified. In addition to the above laws, the author makes the usual assumptions that displacement currents in the dielectric are so small as to be negligible, and that the induced currents are distributed uniformly through the thickness of the sheet. On these suppositions the surface conditions satisfied by the potentials at the two sides of plane, cylindrical, or spherical sheets are determined, and with an additional limitation as to the thickness of the sheet fulfilling certain conditions, extended to current sheets of other forms. In the latter part of the paper a synthetic determination of the images in a plane sheet is given and expressed in the form of a definite integral. In reading the paper to the meeting Dr. Burton pointed out several misprints in the proof.—Prof. Minchin showed that equation (1) of the paper ($\Omega_2-\Omega_1=4\pi\phi$ + constant, where $\Omega_2$ and $\Omega_1$ are the magnetic potentials at the two sides of the sheet, and $\phi$ the current function), could be deduced by purely mathematical reasoning instead of being based on the laws of electromagnetic induction. Moreover, it was true for any function whatever and did not depend on $\phi$ being the current function. Equation (2) $\left(\frac{d\Omega_2}{dz}=\frac{d\Omega_1}{dz}\right)$ followed immediately from the fact that the magnetic force was continuous. The latter part of the paper might be simplified by integrating the linear partial differential equation (15)

$$\left(\frac{d^2\Omega'}{dz\,dt}-\mathrm{R}\frac{d^2\Omega'}{dz^2}=-\frac{d^2\Omega_0}{dz\,dt}\right)$$

in the ordinary way, for the form was one for which the auxiliary equations are well known. Dr. Burton, in reply, said he thought Mr. Bryan's reason for developing the equations from the laws of electromagnetic induction was to give his work a physical rather than a mathematical basis.—A paper on dielectrics was read by Mr. Rollo Appleyard. In testing the insulation resistance of celluloid, by having a sheet pressed between two metal plates, the author noticed that the resistance, which was very high, *decreased* as the time the testing battery was left on increased. The "electrification" (using the word to indicate the rate of diminution of galvanometer deflection) was therefore *negative*. The resistance also diminished greatly with increase of battery power, and a considerable amount of hysteresis was observed, the resistance at any given voltage, after a minute's electrification, depending on the previous history of the specimen. On making contact with the surfaces of the celluloid by mercury instead of by solid metal, the abnormal results disappeared, little or no resistance-hysteresis or "electrification" being present, and only a small diminution of resistance with increase of voltage. For a sheet 6 mils thick the resistance between opposite faces $5\frac{1}{2}$ inches diameter was of the order 30 megohms, and one specimen broke down at 1200 volts. The celluloid condensers used in the experiments were found to discharge slowly at first, and after a certain time the deflection of the galvanometer became reversed, and attained a steady negative value. This the author attributes to an E.M.F. of about 0·0006 volt between the mercury and celluloid. Similar experiments on gutta-percha tissue showed no such E.M.F., and the "electrification" was normal. The resistance usually attained a maximum for voltages between 600 and 800. Although the tissue had a thickness of only 2 mils (0·002"), it stood a pressure of 1200 volts, and offered a resistance between circular faces $5\frac{1}{2}$ inches in diameter of about 3000 megohms. The opaque white spots seen in celluloid under the microscope, led the author to test the behaviour of mixtures of conducting and insulating materials. A strip of gutta-percha was warmed, and coarse brass filings scattered over it as thickly as possible. In spite of this the resistance was practically infinite even when tested with 750 volts. A number of rods were made from mixtures of brass and gutta-percha in various proportions, and on testing these it was found that if the weight of filings exceeded about twice that of the gutta-percha, the resistance of a rod 20 inches long, $\frac{3}{4}$ inch diameter, was small (sometimes a fraction of an ohm), whereas a slightly smaller proportion yielded rods having resistances measured in thousands of megohms. Such rods were found to be affected by oscillating discharges in a manner similar to Prof. Minchin's "impulsion" cells and M. Branly's tubes of filings. Experiments were also made on the behaviour of such rods when subjected to high alternating pressures. This caused small local arcs to form along the rods, but did not permanently destroy their high resistance.—In connection with Mr. Appleyard's paper, a note on the behaviour of certain bodies in presence of electromagnetic oscillations, by Prof. G. M. Minchin, was read by Mr. Elder. Referring to the employment of impulsion cells, metallic films, &c., for detecting the modes of electromagnetic vibrations, he says that so far the physical state of such bodies are too variable to be of service. Metallic surfaces formed by embedding fine metallic powders in films of gelatine, shellac, or sealing-wax, are, as described in a previous communication to the Society, found to act as insulators, but become conducting when subjected to strong electromagnetic disturbances. After a current has once passed through such a film its resistance is changed by very feeble impulses, whereas previously it failed to respond to strong ones. On breaking contact by removing the electrode from the surface, the film loses its conductivity, the time necessary to do this depending on the hardness of the matrix. The resistance of a film containing tin powder, measured between the rounded tips of two platinum wires, 1 c.m. apart, varied under the electromagnetic impulses from infinity to 130 ohms. In conclusion, the author points out that with films and tubes the whole phenomenon relates to change of resistance, whereas impulsion cells may have currents from external sources passing through them whilst in either the sensitive or insensitive states.—Mr. Bright and Mr. Enright asked questions as to the electrification of gutta-percha, and the bridge connections in the resistance tests of the semi-conducting rods respectively, to which Mr. Appleyard replied.

**Royal Meteorological Society**, May 16.—Mr. R. Inwards, President, in the chair.—Mr. W. Ellis, F.R.S., read a paper on the relative frequency of different velocities of wind, in which he discussed the anemometer records of the Greenwich Observatory for the five years 1888-1892, with the view of ascertaining the number of hours during which the wind blew, with each of the different hourly velocities experienced during the period. The results of this discussion show that the wind blew for the greatest number of hours with the hourly velocities of ten and eleven miles.—Mr. W. Marriott gave an account of a series of observations on the audibility of "Big Ben" at West Norwood, which he had carried on for a period of five years. The clock tower at Westminster is five and a half miles distant from the point of observation in a north-by-west direction. The large bell "Big Ben" was designed by Lord Grimthorpe, and was cast in 1858; its weight is about fourteen tons. It is 9 ft. $5\frac{1}{2}$ ins. in diameter, and $9\frac{3}{8}$ ins. in thickness, its tone being E. The observations were 976 in number, and were made at the hours of 9 a.m. and 9 p.m. The bell could be heard more frequently in the evening than in the morning, and on Sundays it was more frequently audible than on week-days. The direction of the wind most favourable for hearing "Big Ben" was between west and north. The observations were also discussed in relation to temperature, moisture, cloud, and barometric pressure.—A paper by Mr. A. W. Moore was also read on earth temperatures at Cronkbourne, Isle of Man, 1880-1889.

**Royal Microscopical Society**, April 18.—Mr. A. D. Michael, president, in the chair.—Dr. W. H. Dallinger directed attention to a stereoscopic photomicrograph of Heliopelta, which had been presented to the Society by Dr. W. C. Borden, of New York.—Dr. Dallinger read a short paper from Dr. H. G. Piffard, in reference to a method which he had adopted for the examination of some of the old immersion objectives.—Mr. J. W. Brown exhibited a "home-made" microscope.—Prof. F. J. Bell read a letter from M. C. J. Pound, describing the laboratories of the Stock Institute of Queensland, which had recently been instituted for the purpose of investigating the nature and causes of animal diseases in that colony.—Mr. J. G. Grenfell read a paper on the tracks, threads, and films of oscillatoriæ and diatoms, illustrating his subject by diagrams and specimens. Mr. T. Comber and the President made some remarks on Mr. Grenfell's paper.

PARIS.

**Academy of Sciences**, May 15.—M. Lœwy in the chair.—On the influence of bending in telescopes mounted as coudé equatorials, by MM. Lœwy and Puiseux.—Researches on the augmentation of crops by introduction into the soil of large quantities of carbon bisulphide, by M. Aimé Girard. The author shows that, for at least two years after treating soils with carbon bisulphide, wheat, oats, beetroot, potatoes, and clover yield much heavier crops than on soil not treated. He traces the increased production rather to the destruction of insect pests than to any action on parasites belonging to the vegetable kingdom.—Observation of Tempel's comet (1873 II.) made at Algiers Observatory. A telegraphic despatch transmitted by M. Tisserand.—On the periodic comet Tempel (1873 II.), by M. L. Schulhof.—Observations of comet Denning (1894, March 26) made at Toulouse Observatory, by M. E. Cosserat.—Observations of Gale's comet (1894, April 3) made at Lyons Observatory, by M. J. Guillaume.—Observations of the same comet made with the coudé equatorial at Lyons Observatory, by M. G. Le Cadet.—Graphic ephemerides giving the co-ordinates of the stars for the purposes of navigation, by M. Louis Favé.—On the equations of mechanics, by M. Wladimir de Tannenberg.—Determination of the relative intensity of gravity, made at Joal (Senegal) by the expedition sent out by the Bureau des Longitudes to observe the total eclipse of the sun on April 16, 1893, by M. G. Bigourdan. Taking $g = 981$ at Paris, at Joal the mean value of $g$, reduced to sea-level, is 978·437. This result confirms Defforge's law that $g$ has a characteristic value for the littoral of the same sea, of which the variation follows exactly Clairaut's law of the sine squared of the latitude.—On the physical properties of pure nitrous oxide, by M. P. Villard. The author describes the preparation of the pure gas by a liquefaction method, and compares the densities of the liquid and its vapour from 0° to 36°·3. He finds the critical temperature of the pure gas to be 38°·8 as compared with Dewar's value, 35·4, and Janssen's 36·4. The critical volume, density, and pressure are respectively 0·00436, 0·454, and 77·5 atmospheres.—On the stability of dilute solutions of corrosive sublimate, by M. Léo Vignon. The stability depends on the absence of alkaline matter which may be present in the water used or derived from the air or the glass of the containing vessel.—On the chemical character and constitution of ethylic acetoacetate, by M. de Forcrand. From a consideration of thermal data, the author concludes that ethylic acetoacetate most nearly resembles phenols, that it is neither an acid nor a ketone, but a tertiary alcohol of a special type, and should be represented by the formula

$$CH_3.C(OH):CH.COOEt.$$

—Comparative study of the isomeric nitrobenzoic acids, by M. Oechsner de Coninck.—The Diptera parasitic on Acridians: viviparous Muscidæ, *à larves sarcophages*. Aptenia and parasitic castration, by M. J. Künckel d'Herculais.—On the fixity of race in the cultivated mushroom, by MM. Costantin and L. Matruchot. The peculiarities distinguishing the varieties recognised by mushroom growers are hereditary.—Remark concerning a recent communication, by M. Issel, on the Zante earthquakes, by M. Stanislas Meunier.—M. d'Abbadie describes a new method of measuring a geodetic base-line in presenting volume li. of "Memoires de la Section topographique de l'État-Major-Général russe," on behalf of M. Vénukoff.

BERLIN.

**Meteorological Society**, April 3.—Prof. Hellmann, President, in the chair.—Dr. Rassner spoke concerning the measurements of the height of clouds at the Eiffel Tower, which had given 150 m. as the lowest value, and discussed the different methods of determining the height of clouds by means of artificial illuminants as proposed and used by La Cour, Cleveland Abbe, Jesse, Hasen, and others. The speaker himself on two occasions had the opportunity of measuring the height of clouds; the first, in the summer of last year, was a thunder cloud, whose height he determined, with the aid of an electric lamp, to be about 80 m.; on the second occasion, in January of this year, he was able by the use of an intermittent benzole light, to measure the height of the clouds to 750 m.—Dr. Schubert made a communication concerning the cyclone of February 12 last, which did very great damage in the forest of Freienwalde and Chorin, especially in the pine districts, where the trees were torn up by the roots, and blown down by the storm. A series of beautiful photographs illustrated the devastation produced by the storm.

**Physiological Society**, April 13.—Prof. du Bois Reymond, President, in the chair.—Dr. Krüger spoke concerning the determination of the uric acid and nuclein bases in urine by precipitation with copper sulphate and sodium bisulphide. With the help of these reagents one can determine exactly the nitrogen of the uric acid and of the nuclein bases. If the nitrogen of the uric acid be now determined by means of the Ludwig-Salkowsky method, one arrives at a quantitative determination of the nuclein bases. On the other hand, the uric acid in the urine may be changed into allantoin by manganese, in which case treatment with the copper sulphate-sodium bisulphide yields only the nitrogen of the nuclein bases. This is then deducted from the total nitrogen which had been found before, and so one obtains quantitative estimation of the uric acid. These reactions were verified in a great number of experiments.—Dr. Jacob reported on a case of leukæmia which he had investigated in conjunction with Dr. Krüger. They first showed that an increase in the nitrogen of the uric acid and nuclein bases of the urine is associated with the increase in the number of the leucocytes. After injection of an extract of spleen, there was observed first a decrease, and later an increase in the number of leucocytes. In proportion to the increase of the leucocytes there was an increase in the quantity of urine excreted and in the amount of uric acid and nuclein bases. When after some days the number of leucocytes decreased the quantity of urine, of uric acid, and of nuclein bases also diminished.—Dr. Lilienfeld communicated the results of experiments which he had made on the condensation of glycocol ether, and on the union of a diamine base derived from glycocol with leucine ether and tyrosine ether. The condensation of glycocol ether and tyrosine ether resulted in a body which gave the reactions of glutin, and resembled glue in appearance, while the union of the above-mentioned three substances gave a proteid-like body, which showed the biuret reaction, and was dissolved by pepsin. The conjectures as to the constitution of these three substances will be tested by further experiments.

April 27.—Prof. du Bois Reymond, President, in the chair. Dr. Ad. Loewy communicated the results of his experiments on the influence of rarefied and compressed air on the circulation. As he showed in earlier experiments a diminution of pressure to about 450 mm. of mercury was tolerated very well and did not lead to any real disturbance, and that the lowered oxygen tension, produced either by still greater rarefaction or by the addition of carbonic acid to the air breathed, is compensated for by deeper respirations. The speaker desired now to determine by experiment whether, with rarefaction of the air, compensating changes can be observed in the vascular system. In particular he determined the velocity of the blood flow by the method recently devised by Prof. Zuntz (NATURE, vol. xlix. p. 168) in animals which respired in rarefied air of about ½ atmosphere, and found that, at each systole of the heart the volume of the blood ejected exactly equals that which the same animal shows under normal pressure. Thus if the tension of the oxygen breathed is reduced one half the effect on the circulation is as slight as it is on the respiration. With still greater rarefaction the oxygen tension in the alveoli can, by deeper respiration, still be brought to the level where the hæmoglobin of the blood is saturated, and no distress appears. Dr. Loewy drew interesting conclusions from his experiments in relation to the meaning of mountain sickness.—Prof. A. Kossel, in his further researches on thymin, a decomposition product derived from nucleic acid extracted from the thymus, has obtained a substance which gave all the reactions of levulinic acid, and produced a salt with silver which possessed exactly the crystalline form of the silver salt of levulinic acid. As levulinic acid originates from levulose, and is viewed by many chemists as proof of the presence of levulose, so from the above reaction the presence of a carbohydrate in nucleic acid is to be deduced. The origin of the nucleic acid is indifferent for this reaction, since it was found with all nucleic acids, a very important fact in relation to the physiology of metabolism. The attempt to discover a carbohydrate in the atom complex of casein, closely related to nucleic acid, led to the discovery of a substance which gave all the reactions of levulinic acid, with the exception of the levulinic acid salts, so that a certain conclusion as to the presence of a carbohydrate complex in casein cannot be drawn.

**Physical Society**, April 20.—Prof. du Bois Reymond, President, in the chair.—Prof. Koenig reported on a form of colour-blindness lately examined by him, which had not been observed before. The typically colour-blind see yellow in the spectrum where the normal eye perceives red, and the yellow continues with increasing admixture of white until the middle of the spectrum, about $\lambda = 530\mu\mu$, where it commences to change to pale blue which becomes continuously deeper until, at the violet end of the normal spectrum, deeply saturated blue is perceived; in the totally colour-blind, as is well known, every colour sensation has vanished; they see in the entire spectrum only white, which attains its greatest intensity about where the normal eye sees green. The typically colour-blind fall into two groups, which differ only in the position of the greatest brilliancy of the spectrum, the maximum in the one lies where the normal eye sees orange, about $650\mu\mu$, in the other it lies at the yellow, near $580\mu\mu$. The newly investigated case of colour-blindness showed a condition intermediate between typical colour-blindness and total colour-blindness. In the entire spectrum only white was seen, but at the red end of the spectrum the white was mixed with a very weak yellow, and at the violet end with a very weak blue. These colours were first perceived when the two ends of the spectrum lay next one another, and were compared. The maximum brilliancy lay in this case where the second group of typically colour-blind show it—near $580\mu\mu$. The present theories of colour perception are unable to explain this new case. [In the report of the meeting of the Physical Society for March 2 (NATURE, vol. xlix. p. 595), for Roepsel read Koepsel, and for Hulske read Halske.]

SYDNEY.

**Linnean Society of New South Wales**, March 28.—The following papers were read:—Notes on Australian *Typhlopidæ*, by Edgar R. Waite. Two new species were described—*T. batillus*, from New South Wales, and *T. diversus* from Queensland. Some discrepancies in the published descriptions of *T. unguirostris*, Peters, and *T. affinis*, Blgr. were pointed out. Three aspects of the head of *T. wiedii*, Peters, the only species hitherto unfigured, were given in order to complete the series. The measurements of a gigantic example of *T. polygrammicus* were recorded, the total length being 717 mm. (28¼ inches).—On the fertilisation of *Clerodendron tomentosum*, R.Br., and *Candollea serrulata*, Labill, by Alex. G. Hamilton. The author showed that both plants possess contrivances for the purpose of ensuring cross-fertilisation. *Clerodendron* is proterandrous, and is fertilised by *Sphingidæ*, the pollen being deposited on the legs and underside of the thorax of the insects, a bending of the style keeping the immature stigma at this stage out of the way. After the pollen is shed the stamens curve downwards and the style straightens, bringing the now mature stigma into the position formerly occupied by the anthers. *Candollea serrulata* and its congeners have the anthers and stigma at the end of a sensitive column. This possesses a hinge, which if touched, causes the style to fly over. The anthers mature before the stigma, and at first conceal it. The flower is so constructed that when a bee thrusts in its proboscis, it inevitably touches the sensitive spot, and the style immediately flies over and clasps the bee, which then receives the pollen on its back. Later, when the pollen is all shed, the stigma, which is papillose, grows out, and a bee visiting a flower is struck by the stigma, when the papillæ being glutinous receive the pollen. The author also noted some experiments and observations on the action of the sensitive column.—Note on Bungwall (*Blechnum serrulatum*, Rich.), an aboriginal food, by Thos L. Bancroft. The rhizome of this fern formed, with the nuts of the Bunya Bunya (*Araucaria Bidwilli*), the most important food of the aborigines of Southern Queensland.—On the nests and habits of Australian *Vespidæ*, by Walter W. Froggatt.—Description of *Calliostoma purpureo-cinctum*, a new Australian marine shell, by C. Hedley. A small Trochoid, ornamented with beaded sculpture, and coloured orange with a spiral lilac band, was added to the local fauna under the above title.—Note on the habitat of the Naked-eyed Cockatoo (*Cacatua gymnopis*, Sclater), by Alfred J. North. Living specimens caught near Burketown in North Queensland, now on view in Sydney, have been examined; and there are specimens in the Macleay Museum from the Gulf of Carpentaria and from Port Darwin, and in the Australian Museum from Cambridge Gulf. The note of interrogation in the record of the habitat for this species given in the British Museum Catalogue of Psittaci ["South Australia (and also Northern and North-west Australia?")] may therefore be dropped.—Oological notes, by Alfred J. North, (1) *Ptilotis analoga*; (2) *Lamprococcyx malayanus*.—Observations upon the anatomy of the "dumb-bell-shaped bone" in *Ornithorhynchus*, with a new view of its homology, by Prof. J. T. Wilson. The "dumb-bell-shaped" bone is not confined to the palatine region, but both dorsally and posteriorly it is in intimate relation to the nasal septum. From the dorsal part of its hinder extremity it sends backwards a distinct vomerine spur, about 3 mm. in length, which is bifurcated posteriorly and grooved along its dorsal border, forming a splint for the ventral edge of the cartilaginous nasal septum. The tips of this bifid spur are connected with those of the anteriorly bifid end of the true vomer by means of a strong "vomerine ligament," varying in length from about 2 mm. downwards. In coronal sections this ligament is seen to possess the same sectional shape as the vomerine spurs, and to be structurally and morphologically continuous with the bone at either end. The vomerine spur lies quite dorsal to the palatine plate formed by the maxillæ, and it extends backwards to a plane from 2–3 mm. behind the tip of the anterior median process of the latter, from which it is separated by an interval. This interval forms a wide passage of communication (1 mm. vertically), below the nasal septum, between the nasal cavities of opposite sides, and it is lined by columnar epithelium like the neighbouring parts of these cavities. The "dumb-bell-shaped bone" is a true "anterior vomer" formed by the fusion of bilaterally symmetrical halves; and both in its nasal and in its palatine relations it resembles the palatine lobe of the vomer in *Caiman niger*.

## DIARY OF SOCIETIES.

LONDON.

*THURSDAY*, MAY 24.

ROYAL SOCIETY, at 4.30.—On the Dynamical Theory of Incompressible Viscous Fluids, and the Determination of the Criterion; Prof. O. Reynolds, F.R.S.—Measurements of the Absolute Specific Resistance of Pure Electrolytic Copper: J. W. Swan and J. Rhodin.—On some Voltaic Combinations with a Fused Electrolyte and a Gaseous Depolariser: J. W. Swan.—On certain Functions connected with Tesseral Harmonics, with Applications: Prof. A. H. Leahy.—On the Measurement of the Magnetic Properties of Iron: Prof. T. Gray.—Researches on the Electrical Properties of Pure Substances—No. I. The Electrical Properties of Pure Sulphur: Prof. Threlfall, J. H. D Brearley, and J. B. Allen.—On the Influence of certain Natural Agents on the Virulence of the Tubercle Bacillus: Dr. A. Ransome, F.R.S., and Dr. Delépine.

ROYAL INSTITUTION, at 3.—Egyptian Decorative Art: Prof. W. M. Flinders Petrie.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Cost of Electrical Energy: R. E. Crompton. (Continuation of Discussion.)

*FRIDAY*, MAY 25.

ROYAL INSTITUTION, at 9.—The Development of the Astronomical Telescopes: Sir Howard Grubb, F.R.S.

PHYSICAL SOCIETY, at 5.—On the Passage of Hydrogen through Palladium: Prof. W. Ramsay, F.R.S.

*SATURDAY*, MAY 26.

GEOLOGISTS' ASSOCIATION—Excursion to Luton, Caddington, and Dunstable. Directors: Mr. John Hopkinson and Mr. Worthington G. Smith.

ROYAL BOTANIC SOCIETY, at 3.45.

*MONDAY*, MAY 28.

ROYAL GEOGRAPHICAL SOCIETY, at 2.30.—Anniversary Meeting.

*TUESDAY*, MAY 29.

ROYAL INSTITUTION, at 3.—The Modern Microscope: Rev. W. H. Dallinger, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

SOCIETY OF ARTS, at 8.—Black and White in Africkanderland: W. A. Wills.

*WEDNESDAY*, MAY 30.

BRITISH ASTRONOMICAL ASSOCIATION (University College), at 5.

*THURSDAY*, MAY 31.

ROYAL SOCIETY, at 4 30.—The following Papers will *probably* be read:—Propagation of Magnetisation of Iron as affected by the Electric Currents in the Iron: Dr. J. Hopkinson, F.R.S., and E. Wilson.—On the Electrification of Air: Lord Kelvin, P.R.S., and Magnus Maclean.—Note on the Possibility of obtaining a Unidirectional Current to Earth from the Mains of an Alternating Current System: P. Cardew.—The Effect of Mechanical Stress and of Magnetisation on the Physical Properties of Alloys of Iron and Nickel and of Manganese Steel: H. Tomlinson, F R.S.—The Root of Lyginodendron Oldhamia (Williamson): W. C. Williamson, F.R.S., and D. H. Scott.

ROYAL INSTITUTION, at 3.—Egyptian Decorative Art: Prof. Flinders Petrie.

CAMERA CLUB, at 8.30.—Twenty Thousand Feet over the Sea: Mr. Edward Whymper.

*FRIDAY*, JUNE 1.

ROYAL INSTITUTION, at 9.—The Work of Hertz: Prof. Oliver Lodge, F.R.S.

GEOLOGISTS' ASSOCIATION (University College), at 8.

*SATURDAY*, JUNE 2.

GEOLOGISTS' ASSOCIATION.—Excursion to Finchley and Whetstone Park Director: Dr. H. Hicks, F.R.S.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Twelve Charts of the Tidal Streams on the West Coast of Scotland: F. H. Collins (Potter).—The Tidal Streams of the Isle of Wight: F. H. Collins (Potter).—The Starry Skies: A. Giberne (Seeley).—This Great Globe: A. Seeley (Seeley).—Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. 11th Annual Issue (Griffin).—The Metallurgy of Gold: T. K. Rose (Griffin).—Materia Medica, Pharmacology, and Therapeutics. Inorganic Substances: Dr. C. D. F. Phillips, 2nd edition (Churchill).—Journal of the Iron and Steel Institute, Vol. xliv. (Spon). Manual of Practical Logarithms: W. N. Wilson (Rivington).—Die Anfänge der Kunst: Dr. E. Grosse (Freiburg i. B., Mohr).—Flora der Nordwestdeutschen Tiefebene: Prof. Dr. F. Buchenau (Leipzig, Engelmann).—The Lowell Lectures on the Ascent of Man: Henry Drummond (Hodder).—Royal University of Ireland. Examination Papers, 1893 (Dublin, Thom).

PAMPHLETS.—Botanical Charts and Definitions: A. E. Brooke and A. C. Brooke (Philip).—The Ethnography of Inishbofin and Inishshark, co. Galway: Dr. C. B. Browne (Dublin).—Scientific Taxidermy for Museums: Dr. R. W. Shufeldt (Washington).—Kew Observatory Report, 1893 (Harrison).—A Summary of Progress in Mineralogy and Petrography in 1893: W. S. Bayley (Waterville, Me.).

SERIALS.—Materials for a Flora of the Malayan Peninsula: Dr. G. King. No. 6 (Calcutta).—Journal of the Franklin Institute, May (Philadelphia).—American Naturalist, May (Philadelphia).—Journal of the Chemical Society, May (Gurney and Jackson).—Journal of the Polynesian Society, Vol. 3, No. 1 (Wellington, N.Z.).—Journal of the Institution of Electrical Engineers, No. 3, Vol. xxiii. (Spon).—Veröffentlichungen aus dem Königlichen Museum für Völkerkunde, iii. Band, 3/4 Heft (Berlin, Spemann).

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