which, Loch Goil, was only half a degree warmer than in April. The range of surface temperature in June was from 45° to 53°, and of bottom temperature from 42° to 47°·3, according to locality. Constant temperature to the bottom commenced at a much lower depth than in April. In the upper basin of Loch Long, which was discussed with more fulness, the surface-temperature was 48°·4, at 10 fathoms it was 44°·2, and from 55 fathoms to the bottom at 70 fathoms it was 44°. But between 10 fathoms and 55 fathoms the water was colder than at either of these points, reaching its lowest temperature of 42°·8 at 20 fathoms. It thus appeared that a lenticular mass of water floated between the warmer strata, the opinion as to the cause of which was meantime reserved until further light can be thrown on the phenomenon. In the Clyde district, Dr. Mill said, physical configuration is the determining cause of differences of temperature, and it appears that as the season advances, warmth descends from the surface everywhere by conduction, and travels inward from the sea by conduction and convection. The study of water climate, he said, was likely to lead to important results, but it must be carried on by a large number of observers, who would note the temperature of rivers and of falling rain, before any degree of completeness could be obtained. The paper was illustrated by a series of admirable charts.

## SCIENTIFIC SERIALS

THE *Journal of the Franklin Institute*, August.—Capt. O. E. Michaelis, the applications of electricity to the development of marksmanship. This is the conclusion of an interesting paper on chronoscopic and chronographic methods, illustrated by cuts of recent instruments.—W. Lewis, experiments on transmission of power by gearing (conclusion of the discussion).—F. Lynnwood Garrison, the microscopic structure of car-wheel iron.—G. Richmond, the refrigeration-machine as a heater.—C. Hoele, a method of designing screw propellers.—F. E. Ives, correct colour-tone photography with ordinary gelatine bromide plates. A proposal to reduce the sensitiveness of the bromide films to the blue and green rays, by introducing into a plate-glass tank mixtures of aniline colour solutions, chiefly yellow and red, in certain proportions, thereby equalising the sensitiveness throughout the range of the visible spectrum.—Joshua Pusey, suggestions towards a simplified system of weather signals, termed the index weather-signal system.—P. E. Chase, Herschel and Jevon on density of the ether.

*Annalen der Physik und Chemie*, vol. xxviii. No. 8, August 1886.—Prof. G. Quincke, electrical researches, No. xii., on the properties of dielectric fluids under strong electric forces. The dielectric constant of a number of liquids is examined by two methods, by attraction between two plane parallel plates immersed in the liquid, and by discharge of their charges through a galvanometer. High potentials were obtained by a Holtz machine, and measured by a long-range electrometer up to 30,000 volts. The results show that with high electric forces the dielectric constant is less than with lower electric forces; in other words, there exists an apparent tendency to saturation in inductive capacity. Measurements of the dielectric constant are always from 10 to 50 per cent. higher when made by the balance-method than those made by the condenser discharge method. In different dielectric fluids the spark-distance for the same difference of potentials is different, and always much shorter than in air. The potential requisite to produce a spark within a dielectric liquid increases with the spark-length, but at a slower rate. The strength of a steady electric current in a dielectric fluid increases more rapidly than the electromotive force which produces it; an exception, apparently, to Ohm's law.—L. Sohncke, electrification of ice by water-friction. Experimental proof that water becomes negatively electrified and ice positively electrified by mutual friction. The author thinks thereby to explain the origin of thunderstorms by friction of cumulus and cirrus clouds.—E. Edlund, researches on the electromotive force of the electric spark. He finds the counter-electromotive force of the electric spark to be divisible into two parts, one at each pole, that at the positive pole decreasing, and that at the negative pole steadily increasing, as the air-pressure is diminished. He regards this as explaining the anomalies of unequal heating of the electrodes.—W. Donle, contributions to knowledge of the thermo-electric properties of electrolytes. According to these experiments the thermo-electromotive force between two electrolytes, such as solution of sulphate of copper and sulphuric acid is approximately proportional to the differences of temperature of the points of contact; the proportionality varying in some way with the concentration of the solutions. The electromotive force is usually less with more concentrated solutions. Through the heated junction of a chloride and a sulphate the current flows from chloride to sulphate.—F. Auerbach, on the electric conductivity of metal powders. Precipitated silver was used. The author finds an enormous reduction when the density is increased by mechanical force.—R. Krüger, on a new method of determining the vertical intensity of a magnetic field. This method consists in sending an electric current radially through a horizontal copper disk suspended by a thin wire, and observing the rotation of the disk.—R. Maurer, on the ratio of the sectional contraction to the longitudinal elongation produced in rods of glue-jelly. The rods were made of gelatine and water, and of gelatine and glycerine. One of the methods was an electrical one, consisting in observing the change of electrical resistance on stretching. These jelly rods exhibit the phenomena of residual strains very markedly.—M. Hamburger, researches on the duration of the impact of cylinders and spheres.—Dr. K. Noack, on the fluidity of absolute and diluted acetic acids. Curious minima of fluidity are observed by the author, varying with concentration and with temperature.—W. Müller-Erzbach, the law of decrease of absorbing power with increasing distance.

## SOCIETIES AND ACADEMIES

### EDINBURGH

**Royal Society**, July 19.—Mr. Robert Gray, Vice-President, in the chair.—The Right Hon. Lord Rayleigh communicated a paper on the colours of thin plates. He has laid down on Maxwell's triangle of colours a curve representing the variation of the colours of thin plates as the thickness of the plates increases.—Prof. Dr. Fr. Meyer communicated a paper on algebraic knots.—Prof. Tait described Amagat's "manomètre à pistons libres."—Prof. C. G. Knott communicated a paper on the electrical properties of hydrogenised palladium. This paper contains the results of experiments on the resistance and thermo-electric properties of hydrogenium or hydrogenised palladium. Up to a temperature of about 200° C. no special peculiarity is noticeable; but at that temperature, or a little higher, hydrogen begins to escape from the wire, and this causes the particular specimen of hydrogenium to recover partially, if not wholly, its pure palladium characteristics. It is known that the resistance of a palladium wire charged with hydrogen at ordinary atmospheric temperatures increases at a rate almost strictly proportional to the amount of charge. The same law seems to hold at all temperatures up to 150° C., and in such a way that the *total* increase of resistance of a given palladium wire for a given rise of temperature is nearly the same at all charges; or the temperature-coefficient for any particular specimen of hydrogenised wire is practically inversely proportional to the resistance as compared with the resistance of the wire in its pure uncharged state. Just before the hydrogen begins to escape, the resistance begins to increase somewhat more rapidly than at lower temperatures; and this peculiarity is more marked in the specimens of higher charge. When once the hydrogen begins to escape, the resistance begins to fall off rapidly as the temperature rises to 300° C. At this temperature the wire cannot be distinguished from pure palladium. In the thermo-electric experiments, peculiar irregularities appear at the higher temperatures, which seem to be due to the fact that the hydrogenium wire is unequally heated, and that the hydrogen, which is almost completely driven out of the heated portion of the wire, returns partially as the wire is cooled down again. In all cases at temperatures below 150° C., the current is from pure palladium to hydrogenium through the hot junction, is probably proportional to the difference of temperature in each case, and is greater for the greater charge. Thermo-electrically, fully saturated hydrogenium lies between iron and copper at ordinary atmospheric temperatures. On the thermo-electric diagram the hydrogeniums of different charge are represented (up to a temperature of 150° C.) by a series of straight lines parallel to palladium, whose thermo-electric powers at 0° C. range roughly from −600 (pure palladium) to +1400 (saturated hydrogenium) expressed in C.G.S. units. (Compare Everett's "Units and Physical Constants," p. 151.)

In other words, the electromotive force in a circuit of palladium and saturated hydrogenium, the temperatures of the junctions being 0° C. and 100° C., is $20 \times 10^4$ C.G.S. units, or ·002 volts. The thermo-electric peculiarities of hydrogenium may be prettily shown by the following simple experiment. Let a palladium wire, by immersion to half its length in the electrolytic cell, be hydrogenised throughout that half length. Attach the ends of this seeming single uniform wire to the terminals of a galvanometer, and let a flame be allowed to play gently at the central point of the wire. A large current is at once obtained, which grows to a maximum, and then diminishes to zero as the temperature rises to a red heat. There is no such current during cooling. This spurious neutral point is due to the hydrogen being driven out of the heated portion, partly, no doubt, into the contiguous colder portions. By following up with the flame the ever-shifting point of separation between the charged and uncharged portions, we may repeat the experiment indefinitely until the hydrogen is all driven out of the wire, or until the distribution of hydrogen has become fairly uniform.—Mr. Thomas Andrews communicated a paper on the electro-chemical reactions between metals and fused salts.—Mr. H. N. Dickson communicated a paper on the hygrometry of Ben Nevis and the Scottish Marine Station.—Mr. J. T. Morrison read a paper on the temperature of Loch Lomond and Loch Katrine during winter and spring; also, a note on the surface temperature near a tidal race.—Mr. John Aitken gave further remarks on dew.—Prof. J. B. Haycraft gave a communication on the nature of the objective cause of sensation.

### SYDNEY

**Royal Society of New South Wales**, July 7.—H. C. Russell, F.R.A.S., in the chair.—The following papers were read:—Further additions to the census of the genera of plants hitherto known as indigenous to Australia, by Baron Ferd. von Müller, K.C.M.G., F.R.S. The author gives the number of Australian plant-genera recorded hitherto as 2248.—Notes on improvements in the construction of reflecting telescopes by hand, and experiments with flat surfaces, by Mr. H. F. Madsen. The author showed an 18-inch speculum, and the glass tool with which it was worked. The latter was composed of three plates of 1-inch rough glass cemented to form a solid block, and worked to about one-quarter more convexity than the required concavity of the speculum, which was partly hollowed out at first by a leaden weight and emery. The speculum-glass was then ground by hand over the block, the two forming themselves into perfectly spherical surfaces having a high reflective power, and free from irregularities of less than 1/50,000 inch. The speculum, having now an absolutely true surface, was polished with emery upon pitch, it being uppermost, and moved round without pressure. The pitch-polisher had an improved graduation, the result being that, without side motion, the speculum was polished by hand for hours without producing the trace of a ring. Both polisher and glass having been regularly raised in temperature, were left together until cool, when ten minutes was required to give the true parabolic curve, the glass being simply revolved on the polisher, great care being taken to avoid the slightest inequality in temperature. Without the aid of machinery, it is doubtful if larger specula than 18-inch could be produced by hand. Mr. Madsen investigated the thickness of the silver film of a speculum by a novel optical method, and confirmed the late Dr. Draper's "chemical" estimate, viz. 1/200,000 inch. Two perfectly flat surfaces 5 inches diameter were taken and illuminated by a homogeneous yellow light of 1/44,000 wave-length, falling at an angle of 30° incidence (Brashear's colour-test), whereby a series of straight dark and coloured bands were visible. By silvering half the upper surface of one of these glasses the bands were displaced or broken at the edge, a distance of about $2x$ ($x$ being the distance between two succeeding bands). The thickness of silver, $\delta$, would be expressed by

$$\frac{\lambda\,(\text{wave-length})}{5} \sec 30 = 0{\cdot}00000525.$$

Several measurements gave less than 1/300,000 inch. Under the same optical methods the effects of heat and cold were rendered plainly visible and measurable. The true surfaces were placed on a 2-inch diameter wooden chuck; the light falling at 65° gave a uniform colour. On applying the finger without pressure upon the centre of the top glass, the colour changed to regular concentric rings, causing the glass to become concave by a measurable quantity. Placing the glass upon an iron support produced convexity (1/30,000 inch) in a regular curve. With a pressure of 8 lbs. on the centre, two wide bands of colour appeared, crossing in the centre, straining the glass in two directions, and destroying its figure. These experiments show how the defining power of specula and lenses is injured by temperature.

### PARIS

**Academy of Sciences**, August 30.—M. Émile Blanchard in the chair.—In the name of the Academy the President felicitated M. Chevreul on his hundredth anniversary, remarking that the case was unique in the annals of the Academy; even Fontenelle, although spoken of as a centenarian, having died shortly before reaching that venerable age. M. Chevreul replied with a few touching words of gratitude for the sympathy of his *confrères*, after which a telegram was read from the University of Kasan complimenting the patriarch of the scientific world on his long and laborious life, so fruitful in valuable contributions to the progress of the technical arts.—On a remarkable case in the problem of planetary perturbations, by M. F. Tisserand. In the case of two planets revolving round the sun, or of two satellites round their planet, in orbits slightly inclined towards each other, it is shown that even if the proper excentricity be null there may be a very sensible apparent excentricity. In other words, if the movement of one orb was originally circular and uniform, the perturbations caused by the other would transform this movement into one approximating to a Keplerian elliptical orbit with a uniform rotation of the long axis. These results are compared with those obtained by A. Hall and S. Newcomb for the Saturnian satellite Hyperion, in so far as its movement results from the perturbations caused by the larger satellite Titan.—On the atomic weight of germanium, by M. Lecoq de Boisbaudran. The atomic weight of this body, provisionally determined by M. Winkler at 72·75, and by the author theoretically at 72·28, is now found by M. Winkler to be 72·32. The law of proportionality between the variations of the atomic weight and those of the wave-lengths, a law already applied to gallium, here receives a fresh and important confirmation. It becomes at the same time highly probable that no appreciable error now exists regarding the atomic weights of cæsium, rubidium, potassium, indium, gallium, aluminium, tin, and silicium. In fact the wave-lengths and atomic weights of Cs, Rb, K, In, and Al have served to calculate spectrally the atomic weight of gallium (afterwards verified analytically), while the $\lambda$ and atomic weights of In, Ga, Al, Sn, and Si have helped to determine spectrally the atomic weight of germanium.—Note on a reptile of the Permian formation, by M. Albert Gaudry. To this reptile, which was found by M. Bayle in the Permian beds of Télots, near Autun, the author proposes to give the name of *Haptodus baylei* (from ἅπτω and ὀδούς), the teeth adhering so closely to the maxillaries as at first sight to be scarcely distinguishable from them. In these rocks, where no animals higher than fishes were for a long time known to occur, there are now found four distinct types of Reptilia: Actinodon, Protriton, Stercorachis, and Haptodus.—Phosphorography applied to the photography of the invisible, by M. Ch. V. Zenger. Observing Mont Blanc after sunset in September 1883, the author noticed that the blue-greenish glow remained perceptible till 10.30 p.m.; hence he concluded that the ice on the summit mingled with carbonate of lime emitted a light like that of Lake Geneva, and that it might be possible to fix the image of the mountain at night by means of the phosphorescent light of the ice, which is highly actinic. On his return he projected the images given by the photographic lenses in the dark chamber on a glass plate covered with a layer of Balmain's phosphorus, just as such plates are prepared with collodion. After exposing it for a few seconds, he removed it in the dark from the chamber in order to place it in contact with a not very sensitive dry photographic plate. After an hour of contact in the dark, the image of the object appeared in all its details as in an ordinary case of photographic impression. Subsequent experiments tended to show that light may be absorbed, and afterwards slowly given back, and that images of objects invisible in the dark may be fixed by simple contact, or by the photographic apparatus. He found it useful to cover the plates with chlorophyll, as when thus prepared they become sensitive to all the radiations of the solar spectrum from the ultra-red to the ultra-violet.—Observations of Winnecke's comet made at the Obser-

vatory of Algiers with the 0.50 m. telescope, by M. Ch. Trépied. On August 23 the apparent position of this comet was :—

| Algiers mean time. | Apparent Right Ascension. | Log. fact. parall. | Apparent Declination. | Log. fact. parall. |
|---|---|---|---|---|
| h. m. s. | h. m. s. | | ° ′ ″ | |
| 8 4 29 ... | 13 21 11·65 ... | 1·656 ... | − 3 2 31·8 ... | 0·731 |

—On some non-linear differential equations, by M. Roger Liouville.—On the algebraic integrals of the problems of dynamics, by M. G. Kœnigs.—Notes were submitted by M. Martin on an apparatus reproducing the motions of the heavenly bodies, and by M. L. Hugo on the geometrical forms of the hailstones which fell in Paris on August 23.

### Berlin

**Chemical Society**, July 26.—C. Liebermann, President, in the chair.—S. Gabriel has further examined isoquinoline obtained by the reduction of monochlorisoquinoline ; it melts at 20°. He has also prepared some new derivatives of dichlorisoquinoline.—Biedermann has prepared some derivatives of para-hydroxybenzylalcohol.—Raschig communicated a very interesting research on the nature of gold chloride. He has prepared nitrogen compounds corresponding to the three oxidation stages of gold, and these he has analysed by a new method ; he points out the analogy between the iodides of nitrogen and gold fulminate and the analogous compounds obtained from gold chlorides and methylamine.—Prof. Pinner reported on the following communications received by the Society :—Clève, on naphthalenesulphonic acids and on the value of orientation determined with the help of phosphorus pentachloride.—P. Bradley, on thienylglyoxylic acid and its derivatives.—R. H. Mertens, on the nitration of di- and mono-methylaniline with dilute nitric acid.—R. Leuckart and E. Bach, on the action of ammonium formate on benzaldehyde and benzophenone ; bases are produced, that from benzophenone having the composition $\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\!\!>\!CH.NH_2$. Camphor also reacts with ammonium formate with production of crystalline compounds which, however, have not yet been further examined.—T. H. van't Hoff and Ch. M. von Deventer have studied the question of the temperature at which reaction takes place in chemical decomposition and the accompanying phenomena : first in the case of double salts, *e.g.* sodium ammonium racemate or copper calcium acetate ; and secondly in the case of double decomposition, *e.g.* the decomposition of magnesium sulphate and sodium chloride with formation of astracamite and magnesium chloride, the reaction temperature in this case being 31°.—B. Tollens describes what he considers the best method for preparing formaldehyde.—Werner Kelbe and H. Stein have a paper on the products of the action of bromine on aqueous solutions of xylenesulphonic acids.—H. von Perger gives a preliminary account of the results obtained from the action of ethyl acetoacetate and ethyl acetonedicarboxylate on hydrazo-compounds.

### Stockholm

**Geological Society**, May 6.—Baron Nordenskjöld gave an account of his researches on the atomic weights of certain rare terrestrial metals, pointing out the peculiar conditions under which they combine in some minerals. He further described the analyses of the dust which had fallen in 1883 in the Cordilleras, believed to be of cosmic origin, being connected with the much-discussed red glows in the autumn of that year. Baron De Geer expressed the opinion that the glow was a natural meteorological phenomenon, though very pronounced in 1883, whilst Prof. Brögger sided with the usual view of its being caused by the Krakatão eruption.—Dr. E. Svedmark exhibited a map of the district of Roslagen, near Stockholm, showing the lakes and valleys which were considered to be caused by the cracking of the earth's crust. He also corrected the reported discovery of basalt at Tolånga, in the province of Scania, which on closer examination had been found to be diabase accompanied by the formation of tophus.—Dr. F. Svenonius read a paper forwarded by Dr. H. Sjögren, on the mud volcanoes in the neighbourhood of Baku, in which locality he has for a long time sojourned, in order to prosecute geological researches. The volcanoes occur in a line along the Caspian Sea some 120 miles in length. One of the greatest mud cones as 1000 feet high, and the crater 2100 feet in diameter, viz. almost equal to that of Etna. Three violent eruptions have taken place this and last year. They were accompanied by severe emissions of fire, as, for instance, once by a column of are 50 feet in height, visible at a distance of 80 versts. There are also violent discharges of gas, which on one occasion, on being fired, produced a fire-column 20 feet in height. The discharge was so violent that the current could only be fired at a height of 7 feet from the opening. The changes which the surrounding rocks and mountains had suffered through the influence of these volcanoes were of the greatest interest.

## BOOKS AND PAMPHLETS RECEIVED

"Journal of Society of Telegraph Engineers," Nos. 62 and 63 : List of Members (Spon).—"Pictorial Arts of Japan," part 3, by W. Anderson (S. Low and Co.).—"The Mulberry Silkworm," by C. V. Riley (Washington).—"Record of North American Invertebrate Palæontology for 1885," by J. B. Marcou (Washington).—"A List of the Mesozoic and Genozoic Types in the Collections of the U.S. National Museum," by J. B. Marcou (Washington).—"Proceedings of the American Academy of Arts and Sciences," October 1885 to May 1886 (Boston).—"Memoirs of the Geological Survey of India," vol. i. 3. "The Fossil Echinoidea." Fasc. vi. "The Fossil Echinoidea from the Makran Series (Pliocene) of the Coast of Bilūckistán and of the Persian Gulf," by P. M. Duncan, and W. P. Sladen (Trübner).—"University College, Bristol : Calendar for the Session 1886-87" (Arrowsmith, Bristol).—"Durham College of Science, Newcastle-on-Tyne : Calendar for the Session 1886-87" (Reid, Newcastle).—"University College, Dundee : Calendar for the Fourth Session 1886-87" (Lang and Co., Dundee).—"Analysis Tables for Chemical Students," by R. S. Taylor (S. Low and Co.).—"Exercises on Mensuration for Junior Students," by T. W. K. Start (S. Low and Co.).—"The Methods of Glass-Blowing," by W. A. Shenstone (Rivingtons).—"First Lessons in Zoology," by A. S. Packard (Holt and Co., New York).—"Fancy Pigeons," parts 11, 12, 13, by J. C. Lyell (U. Gill).—"British Cage Birds," parts 11, 12, 13, by R. L. Wallace (U. Gill).—"Loggio di Igiene Antimicrobica," by I. Giglioli (Napoli).—"Journal of the Chemical Society," September (Van Voorst).—"Thèses à la Faculté des Sciences de Paris," 1 and 2, by J. Deniker (Poitiers).—"Goolden and Trotter's Dynamos," 4th edition.

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