SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 22.—"A Determination of the Specific Heat of Water in terms of the International Electric Units." By Prof. Arthur Schuster, F.R.S., and William Gannon, Exhibition (1851) Scholar, Queen's College, Galway.

This research was originally undertaken by Prof. Schuster and Mr. H. Hadley, before the authors were aware that Mr. E. H. Griffiths was engaged on a similar investigation. After a number of preliminary experiments, and just as the final arrangements for the conduct of the measurements were being definitely made, Mr. Hadley, on his appointment to the head-mastership of the School of Science and Art, Kidderminster, had to leave Manchester.

On Mr. Hadley's departure, Mr. W. Gannon took his place. From the former gentleman we received a good deal of help in the devising and construction of some important parts of the apparatus.

The principle of the method we have used is extremely simple. The electrical work done in a conductor being measured by $\int ECdt$, where E is the difference of potential at the ends of the conductor, C the current, and t the time. We keep the electromotive force constant, and measure $\int Cdt$ directly by a silver voltameter. We do not, therefore, require to know the resistance of the wire, and we thus avoid the difficulty of having to estimate the excess of temperature of the wire over that of the water in which it is placed. We also gain the advantage of not having to measure time, and therefore to be able to complete the experiments more quickly than we could have safely done if the length of time the current passed had to be measured with great accuracy.

Our final value is

J = 4·1804 Joules on the mercury scale of hard French glass,
4·1905 on the nitrogen scale,
4·1917 on the hydrogen scale,
at a temperature of 19°·1.

In comparing our results with that of other observers, we have in the first place to consider the value which Mr. Griffiths has obtained in his very excellent series of measurements. His final result (*Roy. Soc. Proc.* vol. lv. p. 26; *Phil. Trans.* clxxxiv. A (1893) is

$$J = 4{\cdot}1982(1 - 0{\cdot}00266\,\overline{\theta - 15}) \times 10.^7$$

This refers to the nitrogen thermometer. At a temperature of 19°·1, the value would be reduced to 4·1936, which corresponds to our 4·1905 at the same temperature. Griffiths' value is to be increased slightly, owing to the fact that he really measures the difference between the specific heat of water and of air. This would increase the value of J by ·0011 about, so that the value of J at 19°·1 would be raised to $4{\cdot}1947 \times 10^7$, which is exactly one part in a thousand larger than ours. The difference is small, but must be due to some systematic error, as both Griffiths' value and our own agree so well with each other, that ordinary observational errors and accidental disturbances could not have produced so large a difference in our results. The least satisfactory part of a calometric measurement must always be the application of the cooling correction, and we have considered it of great importance to reduce that correction as much as possible. The uncertainty of the cooling correction does not necessarily depend on its value; thus we can much diminish it by starting, as we have done in the third series, with the initial temperature of the calorimeter about as much below that of the water jacket as the final temperature is above it; yet the *uncertainty* of the correction does not seem to us to be diminished by that process. We may reasonably estimate the uncertainty due to the cooling correction, by calculating what the error in the observed rate of cooling, either at the beginning or the end of the experiment, must have been in order to produce a difference of one part in a thousand in the final result. We find in our own experiments that the error must have amounted to more than 15 per cent. We consider it unlikely that so large an error occurred always in the same direction. Apart from the cooling correction, however, it is difficult to see how a difference one-tenth per cent. in our result can be produced unless by the accumulation of a number of small errors.

The difference between our value of the equivalent and that of Mr. Griffiths are, however, of smaller importance than the difference which exists between them and the equivalent as determined directly by Joule, Rowland, and Miculescu. Joule's latest value, which is the only one which needs consideration, is 772·65 foot-pounds, at 61·7 F. The number refers to the degree as measured by Joule's mercury thermometer. Rowland adds to this a correction to the air thermometer of about 3, and another small correction for a change in the heat capacity of the apparatus, which brings the value up to about 776. The correction to the air thermometer has been obtained by means of a comparison made by Joule himself with one of Rowland's thermometers. Joule's original thermometers have been temporarily placed by Mr. B. A. Joule in the hands of Prof. Schuster, in order that an accurate comparison may be instituted between them and modern thermometers. A full description of the comparisons made will be given on another occasion. The result arrived at shows that the correction is less than that assumed by Rowland, and would bring his value up only to 775 at the temperature indicated.

Great weight must be attached to Rowland's determination, which at the temperature to which Joule's number applies is 777·6, and at 19°·1, 776·1, corresponding to our 778·5.

Equivalent in foot-pounds at Greenwich at 19°·1 referred to the "Paris" Nitrogen Thermometer.

Joule.	Rowland.	Griffiths.	Schuster and Gannon.
774	776·1	779·1	778·5

We now turn to an investigation of Miculescu (*Annales de Chimie et de Physique*, vol. 27, 1892), in which the mechanical equivalent of heat is measured directly by what seems a very excellently devised series of experiments. Its result is $4{\cdot}1857 \times 10^7$.

In order to compare Miculescu's value with that of others, we must apply a temperature correction which is somewhat doubtful; but taking the mean of Rowland's and Griffiths' values as the most probable at present, we obtain at 15° the following table:—

Equivalent in foot-pounds at Greenwich at 15° referred to the "Paris" Nitrogen Thermometer.

Joule.	Rowland.	Miculescu.	Griffiths.	Schuster and Gannon.
775	778·3	776·6	780·2	779·7

If we remember that Rowland's number referred to the "Paris" nitrogen thermometer would probably be smaller by one unit, we are struck with the fair agreement there is, on the one hand, between the results of Joule, Rowland, and Miculescu, and on the other hand between Griffiths and ourselves.

As far as we can draw any conclusions from the comparison, it seems to point to a difference in the value obtained by the electrical and direct methods. Whether this difference is due to some remaining error in the electrical units, or to some undiscovered flaw in the method adopted by Mr. Griffiths and ourselves, remains to be decided by further investigation.

Linnean Society, December 6.—Mr. C. B. Clarke, F.R.S., President, in the chair.—Mr. E. M. Holmes exhibited and made remarks upon a small collection of Japanese marine algæ, some of which were of considerable rarity in European collections.—Prof. D. Campbell brought forward some illustrations of the relations of vascular cryptogams, as deduced from their development. His remarks, which were listened to with great attention, gave rise to an interesting discussion, in which Prof. Bower, Dr. D. H. Scott, Mr. Carruthers, and Prof. Marshall Ward took part.—"A new revision of the *Dipterocarpeæ*," was the title of a paper by Sir Dietrich Brandis, K.C.I.E., who gave an excellent account of this order of forest trees, their structure and mode of growth, together with a survey of the literature relating to them, and a clear exposition of his views concerning classification. He pointed out that the order *Dipterocarpeæ* consists almost entirely of large trees which do not flower until they have attained a great size, with a spreading crown on a branchless stem often more than 100 feet high. Hence it is difficult to obtain complete specimens in flower and fruit; and this explains why a large proportion of the genera and species have only of late years become accurately known. Korthals in 1840 knew 34 species; A. de Candolle in 1868 described 126; Mr. Thiselton Dyer in 1874 estimated the order at 170. Sir D. Brandis now considers that there are 320 wellascertained species, belonging to sixteen genera, omitting the genera *Ancistrocladus* and *Lophita*, which he regards as justly excluded from the order. Notable species are the Sâl tree of India (*Shorea robusta*), great forests of which extend along the foot of the Himalayas and in Central India, the Eng tree (*Dipterocarpus tuberculatus*) of similar growth in Burma, and others found in Cochin China and Borneo. In the discussion which followed, an extended criticism was offered by Mr. Thiselton Dyer, who had paid special attention to this order of trees, and who, admitting the soundness of the author's views, considered his exposition of them most valuable. The paper was illustrated by lantern-slides showing the chief peculiarities of structure in the flowers and fruit.

Royal Meteorological Society, December 19.—Mr. R. Inwards, President, in the chair.—Mr. H. Southall read a paper on floods in the West Midlands, in which he gave an interesting account of the great floods which have occurred in the rivers Severn, Wye, Usk, and Avon. He has collected a valuable record of the floods on the Wye at Ross, which he arranges in three classes, viz. (1) primary or highest of all, those of 14 feet 6 inches and above; (2) secondary, those with a height of 12 to 14½ feet; and (3) tertiary, those with a height of 10 to 12 feet. The dates of the floods above 14 feet 6 inches are as follows: 1770, November 16 and 18; 1795, February 11 and 12; 1809, January 27; 1824, November 24; 1831, February 10; 1852, February 8 and November 12. The height of the recent flood on November 15, 1894, was 14 feet 3 inches, which was higher than any flood since November 1852. The flood on the Avon at Bath on November 15, 1894, is believed to have been the highest on record.—Mr. R. H. Scott, F.R.S., gave an account of the proceedings of the International Meteorological Committee at Upsala in August last, with special reference to their recommendations on the classification of clouds and the issue of a cloud atlas (see NATURE, December 20).—A paper by Mr. S. C. Knott was also read, giving the results of meteorological observations made at Mojanga, Madagascar, during 1892 to 1894.

EDINBURGH.

Royal Society, November 27.—Prof. Copeland, Astronomer-Royal for Scotland, Vice-President, in the chair.—Prof. M'Kendrick read a paper on observations with the phonograph, with experimental illustrations. He has devoted great attention to the development of the instrument. He uses very large conical metallic resonators, and has succeeded largely in getting rid of the nasal sound of the instrument, so that part-songs and concerted instrumental pieces can be reproduced with considerable accuracy, and can be made audible throughout a very large room. He exhibited, by means of a lantern, a large number of photographs of the surface of the wax drum, pointing out the peculiarities of the record corresponding to various qualities of instrumental or vocal notes and chords.

December 3.—Prof. Geikie, Vice-President, in the chair.—Dr. John Smith communicated notes on a peculiarity in the form of the mammalian tooth. Roughly speaking, the general appearance of the mammalian tooth is that of a cone, flattened to some extent, and twisted about its axis to a greater or less degree, and then bent so as to form a portion of a circle. If this bending takes place to a large extent, it is not easy to recognise the axial twist. The author showed that the characteristic is always present, being easily seen in the strong spiral of the narwhal's tusk, or the remarkably twisted teeth of the *Mesoplodon* described by Sir William Turner in the Reports of the *Challenger* expedition, and being almost unrecognisable in the human tooth. The axis of the twist is directed backwards and inwards from the face of the tooth, and it is this characteristic which enables dentists to distinguish teeth from each side of the mouth.—Mr. Gregg Wilson read a paper on the development of the Müllerian duct of amphibians. He contends that this duct does not arise from splitting of the segmental duct, but is developed in the same way as the Müllerian duct of the higher mammals.—Dr. George Hay, Pittsburg, submitted an account of a new method of correcting courses at sea. His apparatus consists of two superposed compass cards, whose north points are set at an angular distance apart which is equal to the magnetic variation. The true course being read off on one, the corresponding point of the other gives the compass course. Simple as this arrangement is, Dr. Hay asserts that he has never known it to be employed at sea.—Prof. Tait read a note on the constitution of volatile liquids. His equation, deduced from the graph of the *Challenger* results, applies with great accuracy to non-volatile liquids, such as water, at ordinary temperatures and at pressures up to 3000 atmospheres. It does not apply with quite so great accuracy at the lower pressures to such liquids at or near their boiling points, and it is still less accurate in this respect when applied to volatile liquids. Prof. Tait suggests that this may be due to the existence, in the liquid, of dissolved gases or of vapour.—Prof. Tait also read a note on the isothermals of ethylene." His equation enables one to calculate, with great accuracy, the pressure, at a given temperature and volume, in the neighbourhood of the critical point, from Amagat's observations; but the volume, at a temperatu e and pressure in the neighbourhood of the critical point, given by Amagat's observations, cannot be calculated, with any approach to accuracy, from the equation. This is due to the excessive rapidity with which the difference of the volumes in the liquid and vapourous states diminishes with increase of temperature as the critical point is approximated to.

PARIS.

Academy of Sciences, December 17.—Annual public meeting.—M. Maurice Lœwy in the chair.—The proceedings were commenced by an address, delivered by the President. The past year was referred to as a period of slow growth and consolidation of knowledge rather than as being characterised by any very brilliant discoveries. The members and associates deceased during the year—MM. Edmond Fremy, Brown-Séquard, Mallard, Duchartre, Ferdinand de Lesseps, General Favé, MM. Hermann von Helmholtz and P. Tcéhbichef—were referred to appreciatively, and their influence on the progress of science pointed out. The system of prizes given by the Academy was referred to at the conclusion of the address, which was followed by the reading of the awards by M. Berthelot. In Geometry the grand prize for the mathematical sciences was awarded to Dr. Julius Weingarten; honourable mention was accorded to M. C. Guichard. The Bordin prize was adjudged to M. Paul Painlevé (Analytical Mechanics), MM. Liouville and Elliot receiving honourable mention. The Francœur prize was obtained by M. J. Collet; the Poncelet prize by M. H. Laurent, for his mathematical works. In Mechanics the extraordinary prize of 6000 francs was awarded to (1) M. Lebbond (2000 fr.), for his works on electricity; (2) Commandant Gossot (2000 fr.), for the determination of the velocity of projectiles by means of sound phenomena; (3) Commandant Jacob (1500 fr.), for his study of the ballistic effects of the new powders; (4) M. Souillagouët (500 fr.), for his "Recueil de Tables du point auxiliaire." The Montyon prize fell to M. Bertrand de Fontvioland, for his works on the resistance of materials. The Plumey prize was equally divided between M. André Le Chatelier and M. J. Auscher. M. Autonne received the Dalmont prize (3000 fr. triennially) for his works on anal sis. In connection with the same prize, M. Maurice d'Ocagne was awarded a supplementary prize, M. Pochet exceptionally honourable mention, and M. Willotte very honourable mention. In Astronomy the Lalande prize was adjudged to M. Javelle for his researches on nebulæ. The Damoisean prize, for perfecting methods of calculation of perturbations of minor planets, went to M. Brendel. The Valz prize was awarded to M. Coniel for work on small planets, and the Janssen prize to Prof. George Hale (solar photographic observations). In Statistics the Montyon prize was adjudged to M. Boutin, a supplementary prize to Dr. Faidherbe, and honourable mention to Dr. A. Cartier and Dr. Tastière. In Chemistry the Jecker prize was divided between MM. Barbier, Chabrié, P. Adam, and Meslans. In Mineralogy and Geology the Vaillant prize was not awarded, as no memoir had been presented. In Botany the judges for the Desmazières prize awarded an "encouragement," to M. Sappin-Trouffy. The Montagne prize was accorded to M. Husnot for his publication on Mosses; Brother Joseph Héribaud received a second prize for his "Diatomaceæ of Auvergne." In Anatomy and Zoology the Thore prize to M. Cuénot for work on the physiology of insects. The Savigny prize to M. Mayer-Eymar for researches in conchology. The Da Gama Machado prize was reserved, although the Commission gave high praise to work submitted by Dr. L. Phisalix and M. L. Joubin. In Medicine and Surgery the Montyon prize to (1) M. Félizet for a treatise on "inguinal hernia of infancy, (2) M. Laborde for his work on "the physiological treatment of the dead body," (3) M. Panas for his treatise on "affections of the eyes." Mentions and minor awards went to MM. Legendre, Broca, Vacquez, Vaudremer, Marcel Baudouin, Ferreira, Ernest Martin, Pietra Santa, Voisin, and Petit. The Barbier prize was awarded to Prof. Henri Leloir for his work on scrofulo-tuberculosis, Drs. Artault and Tscherning receiving honourable mention. The Bréant prize was adjudged to M. Arloing for his work on the bacillus of peripneumonia in cattle; the Godard prize was accorded to MM. Melville-Wassermann and Noël Hallé; the Parkin prize to MM. Behal and Choay; the Bellion prize between Dr. Lardier and MM. Beni-Barde and Materne, Dr. Renon receiving honourable mention; the Mége prize to M. Faure; the Lallemand prize to M. Gley, honourable mention to MM. Nabias and P. Janet.—In Physiology, the Montyon was divided between MM. Phisalix and Bertrand and M. Raphaël Dubois, honourable mention being given to MM. Morot, Blanc, and Philippon; the Pourat prize fell to M. Haufmann, a mention being accorded to M. Thiroloix. In Physical Geography, the Gay prize was awarded to M. Martel. General prizes—The Montyon prize (unhealthy industries) was divided between MM. Balland and Layet; the Cuvier prize was awarded to Mr. John Murray, of the *Challenger* expedition; the Trémont prize was accorded to M. Émile Rivière; the Gegner prize to M. Paul Serret; the Delalande-Guérineau prize to the Marquis de Folin; the Jérome Ponti prize to Commandant Defforges; the Tchihatchef prize to M. Pavie; the Houllevigue prize to M. Bigourdan; the Cahours prize (1) to M. Varet and (2) M. Freundler; the Saintour prize to MM. L Deburaux and M. Dibos; the Laplace prize to M. Édouard Glasser; and the Rivot prize to MM. Glasser, Leprince-Ringuet, Henri Parent, and Le Gavrian. The programme of prizes for 1895, 1896, 1897, and 1898 is given in detail so far as yet decided.

BERLIN.

Physiological Society, November 23.—Prof. du Bois Reymond, President, in the chair.—Prof. Zuntz gave an account of his researches on the measurement of the amount of blood in circulation and the work done by the heart. For the horse he found 71 to 72 c.c. of blood per kilo body-weight per second; for the dog, as based on the consumption of oxygen, 78 c.c. These values do not correspond to the marked difference in size of the animals, but may be explained as due to the fact that the dog was experimented upon while fasting and at rest, whereas the horse was not. For a horse in complete rest the value obtained was 50 c.c. For man he estimated the value at 60 c.c. Blood-pressure falls but slightly along the arterial system, and was found to be nearly the same in the carotid and in a small branch of the facial artery. The work done by the human heart he calculated as amounting to about 20,000 kilogram-metres in the twenty-four hours. When the body is working the work done by the heart increases also, so that in the case of the horse the blood pumped out now amounted to 600 c.c. per kilo per second, or twelve times as much as during rest. The frequency of the pulse could by work be increased four-fold, and the work done by the heart to thrice its normal amount.—Dr. Cohnstein had carried out further experiments on the transudation of solutions of salts into distilled water, and using mixtures of salts as well as mixtures of colloids and crystalloids, he had observed that an increased transudation of the solids follows upon an increase of external pressure. He applied these results to explain the mode of formation of lymph, which he attributed to transudation as well as to filtration, thus opposing Heidenhain's view that it is due to a distinct secretion. He explained the action of lymphagogues, on the basis of his own experiments, as due to the power these substances possess, when mixed with an albuminous fluid, of confining the diffusion of the external fluid entirely towards the interior of the tube which contains them in solution.

AMSTERDAM.

Academy of Sciences, November 24.—Prof. Van de Sande Bakhuyzen in the chair.—Prof. J. A. C. Oudemans communicated the results obtained in solving two problems, an astronomical and a geodetical one, namely:—(1) In how long a period do stars, the velocities of which in the line of vision are known, lose or gain 0·1 magnitude? (See "Our Astronomical Column," December 13, p. 160).—Dr. Van Romburgh (Buitenzorg) has examined the essential oils of *Polygala variabilis*, H. B. K., *B. albiflora*, *Polygala oleifera*, Heckel, and *Polygala Javana*, and found them to be nearly all methylsalicylate.—Mr. Jan de Vries: on a group of plane curves. This paper contains some theorems on plane curves ϕ of the $(n+m)^{th}$ order, with m^2 double points, (Δ), forming the base of a pencil of curves of the m^t degree.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, DECEMBER 27.

ROYAL INSTITUTION, at 3.—The Manufacture of an Electric Current: Prof. J. A. Fleming, F.R.S.

FRIDAY, DECEMBER 28.

ROYAL GEOGRAPHICAL SOCIETY, at 4.—Holiday Geography: Dr. H. R. Mill.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—The Current Working of a Chemist: Prof. J. A. Fleming, F.R.S.

SUNDAY, DECEMBER 30.

SUNDAY LECTURE SOCIETY, at 4.—The Action of Light on Bacteria and Fungi: Prof. Marshall Ward, F.R.S.

TUESDAY, JANUARY 1, 1895.

ROYAL INSTITUTION, at 3.—The Working of an Electric Current: Prof. J. A. Fleming, F.R.S.

THURSDAY, JANUARY 3.

ROYAL INSTITUTION, at 3.—The Working of an Electric Current: Prof. J. A. Fleming, F.R.S.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—The Working of an Electric Current: Prof. J. A. Fleming, F.R.S.

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