THURSDAY, JANUARY 1, 1885

THE "AMERICAN JOURNAL OF MATHEMATICS"

American Journal of Mathematics, Pure and Applied. Published under the Auspices of the Johns Hopkins University. Vols. v., vi., vii., Part I. (Baltimore: Isaac Friedenwald, 1882-4.)

THE general features of this *Journal* have been clearly indicated in the notices of the previous volumes (see NATURE, vol. xxii. p. 73, vol. xxvii. p. 193), and we need only remark under this head that these original characteristics have been maintained throughout the numbers now under our consideration.

Prof. Sylvester was the editor-in-chief until his return to this country; now the mantle has fallen upon his successor, Prof. Newcomb, under whose auspices vol. vii. is being published. Dr. Thomas Craig has been the assistant editor during the issue of all the numbers.

The chief papers treat of the higher algebra. In this branch the contributions of Prof. Sylvester naturally loom large. They are "On Sub-Invariants, *i.e.* Semi-Invariants to Binary Quantics of an Unlimited Order," "Tables of Generating Functions, reduced and representative for certain Ternary Systems of Binary Forms" (the "Tables" were calculated by Messrs. Durfee and Ely), "A Constructive Theory of Partitions, arranged in Three Acts, an Interact, and an Exodion," a most valuable contribution to the theory, written with the author's characteristic fervour, but perhaps the gem of the collection is the first instalment of the "Lectures on the Principles of Universal Algebra."

We naturally turn next to the papers by Prof. Cayley. These are a "Note on a Partition-Series," "A Memoir on Seminvariants," following up a "remarkable" discovery by Capt. Macmahon, which leads to the conclusion that the theory of seminvariants is a part of that of symmetric functions, and three sets of tables, viz. non-unitary partition tables, seminvariant tables, and tables of the symmetric functions of the roots, to the degree 10 for the form—

$$1 + bx + cx^2/1\cdot2 + \ldots = (1 - ax)\ (1 - \beta x)\ (1 - \gamma x)\ldots$$

Following in the wake of these leviathans, Mr. Durfee contributes "Tables of the Symmetric Functions of the Twelfthic," and "The Tabulation of Symmetric Functions"; Capt. Macmahon writes on "Seminvariants and Symmetric Functions," "Symmetric Functions of the 13^{ic}," and "On Perpetuants"; he is also the author of a short "Note on the Development of an Algebraic Fraction," the moving cause of which is a previous article by M. Faà de Bruno, entitled "Sur le développement des fonctions rationnelles," which in its turn owed its origin to a note by Prof. Sylvester in the *Johns Hopkins Circulars*. Mr. J. Hammond, another worker in this field, has a paper "On the Solution of the Differential Equation of Sources," in which he gives a disproof of Prof. Sylvester's fundamental postulate, a discovery which he first communicated to the London Mathematical Society. Mr. G. S. Ely applies the method of graphs to compound partitions, and Mr. Morgan Jenkins gives a proof of a theorem in partitions, and furnishes a note on Prof. Sylvester's constructive theory of partitions, mentioned above.

We pass from this group of subjects, which centres more especially round the name of Sylvester, and come to papers on elliptic functions in one or other of the forms under which that branch is now ranged. M. Faà de Bruno has a long article on "Quelques applications de la théorie des formes binaires aux fonctions elliptiques"; Dr. Craig contributes several papers, viz. "Some Elliptic Function Formulæ," "On a Theta-Function Formula," "On Quadruple Theta-Functions" (two papers), "On Theta-Functions with Complex Characteristics," and "On Certain Groups of Relations satisfied by the Quadruple Theta-Functions." Prof. W. W. Johnson presents a proof of the imaginary period in elliptic functions; Mr. A. L. Daniels communicates three notes on Weierstrass's methods in the theory of these functions; and Prof. Cayley, in a memoir on the abelian and theta functions, reproduces, with additional developments, the course of lectures which he delivered at the Johns Hopkins University in the early months of 1882.

The other papers on algebraical subjects may be grouped together. They are:—"On Division of Series," by Rev. J. Hagen; "Tables for Facilitating the Determination of Empirical Formulæ," by A. W. Hale; "On the Development of an Algebraic Fraction," by Dr. Franklin; some papers "On the Theory of Numbers," by A. S. Hathaway; "Sur une formule relative à la théorie des fonctions d'une variable," by M. Hermite; "Calculus of Direction and Position," by E. W. Hyde; "Compound Determinants," by C. A. Van Velzer (written before the author had seen Mr. R. F. Scott's paper in vol. xiv. of the London Mathematical Society's *Proceedings*), in which is discussed Picquet's proof of a theorem of Sylvester's. Mr. McClintock writes on the resolutions of equations of the fifth degree, a subject which is also handled by Mr. G. P. Young, who in addition discusses the principles of the solution of equations of the higher degrees. Mr. G. S. Ely furnishes some notes on the numbers of Bernouilli and Euler (adopting a name given by Sylvester), and gives a useful bibliography of Bernouilli's numbers. Such lists as these are of great service to workers.

Dr. Story defines the absolute classification of loci to be that classification which is not altered by any real linear transformation, and which is identical with the ordinary classification in so far as the latter is independent of all consideration of the nature of the infinite elements of the loci; a part of this classification has been made (as Dr. Story remarks) in essence by Prof. Sylvester in the *Phil. Mag.* (February 1851). The title of the paper is "On the Absolute Classification of Quadratic Loci, and on their Intersections with each other and with Linear Loci." The same author also contributes two articles on the non-Euclidian geometry: one is a continuation of a paper by him in vol. iv., and in it are given a number of formulæ relating to distances, angles, areas, and volumes; the other is entitled "Non-Euclidian Properties of Conics," and contains an application of Prof. Cayley's projective measurement, generalised by Klein, and still further extended by the author in the paper just cited, to the conic.

Dr. Franklin discusses some points in the theory of

cubic curves by a novel method, but not many new theorems are the result; and Mr. E. W. Davis gives an expression for the co-ordinates of a point on a binodal quartic curve as rational functions of the elliptic functions of a variable parameter.

The only purely geometrical article is one by Mr. B. Alvord, entitled "The Intersection of Circles and the Intersection of Spheres." The problems discussed are to draw a circle which shall make a given angle with three given circles; to draw a sphere which shall cut each of four given spheres at a given angle; and then two Steinerian problems, viz. to draw a circle which shall cut four given circles at the same angle (angle unknown), and the analogous problem for five spheres. The number of solutions in each case is given, and there are four plates containing thirteen figures. Prof. C. H. Smith supplies a graphic method of solving spherical triangles.

There is a single astronomical article on certain possible abbreviations in the computation of the long-period inequalities of the moon's motion due to the direct action of the planets, by Mr. G. W. Hill, who states that Hansen has characterised the calculation of the coefficients of these inequalities as extremely difficult, but he himself thinks that, if the shortest methods are followed, there is no ground for such an assertion.

Prof. Turazza gives a note (which the editor had mislaid for three years), "Di un nuovo teorema relativo alla rotazione di un corpo ad un asse."

The only physical paper is Prof. Rowland's, "On the Propagation of an Arbitrary Electro-magnetic Disturbance on Spherical Waves of Light and the Dynamical Theory of Diffraction." The classical paper by Stokes "On the Dynamical Theory of Diffraction" is discussed; in addition the author treats of the general problem of spherical waves of light, which he has not seen considered anywhere else.

We think the titles of the papers and a perusal of their contents quite bear out Mr. Glaisher's opinion, pronounced in his notice of the previous volumes (vol. xxvii. *ubi supra*), viz. that "the volumes represent a considerable amount of mathematical work, a fair proportion of which may have real influence on the advancement of the science." Some readers might like to have a more diversified bill of fare set before them, but no one can say that what is offered is not generally first class. The form of the *Journal* lends itself admirably to the important tables with which it has been enriched from its earliest days. We are glad to find this young work maintaining its early promise, and we wish for it even a higher success in the days to come.

A SYSTEM OF PSYCHOLOGY

A System of Psychology. By Daniel Greenleaf Thompson. 2 vols. (London: Longmans, 1884.)

PSYCHOLOGY, like other sciences, may be regarded as a pure science, or as a set of generalisations capable of application to practice, or as material for a philosophical construction. Mr. Thompson has treated it, for the most part, in the spirit of a scientific inquirer. He does not stop to make applications to practical questions, and although he is not without metaphysical views of his own, it is evident that he is interested in psychology more for its own sake than for the sake of its bearing on his theory of the universe. There is, therefore, no need to discuss here the questions in dispute between the empirical school to which Mr. Thompson belongs and its various critics. As he has treated psychology so much in the scientific spirit, we may confine ourselves to indicating the kind of work he has done in his own special line.

Some have denied that psychology is a science, on the ground that it does not make progress; but it is only necessary to compare Locke's "Essay" with any modern work in which the treatment is not altogether inadequate, in order to see that progress has been made both in accuracy of description and in refinement of analysis of psychological facts. The admiration that must be felt for what Locke was able to do only makes the comparison more conclusive so far as the establishment of the scientific character of psychology is concerned. In criticising any new book, then, we ought to ask whether the author has made any advance on his immediate predecessors. We ought, in fact, to apply to the particular author we are criticising the test of progress to which psychology as a whole may be submitted. Mr. Thompson's book will emerge successfully from an examination such as that which is here suggested. In dealing with many special questions he goes beyond the later English psychologists just as they themselves have gone beyond Locke.

A student might very well begin with the sixth part of Mr. Thompson's book, entitled "The General Development of States of Consciousness," in order to get at the author's more important results, and then read the parts that come before it to understand more fully his general view of his subject, and the parts that come after it for new details. In this division of his work, the author brings out very clearly the difference between "presentative" and "representative" states of consciousness, and shows the influence of this difference in the spheres of feeling and of will, as well as of cognition. Emotional states are classified according to their relation to the environment, which may take the form of "pleasurable interest in external objects" or of "aversion to external objects." The chapter on "volitional development" (the first of the second volume) deserves the special attention of the psychological student. Mr. Thompson's introduction into the view he gives of the external world in its relation to mind (in Part III.), of a sort of Cartesian conception of "matter" as including "space," must be at least alluded to as likely to be found interesting both by physicists and metaphysicians. Although philosophy and science are now too much specialised for an idea of this kind to have any direct influence on research, yet all discussion between philosophers and men of science of the more general terminology of the sciences, and especially of physics, must have some effect in compelling clear definition of terms on the part of physicists and at the same time in keeping philosophic thought in contact with its basis of scientific law.

Mr. Thompson might perhaps have given a better account of the introspective method in psychology if he had had fuller possession of the idea of mind as something common to all individuals; if he had been able to show more clearly that it is not simply the individual

mind, but rather the general human mind, that the psychologist analyses. His omission to make it clear that psychology is really the science of human nature, and not a mere description of the mental states of an individual, or of as many individuals as possible, does not, however, destroy the value of his results. When he describes the science of psychology as being a sort of resultant of the contributions of various people who "chronicle their states," this is only an imperfect description of the method of psychology and of what it implies. To state the case in this way is to lose sight of the fact that society is an organism, and to consider it as an aggregate of isolated individuals; but, without any elaborate analysis, we may show that the introspective method of Mr. Thompson and of the older psychologists really implies more than the examination of any number of individual minds merely as such.

There is probably quite as much minute observation of mental states to be found in literature with no scientific pretensions,—in novels and autobiographies, for example,—as in books of psychology. Why has this kind of "introspection" first of all a literary, and only secondarily a scientific, interest? Is it not because the states of mind described are regarded as states of a particular mind, because they are merely elements in the description of some one personality, because they have no distinct reference to a law of mind in general? Of course some things in books of psychology have only a personal interest, and some things in books of pure literature may have a scientific interest; but there is no difficulty in distinguishing the two kinds of "introspection" when we meet with them, or in recognising them as essentially different.

The scientific character of the introspective method as being one that yields general conclusions is quite evident in Mr. Thompson's book, in spite of his omission definitely to point out this character. It has already been said that his "System of Psychology" furnishes new evidence of the progressive character of psychological studies. We may conclude by saying that, although in some respects an unequal book, it is decidedly an important contribution of America to the treatment of psychology on the lines with which English readers are most familiar.

OUR BOOK SHELF

The Student's Flora of the British Islands. By Sir J. D. Hooker, K.C.B., &c., &c. Third Edition. (London: Macmillan and Co., 1884.)

THE lover and collector of our wild plants may congratulate himself on the number of botanists of the first rank who have devoted their energies to his service. Bentham, Hooker, and Babington have all of them written hand-books of the British flora, all of them excellent in their way. In the one now before us we have the well-known lucidity of description characteristic of the author combined with the most recent extensions of our knowledge as regards British plants. Very great care and labour have been expended in bringing the "Student's Flora" abreast of the most recent discoveries. The number of species of flowering-plants added to the British flora since the publication of the last edition in 1878 is not inconsiderable, indeed is surprising, considering the limited extent of the field and the number of workers on it. In addition to the introduction of these new species, the limits of species and sub-species have been carefully revised, and the "critical" genera submitted to the criticism of experts; the genus *Potamogeton* having been, in particular, revised by Mr. Arthur Bennett. Nor has the physiological side of the subject been neglected. For the first time, as far as I am aware, in any local flora of importance, the characters of the genera concerned in the process of fertilisation are given, especially those illustrated by the writings of the late Hermann Müller. Under the diagnosis of each genus it is stated—as far as is known—whether the plants belonging to it are wind-fertilised, insect-fertilised, or self-fertilised; whether honey is secreted in the flower or not; and whether the stamens and stigma ripen together, or, if not, which is the earlier. The result is that the field-student has now a hand-book of the characters of the plants that he meets with in wood and field, by stream and bog, and on the mountain-side, more complete than any which has heretofore been ready to his hand. A. W. B.

Elementary Text-Book of Zoology. General Part and Special Part, Protozoa to Insecta. By Dr. C. Claus. Translated and edited by Adam Sedgwick, M.A., Fellow and Lecturer of Trinity College, Cambridge, with the assistance of F. G. Heathcote, B.A., Trinity College, Cambridge. (London: W. Swan Sonnenschein and Co., 1884.)

PROF. CLAUS'S "Elementary Text-Book of Zoology" has long been known as an excellent introduction to this branch of biology, and there was a certain charm in the way in which the introductory chapters, constituting the "General Part" of the work were written, that marked out the "Lehrbuch der Zoologie" as something different from many of the text-books that had preceded it. Its well-merited success in parts of the Continent where German is spoken is a matter of congratulation, and Mr. Sedgwick has translated it "with a view of supplying the want which," he tells us, "has long been felt by teachers as well as students in this country, of a good elementary text-book of zoology." It appears to us a pity that with this local demand for a good introduction to zoology, there should be apparently no other way of supplying it than by translating the works of our illustrious neighbours. It is certainly not the way that the schools of the great Continental centres are supplied, nor do we believe that it is from any want of original power to supply the need among our own zoologists. This view of the subject apart, the English student of zoology will find this translation of Claus's "Lehrbuch" a very excellent introduction. It is true that he may now and then note that it was not written for him, that the illustrations of specific forms referred to are not always, even when they might have been, within his easy reach; that some of the contributions of his countrymen are referred to as if they had first appeared in a foreign tongue, and that many very important ones are overlooked, but these will be scarcely difficulties in his way; and if they are, on application to an intelligent teacher they will be soon got over.

The original German has, with a few "unimportant exceptions, been closely followed throughout," but has it not been too closely adhered to, when it has been left altogether untranslated, as it apparently has been in the case of many very familiar families of insects? In some of these, too, the English equivalents are not perhaps of the best; thus Acanthiadæ (skin-bugs). In welcoming this attempt to introduce Prof. Claus's most useful work to the English reader we have no wish in any way to criticise the treatise in detail. It is got up in a very creditable manner, though a little more uniformity in the style of printing the technical words would have been desirable; thus, on the same page we find the words "Cirripedia" and "Malacostraca" in roman and in italic type, and specific names are not italicised in all cases,

while sometimes such English words as "insect," "spider," "scorpion" will be in one form of type, and sometimes in another. These are trifles, but still they are worth attending to, and they do not detract from the general merit of this translation, which we would freely place in the hand of any student.

Bosnien, Land und Leute. By Adolf Strausz. 2 vols. (Vienna, 1882-4.)

AFTER the occupation of Bosnia and Herzegovina by Austria in 1878, the want of an authoritative and comprehensive treatise on those hitherto neglected provinces of European Turkey soon became manifest. This want is fully supplied by the present work, on which the author has been engaged for the last four years, and for the composition of which he has qualified himself by repeated visits to the region he has undertaken to describe. The first volume, issued two years ago, is mainly historical and ethnographic, and embodies a complete history of the country, from the arrival of the Slavs in the fifth century, down to the Austrian occupation in 1878. Special sections are devoted to the various ethnical elements, Mohammedan and Christian Bosnians, Jews, Albanians, Zinzars, and Gypsies. These are all adequately treated, except the Zinzars (Macedo-Roumanians or Kutzo-Vlacks), the account of whom is confusing and even contradictory. The author seems unaware that their true relations to the surrounding populations, and especially to the Roumanians, now settled in Moldavia and Wallachia, north of the Danube, have been placed in a clear light by the recent investigations, especially of Roesler and P. Hunfalvy. The volume concludes with a series of social sketches, in which the habits and customs, legends, traditions, religions, national aspirations of the people are ably dealt with. The second volume, whose publication was delayed by various causes till the present year, is perhaps the more important of the two. It contains a complete description of the provinces, their geographical features, climate, fauna, flora, natural and industrial resources, administration, present condition and future prospects. On all these points the author speaks with great authority, and brings together a vast amount of information at first hand. Although bitterly opposed to the Austrian occupation, he believes that the inhabitants will eventually acquiesce in a step which political considerations had in any case rendered inevitable. The area of the country is given at about 52,000 square kilometres, an estimate based on recent but still incomplete surveys. The population, given by the Salname of 1877 at 2,047,000, was reduced by the census of 1879 to 1,158,000, of whom 448,000 were Mohammedans, 496,000 Orthodox Greeks, 209,000 Roman Catholics of the Latin rite, and 3400 Jews. The work unfortunately appears without either map or index, for which two meagre tables of contents are poor compensation.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Solar Corona and After-Glow

THE inclosed extract from a letter from the Rev. A. W. Heyde, resident at Kailang in Lahoul, a hill state in the North-West Himalaya (N. lat. 32° 34′ 10″, E. long. 77° 4′ 10″), 10,000 feet above sea-level, gives an interesting notice of the solar corona and after-glow, and affords some reason for the inference that the conditions producing these appearances have been persistent, although they may not have been observed in the cloudier and more hazy atmosphere over the plains of India. Mr. Heyde's letter is dated November 3:—

"The corona round the sun has been visible since my last letter to you in July, whenever the sky was clear. It was not always equally distinct, but never entirely absent. It is beautifully distinct to-day. The same has been the case with the after-glow, which no doubt results from [the same conditions as] the corona."

The following extract from the same letter is also of interest:—

"I think I have mentioned already, in former letters to you, that since about twelve or fifteen years the latter half of August and the whole of September and October have become very unsettled as regards the weather, rain or snow occurring now often during these months, which, as a rule formerly, were a time of fine, clear weather. These untimely precipitations interfere very unpleasantly with the haymaking and harvesting in the valley now nearly every year, of which many complaints are heard. . . . A similar experience is made in Ladak and other parts of the Western Himalayas. Officers who took part in the triangulation of Ladak during the four or five seasons between 1860 and 1870 say they never could have done their work if at that time the sky over Ladak had always been so cloudy, and the high ranges so frequently enveloped in clouds, as is now the case."

In corroboration of this last remark I may mention that the hopes that had been entertained of obtaining a valuable series of actinometric observations at Leh, for which purpose two trained observers were deputed to that station rather more than a twelvemonth ago, have been so far grievously disappointed. The atmosphere of Leh was believed, on the reiterated assurance of former residents, to be remarkable for its clearness and freedom from cloud and haze. From the actinometric registers received during the past year, and the notes which accompany them, this appears to be very far from the case.

HENRY F. BLANFORD

Meteorological Office, India, 4, Middleton Row, Calcutta, November 21, 1884

Flying-Fish do not Fly

FLYING-FISH *are incapable of flying* for the simple reason that the muscles of their pectoral fins are not large enough to bear the weight of their body aloft in the air. The pectoral muscles of birds depressing their wings weigh, on an average, $\frac{1}{8}$ of the total weight of the body, the pectoral muscles of bats $\frac{1}{18}$, the muscles of the pectoral fins of flying-fish only $\frac{1}{32}$. The impulse to which flying-fish owe their long shooting passage through the air is delivered, while they are still in the water, by the powerful masses of muscle on both sides of their body, which are of much greater breadth than in the case of the herring or any other fish of their own size.

The "flickering of the fins," which Dr. John Rae (NATURE, December 4, p. 102), like many others before him, takes for a rapid muscular movement of the pectoral fins, is only a vibration of their elastic membrane, and is to be referred to the same laws as those which govern the flapping of a tight-set sail when a ship under a stiff breeze is driving close to the wind. The flapping or vibration at once springs up whenever the sail gets parallel to the wind.

The more rapidly a flying-fish darts out of the water, the greater is the momentum with which the air presses on its outspread pectoral fins. Should, now, the atmospheric pressure induce these fins into a horizontal position parallel to the wind, their vibration is a necessary result. Let the outspread pectoral fins of a dead flying-fish be held horizontally before the opening of a pair of bellows, and the fins will be seen to vibrate as soon as the current of air passes under them. For full proofs of the accuracy of these propositions I beg to refer to my paper, "The Movements of Flying-Fish through the Air" (Leipzig, 1878).

Zoological Institut, Kiel, Dec. 15, 1884 K. MÖBIUS

Iridescent Clouds

IN addition to the particulars given in NATURE for December 18, 1884 (p. 148) of the brilliantly-coloured clouds, the following observations made here may be interesting. They were visible every day from the 6th to the 13th instant, except it be on the 9th, and at all times of the day, but only strikingly noticeable near sunrise and sunset. The colours did not appear

on them when they were very far from the sun, they then being simply white. I did not see any dark ones, as described by J. E. Clark; indeed they always struck me as being very thin, merely like a nearly flat sheet. They tended to be arranged in bands like "Noah's Arks," and, while their texture was smoother than most cirrus clouds, they were more or less striated transversely. On some afternoons I noticed in many cases a feeble smoke-like prolongation, or tail, on the east side of the cloud; this had no colouring. They had thus sometimes a striking resemblance to an aurora, differing essentially, however, in their real position being horizontal, while the auroral band and rays are almost vertical. Their direction also was quite different: on the 11th at 8·15 a.m., and 13th at 3·40 p.m. I noticed that the striæ pointed to east by south. In shape they approached parallelograms apparently; really, to rectangles; sometimes they were very perfect rectangles. One of the most striking clouds was, however, a perfect right-angled triangle in form. Their motion was very slow. Some time after sunset they were so bright as to give a material amount of light, and to make the dust-circle around the sun look quite dim. They were evidently at a great height, though they looked lower than the dust-wisps. They were incapable of producing an ordinary halo.

Like Prof. C. Piazzi-Smyth, I can say that I have no recollection of seeing any clouds of the kind before. I saw nothing like them at the time of the grand sunsets last autumn, and I think he is mistaken in supposing any of the phenomena then seen were of the same character. T. W. BACKHOUSE

Sunderland, December 22, 1884

REFERRING to the letters which have appeared in these columns on the subject of "Iridescent Clouds" as seen at Edinburgh and York on the evening of December 11, a very similar phenomenon was seen at Derby at sunrise on that day, and was thus described in the *Derby Express* the same evening:—"About half an hour before sunrise the eastern half of the sky was covered with a dense pallium of cirrus cloud. About 30° above the horizon was seen what appeared to be an elongated opening in the dark grey of the cloud. Through this spindle-shaped opening the sky was of an intense emerald colour. The strangest part of the phenomenon, however, occurred shortly before eight o'clock, when the vivid green had given place to a mass of brightness comprising all the prismatic colours arranged in bands transversely, each of the primary colours shading gradually into its neighbour in the same manner as in a solar rainbow. The appearance was now not unlike a huge many-coloured eye set in a dark uniformity of cirro-stratus. As the sun arose the colouring faded, and when the solar orb was several degrees above the horizon the phenomenon remained as a patch of brightness upon a silver-grey vapour, and was somewhat similar in appearance to an imperfectly formed parhelion. Its position, however, with regard to the true sun, showed at once that the phenomenon was not of the parhelion class."

C. J. P.

THE iridescent cloud effect mentioned by your correspondents (see NATURE, p. 148) was well seen here on the 13th about 4 p.m., and was very much as described by Mr. Clark. Three distinct bands of colour were seen just at the upper edge of a dark slate-coloured cloud towards south-west, and two faint ones on the clearer sky above. I write specially to remark on the nature of the colour of these bands. They were not *prismatic* colours as mentioned by Mr. Clark, but unmistakable *interference* or residual colours, the lowest bright purplish pink, shading into green, the next the peculiar light brick red seen in Newton's rings, and a very recognisable colour, also shading into green, and the rest pink and green, of similar colour to the lowest. There can be, I thiuk, no question that this was an interference-phenomenon, and I hope some of your correspondents may be able to give the *rationale* of it.

Fairfield House, Darlington JAMES I'ANSON

I SEE notes in NATURE, December 18, 1884 (p. 148), on iridescent clouds. I observed similar appearances on the Yorkshire Wolds, between Market Weighton and Brough, on December 6 and again on December 13, 3-4 p.m.; but instead of the clouds being totally coloured, only the edges of rifts in a thick cloud-mass were so tinged. The phenomenon was much finer on the latter date, the rift being much larger and the colours more widely dispersed at one end, so that a rose tinge occupied there the whole of the acute angle of the gap.

Broseley, Shropshire W. W. WATTS

The Rotation of Neptune

SEVERAL circumstances delayed my observation of the planet Neptune this autumn until November 24. On that and the two following nights the light of Neptune was compared with the light of the star B.A.C. 1072; and, assuming that the light of the star was steady, that of Neptune was found to undergo apparently regular variations, but much smaller than they were last year.

The observations were combined in the following manner:—The magnitude, m, at any time, t, was assumed equal to

$$m_0 + k \sin n (t - t_0),$$

where m_0 was the mean magnitude at the time t_0, k one-half the variation between maximum and minimum, and n equal to $\frac{360^\circ}{7{\cdot}92}$, or 45°·45, according to the observations of Neptune last year, which gave 7·92 h. as the rotation-period. Subtracting m', the unknown magnitude of the comparison star, which is, however, of about the seventh magnitude, we have

$$m - m' = m_0 - m' + k \sin n (t - t_0);$$

and by assuming approximate values, by introducing corrections, and by solving the 11 equations corresponding to the 11 observations by the method of least squares, it was found that

$$\begin{aligned} m_0 - m' &= 0{\cdot}86 \\ k &= 0{\cdot}19 \\ t_0 &= \text{Nov. 24d. } 13{\cdot}01\text{h. G.M.T.} \end{aligned}$$

The preceding epoch of maximum will be found by subtracting 1·98h.; and similarly the following epoch of minimum will be found by adding 1·98h.

Now these observations were made without special care, and consequently the probable errors were larger than they should be in comparison with the small variation; but on the night of November 29 every care was taken to obtain accuracy in the photometric measures, and the following results were obtained:—

$$\begin{aligned} m_0 - m' &= 0{\cdot}82 \\ k &= 0{\cdot}20 \\ t_0 &= \text{Nov. 29d. } 11{\cdot}72\text{h. G.M.T.} \end{aligned}$$

The following is the comparison of observation and computation:—

Kempshot M.T. 1884 Nov. 29 h. m.		Diff. mag. $(m - m')$ Obs.		Comp.		O − C.
7 10	...	0·91	...	0·92	...	−0·01
8 26	...	1·03	...	1·02	...	+0·01
10 5	...	0·88	...	0·88	...	0·00
12 7	...	0·64	...	0·63	...	+0·01

It should perhaps be added that Kempshot is 5·19h. west of Greenwich.

By comparing the epoch on November 29 with the corresponding epoch on November 24, we find that 15 rotation-periods occupy 118·71h., so that each rotation-period is 7·914h., which may be considered identical with the period found last year. MAXWELL HALL

Jamaica, December 1, 1884

Peculiar Ice-Forms

CIRCUMSTANCES have prevented my replying earlier to Dr. Rae's letter in NATURE of November 27 (p. 81). The situation of the ice described in my letter of November 6 (p. 5) precludes the possibility of its having been a remainder from last winter's snow, since it was only some fifteen hundred feet above the valley of Chamounix, and exposed during the summer months to daily sunshine. In fact, the mid-day sun only just failed to reach it on the 17th of October.

In the *Neues Jahrbuch für Mineralogie* for 1877 (referred to by Dr. Wetterhan of Freiburg in NATURE, vol. xxi. p. 396) is an article by Dr. G. A. Koch giving an elaborate description and discussion of a very similar ice-structure, formed under very similar circumstances, which he observed on October 18, 1875, near St. Anton in the Arlberg. He also quotes other cases observed on the Wormserjoch in the Tyrol, and by Prof. Doenitz

in Japan. In all these, as well as in the case of the hills near Freiburg mentioned by Dr. Wetterhan, the soil appears to be a porous detritus with a hard substratum. At St. Anton, as at Chamounix, the hill-side sloped at an angle of about 50°, with a northern aspect, and in both cases and in Japan the phenomenon occurred in the autumn, a season often characterised, especially at high elevations, by cold nights and genial days. Dr. Koch calls it "*sonderbar*" and "*ganz eigenthümlich*," and it is plainly not of common occurrence.

Dr. Koch's explanation of the phenomenon is virtually the same as had occurred to me, except that both he and Dr. Wetterhan appear to consider that the water was derived by absorption from a moist atmosphere. In none of the descriptions, however, is there any mention of what was one of the most striking features of the ice which I tried to describe, viz. its division into distinct layers, each layer being of uniform depth; and this, showing as it does that the crystallisation was interrupted, and not continuous, seems to make it more probable that the water was supplied from below. The cylindrical perforations were, no doubt, caused by the presence of pebbles or small lumps of earth too dense to allow the ice-crystals to penetrate them, and too heavy to be pushed up. The layer of dust on the surface was much thinner in my case than in Dr. Koch's, which was no doubt due to accidental difference in the soil.

A friend in the country tells me that on a bright winter's day two or three years ago he picked up a piece of a dead beech-branch which was covered with filamentous ice, such as is described by the Duke of Argyll and others in NATURE (vol. xxi. pp. 274, 302). He brought it home, and, having examined it, left it out in the sun, when the crystals of course soon vanished. Next morning, however, he was surprised to see that they had all reappeared as before. The water from the melting ice had again filled the pores of the wood, and again been extruded in the same crystalline form. Now, if the highest temperature to which they had been exposed during the day had been 32° F., and a fresh supply of water had been afforded from any source to the wood, then neither would the ice have melted nor the water frozen; until the temperature fell again at night, when a fresh formation of crystals would have taken place, which would have pushed up those previously existing, and the result would have been a formation similar to that described in my letter. It seems more probable, therefore, that the moistening took place from below, as I suggested.

Hampstead, December 20, 1884 B. WOODD SMITH

Lightning in the Tropics

MY experience confirms the remarks of Dr. Von Danckelman in NATURE (p. 127) respecting the little damage done by lightning in tropical climates.

In the plains of India at the commencement of the monsoon, storms occur in which the lightning runs like snakes all over the sky at the rate of three or four flashes in a second, and the thunder roars without a break for, frequently, one or two hours at a time. During twelve years' residence in India I heard of only two human beings and, I think, three buildings being struck, although in parts of Lower Bengal the population amounts to more than 600 to the square mile. I always attributed the scarcity of accidents to the great depth of the stratum of heated air next the ground keeping the clouds at such a height that most of the flashes pass from cloud to cloud, and very few reach the earth. This idea is supported by the fact that in the Himalayas, at 6000 feet or more above the sea, buildings and trees are frequently struck. I have seen more than a dozen pine-trees which had been injured by lightning on the top of one mountain between 8000 and 9000 feet high. In the British Islands thunderstorms are said to be more dangerous in winter than in summer, and such a fact, if true, can be explained by the very thin stratum of air then intervening between the clouds and earth.

J. J. MEYRICK

London, December 19, 1884

An Unnoticed Factor in Evolution

I AM surprised that the letter of Mr. Catchpool in NATURE (vol. xxxi. p. 4) has remained unnoticed by your correspondents. His hypothesis that mutual sterility may be the *cause*, not the *result*, of specific divergence, is, I think, quite in accordance with many observed facts. The buffalo and the ox, the sheep and the goat, have lived for ages side by side without, as far as I am aware, a hybrid between either of them having been produced. Mule or hinny hybrids between the horse and the ass are obtained easily, but the offspring is rarely fertile, so rare, that the British Consul at Granada told me, when I was there, that he had never known of a case, although in Spain mules exist in thousands. Amongst bovine animals many species produce hybrids which are apparently perfectly fertile; those between the Indian ox and the gayal, species of different genera, *Bos* and *Bibos*, are common, and their fertility is shown by the existence of numerous intermediate hybrids. There is living at the Zoological Gardens at the present time, a hybrid between the Indian ox, the gayal, and the bison, and, by her side, a hybrid between herself and a bison. The offspring of the cross between many species of ducks are perfectly fertile. This I have repeatedly seen in the case of the hybrids between the tufted duck and the pochard. I think there is another *unnoticed factor in evolution*. The scent of animals plays an important part in their sexual relationships, and "sports" in this respect are as likely to occur as in the organs of the body; thus the peculiar odours of the sheep and the goat may be mutually repulsive.

J. JENNER WEIR

Chirbury, Beckenham, Kent, December 15, 1884

A Large Meteor

A MAGNIFICENT meteor was observed here last night. Its path lay from the west of σ Hydræ towards the west of η Monocerotis. Its head could not exactly be said to explode but broke up and extended suddenly considerably along its course, emitting a deep red and bluish white light, the latter of a most extraordinary brightness, for a moment quite sufficient to allow print to be discerned. It disappeared very near 11h. 19m. 6s. M.T. Dublin, and left a bluish white trace behind it, which could still with certainty be perceived seventeen minutes after the meteor had disappeared.

OTTO BOEDDICKER

Birr Castle Observatory, December 23, 1884

THE FORMATION OF THE SOLAR SYSTEM [1]

THE aspect of the heavens, the appearance of the planets, do not give us the least idea of the solar system. In order to understand it well, we must in imagination quit our world altogether, and remove ourselves to a distance, so as to embrace in one glance the little system of which so ordinary a star as our sun occupies the centre.

Around the sun there move eight primary planets at very unequal distances. Of these planets six have satellites; that is to say, they in their turn are centres of little systems reproducing the solar system in miniature. Thus the Earth has a satellite, the moon; Mars has two, Jupiter four, Saturn eight, Uranus four, and Neptune, the most distant, has one. A striking thing in this system, that which makes it unique, is that the sun turns on its own axis from right to left, and all the planets without exception revolve around it in the same direction, almost in the same plane, that of the rotation of the sun, and describe orbits very nearly circular.

Would not one say that a vast gyratory movement animates all these bodies, and that the secondary systems of the Earth, Mars, Jupiter, &c., are little whirlpools moving in the primary one? Such was the idea of Descartes. If the solar system does not actually constitute a whirlpool, it was originally formed by a movement of this nature in the nebula which gave it birth.

The sky exhibits here and there a large number of gigantic masses of extremely rarefied matter, like the mists of chaos, without shape, having undergone only that degree of condensation necessary to create a feeble light. We require usually a powerful telescope to distinguish them, and then we can see them by thousands in the heavens; these are *nebulæ*.

When you visit an observatory under the escort of an astronomer whom you know, tell him several days beforehand that what you wish is not to gaze at the moon, or the planets and their satellites, or the fixed stars, double

[1] Translation of an article by M. Faye in a recent number of *L'Astronomie*.

or treble, white or coloured, but only to examine the nebulæ of various degrees of condensation. Your wishes being thus indicated, the astronomer will point out to you the most characteristic objects, he will calculate their exact positions, will prepare his most powerful telescope, and then you will be able to make an interesting journey into space.

The nebula of Orion has not a clearly defined form; one region more brilliant than the rest can be distinguished, where the condensation of the chaotic matter is rather far advanced. In all other parts the light is feeble, and one can detect long streamers of matter of which it is impossible to predict the action.

The nebula of Andromeda is one of the most remarkable objects in the heavens. It has an almost geometrical form, and in the centre it exhibits a most distinct condensation.

The nebula of Leo presents nebulous rings in course of formation.

Finally, the curious double nebulæ of Virgo, Aquarius, &c., are evidently very near their ultimate transformation into stars.

It would be easy to multiply the intermediate stages, and to show, for example, some nebulous stars presenting the penultimate phase of this series of transformations, which commences with a feebly luminous mist without shape, and finally arrives at one or many suns variously connected. Needless to say, we are not present at these transformations, but we are like the botanist who in the forest studies the trees in their different degrees of development. Thus the creation of the universe is carried on, so to speak, under our eyes. In the beginning nebulæ separated out from a universal chaos; in the end, incandescent stars, or other globes so small that we cannot see them, because their formation has produced so little heat that their light is already extinct.

Let us imagine that, owing to some cause of which we shall presently speak, the spirals of a whirling nebula are transformed into nebulous concentric rings, governed by a common movement of rotation. In reality there exist in the heavens objects of this description: for example, the annular nebula in Lyra.

If such as these are rare, it is because they usually do not possess great stability. It is only a transitional form. In reality, in virtue of the differences of linear speed which predominate there, and because of the mutual attraction of their parts, the least cause will lead to eddyings, which, being obliged to follow somewhat the same road with rather different speed, reunite and are lost in a single nebulous mass, where, little by little, all the material of the rings will be absorbed. This nebulous mass, excited by a rotation in the same direction as that of the ring, will in its turn give birth to a planet surrounded by satellites revolving in the same direction and in the same plane.

We have a series of nebulous rings, some of which show the eddying condensation which ends in a mass of planets. At the same time the enormous quantity of material which in the midst of the original nebulæ was not used up in the rings, has little by little reunited in the middle, very slowly at first, but afterwards very quickly, giving rise to a central globe, a Sun, turning on its own axis in the same direction and in the same plane as the planets.

We thus see how a slow whirling movement, more or less indistinct, would be able to be governed so far as to give rise to these circular rings, all of them concentric and situated in the same plane.

It is necessary and sufficient for this theory that the solar nebula has been, in the first instance, spherical and homogeneous. In such a mass of matter the internal gravity resulting from the attraction of all the molecules varies in a direct ratio with the distance from the centre. The particles or the small bodies which move in such a medium, where the rarity is inconceivable, necessarily describe ellipses or circles round the centre *in the same time*, whatever may be their distance from that centre. Thenceforth the existence of rings rotating in one piece, with the same movement, is quite compatible with this condition of gravity, and if a whirling motion has pre-existed, some of these spirals, which are not so very different from circles, will have little by little become transformed into the rings previously described, owing to the small amount of resistance at the centre.

Let us take a step further. In virtue of the force of attraction these rings tend generally to break up and to form a nebulous spherical mass, which in the end contains all the material of the ring. Now these secondary nebulæ must necessarily be endowed with the same direction of rotation as that of the rings. Phenomena exactly like those of the primary nebula will then take place; that is to say, they will resolve themselves into concentric rings, then into a central globe. In their turn, the rings will be condensed into other very small balls—satellites revolving round each planet, always in the same direction, whilst the planet will turn on its own axis exactly in the direction and in the plane of these secondary rings.

It is thus that these things have come about. By a lucky chance some rings of the little secondary system of Saturn have escaped destruction, and have not been formed into satellites. I attribute their existence to the extreme thinness of these rings and to their rapid rotation.

We should now have finished the explanation of the solar system if this system did not offer a striking peculiarity, apparently in complete contradiction with what has preceded. Of the eight large planets revolving round the sun six have satellites, and thus form secondary worlds, exact representations of the solar world which includes them. After what I have said, all the rotations and revolutions ought to be in the same direction, and, what is more, in the "direct" direction. Now in the secondary worlds of the two planets furthest off—those of Uranus and Neptune—the rotations and revolutions of the satellites are in the opposite direction, that is to say, *retrograde*.

Must we believe that the theory that I have put before you is false? It is not false, but it is incomplete. And here we come to one of the most interesting points in the history of science. Newton and Laplace believed that all the rotations, all the revolutions must be in the same direction. Laplace went further, and applied to this question the theory of probabilities. In working on the planets and satellites as known in his day, his analysis showed that, if a new planet or satellite was discovered, the chances were tens of thousands to one that the revolution of this or that satellite, or the rotation of this or that planet, would be direct, like all the others, and he added that this probability is much greater than that of historical events which we accept with the utmost confidence. The study of the satellites of Uranus, and the discovery of the system of Neptune, however, has at once destroyed this probability, and the celebrated cosmogony of Laplace. This in fact by an ingenious process derives all the planets from the sun, but it can only give to the planets and satellites relations and revolutions in the same direction from one end of the solar system to the other, whilst in fact they are direct in the first half and retrograde in the second.

Let us actually complete our theory. In the primitive nebula, homogeneous and spherical, where the presence of rings revolving round the centre ought not to alter anything in the law of internal gravity, we have seen that this gravity varies in a direct ratio with distance from the centre. But, later, the sun was formed by the reunion of all the matter not wanted for these rings; this has produced an empty space around it. Therefore the law of gravitation in the interior of the system thus modified became quite different. Under the action of the preponderating mass of the sun (that of the rings was not

the 700th part of it) the internal gravity has varied, not in the direct ratio of the distance, but in the inverse ratio of the square of the distance from the centre, and that is the state of things to-day.

In this last case the method of rotation of a ring of diffused matter entirely changes. Let us hasten to say that this alteration does not hinder the ring from existing. Saturn is the proof of it.

But whilst, according to the law of gravity first in operation, the linear velocity of revolution in these rings increased with the distance; according to the second, this velocity on the contrary decreased in the ratio of the square root of this distance.

In the first case, when the ring will have degenerated into a secondary system, that is to say, into a nebula with exterior rings, and finally into a planet with its satellites, the rotation of the planet and the revolution of the satellites will be in the same direction as the movement of the original ring, that is to say, the motion will be "direct." In the second case the secondary system thus formed will be retrograde.[1]

What are we to conclude from this? It is evident that the planets from Mercury to Saturn, included in the central region, were formed according to the first law, when the sun did not yet exist or had not acquired a preponderating mass; and that the planets included in the exterior region, which was by far the larger, were formed when the sun had already come into existence.

If then it should be discovered that Venus had a satellite, its motion would be direct. If a planet were discovered outside Neptune, its rotation and that of its satellites would be retrograde. Here we have at last arrived at a conclusion of the greatest interest: the earth is much older than the sun. If it were otherwise—if, as Laplace would have said, its formation had been long after that of the sun—all would have been changed in the aspect of the skies: the stars would rise in the west and set in the east; the moon would have a retrograde motion, like the satellites of Uranus and Neptune. Let us add that at that time it was further from the centre than it is now; for when the matter which was outside the terrestrial orbit had passed over it to be reunited in the interior to orm the sun, as the attraction of the latter gradually preponderated, the revolution of all the planets within the orbit of Uranus was accelerated. These planets approached the sun at the same time that their satellites receded from them.

Finally, the actual state was attained, with the stability which characterises it, when the mass of the sun, having become enormous, could attract nothing more from the original nebulous matter, and had at last created around itself an empty space.

The universe has grown out of chaos, that is to say, out of a mass of matter excessively rare, without shape, occupying a vast space and moving in various directions, in virtue of which this chaotic matter was divided into separate masses. It is by the progressive condensation of these masses of chaotic matter towards certain centres of attraction that the innumerable stars have been formed. Their incandescence comes from the heat developed during the act of their formation. The amount of their heat is limited; they will end by being extinguished.

Amongst all the systems, which are infinitely varied, which have grown out of the condensation of this primary chaos, the solar system may be regarded as a very special case. The primary nebula which gave birth to it was spherical and homogeneous. In separating itself from other portions it had carried with it traces of a slow whirling movement. These motions were soon regulated, thanks to that particular law of internal gravitation resulting from its shape and its homogeneousness. Nebulous rings were thus formed in the same plane long before the appearance of a central condensation. They gave birth to nebulous masses also moving in this plane, in the same direction and in circular orbits, around their common centre.

The secondary systems formed in the same way into these partial nebulæ can be definitely separated into two categories: those which preceded the formation of the sun, revolving on their own axes in "direct" directions; whilst the secondary systems, the furthest off, formed after the sun, revolve in a retrograde direction. These strange phenomena which are presented by our solar system, are doubtless, by a rare exception in the universe, only the natural consequences of the initial conditions and of the laws of mechanics.

[1] Laplace believed that in the nebulous rings derived from the sun (according to his hypothesis)—rings which will have belonged to the second case as they would be exterior to the sun—the friction of different concentric layers would have had the same effect as what occurs in the atmosphere of a planet, which ends in moving altogether with the central globe. In this way the ring will have taken on the movement of the first form, that is to say a rotation; its outer marginal layers will have had a greater linear speed than that of the layers nearer the centre, and its condensation will have given place to satellites with direct motion. It is easy to show that this manner of looking is not altogether exact (in proof of this we can point to the rings of Saturn). The layers of an atmosphere press on one another; further, the external layers only resist by their inertia to the communication of the rotatory movement which tends to establish itself between the central globe and the extreme layers of its atmosphere. But, in a nebulous ring, the concentric layers do not press one on the other as in an atmosphere, for each one moves in virtue of its own speed at its distance from the sun. Further, the retardation of the layers situated near the extreme edge as compared with the internal layers is not due to their inertia, but to the laws of their motion. If then the solar system has been created in accordance with the hypothesis of our great geometrician, all the planets would have revolved round the sun in the direct direction, but their rotations and their satellites would be retrograde.

BERZELIUS AND WÖHLER

THE "Jugenderinnerungen eines Chemikers," which the late Prof. Wöhler contributed to the *Journal* of the German Chemical Society in 1875, contains a delightful sketch of the personal relations in which the great German chemist stood to his illustrious master; and Dr. Hofmann's account of Wöhler's life and works, published in the same journal for 1882, serves to fill in the details of the picture. The story of Wöhler's visit to Stockholm, of his intercourse with Berzelius, and of the influence which it exerted on the development of his scientific life, are now well known to chemists.

All the papers left by Berzelius are in the possession of the Swedish Academy of Sciences at Stockholm, and among them are the letters which he received from Wöhler. Some time before his death Wöhler presented his letters from Berzelius to the Academy with the injunction that they were not to be published before the close of the present century. Some extracts from the letters of Wöhler, on the publication of which no restriction was made, have recently been given to the world by Dr. Edv. Hjelt of Helsingfors,[1] from which we may gather some notion of the wealth of material which will be at the disposal of him whose lot it is to write the personal history of the chemistry of this century.

Wöhler's letters to Berzelius extend from 1823 to 1846, and are 230 in number. In all probability the correspondence was continued up to the time of Berzelius's death in 1848, but the letters of the last two years are not contained in the collection. The greater portion of the letters from Wöhler consist of accounts of his investigations, of discussions of scientific questions, of critical opinions on new works and new theories, and of *memorabilia* of the chemists of the time. Many of the letters have reference to the translation of Berzelius's "Jahresberichten" and his large "Manual of Chemistry" into German. Now and again we have a gossiping letter, rich in a quiet humour, and occasionally illustrated by quaint characteristic sketches. First in order of time comes Wöhler's application for a place in Berzelius's laboratory, dated July 17, 1823, and next is his grateful acknowledg-

[1] "Bruchstücke aus den Briefen F. Wöhlers an J. J. Berzelius." Herausgegeben von Dr. Edv. Hjelt. (Berlin: Robert Oppenheim, 1884.)

ment of Berzelius's prompt and cordial acquiescence in his wish :—

"Wie sehr freue ich mich auf diesen Winter," he writes, "wo ich mich einmal so ganz *con amore* der Chemie ergeben kann, ohne die Zeit in andere, mehr oder weniger fremdartige, nicht so ansprechende Studien theilen zu müssen."

Wöhler remained about a year in Stockholm ; he was wont to speak of his stay with Berzelius as "eine nicht zu berechnende Wohlthat." As to Berzelius, no one of his pupils lay nearer to his heart than Wöhler.

In the selection of his letters it is obvious that Dr. Hjelt has been loyally mindful of the condition imposed by Wöhler. Doubtless much of the correspondence had reference to letters of Berzelius, and therefore to matters which the world can only know of in the twentieth century. The letters which we are permitted to see have, however, a great interest from the light they shed on the writer's character, and from the accounts they give of the origin of those fruitful discoveries which have made the names of Liebig and Wöhler inseparable. How that partnership originated need not be told again. It seems, however, that in more than one letter Berzelius had expressed his conviction that Wöhler's share in the work was but imperfectly recognised. That Wöhler was, in fact, the mainspring of much of their labour is now known, but he himself writes, "What matters it, however, when the business in hand profits thereby, and such is assuredly the case. We two, Liebig and I, have dissimilar kinds of talent ; each, when in concert, strengthens the other. No one recognises this more fully than Liebig himself, and no one does me greater justice for my share of our common work than he."

In the following letter we get a glimpse of Liebig's mode of work :—

"The days which I spend with Liebig slip by like hours, and I count them as among my happiest. His apparatus for organic work seems to me most excellent, and he is a master, of almost pedantic exactitude, of organic analysis. But in all that relates to inorganic analysis, as, for example, filtration, use of lamps, &c., one sees throughout the imperfect French methods. He uses neither a filter-stand, nor good filters, nor usually a lamp. . . ."

Liebig's earnestness, and restless energy, and fiery impulsiveness, brought him unfortunately into frequent conflict with his contemporaries. It was almost inevitable that he and Berzelius should sooner or later come into collision. Nothing in the letters is more charming than the manner in which Wöhler sought to maintain peace between his friends, constantly seeking to excuse the one to the other. He writes of Liebig to Berzelius :—

"He is thoroughly upright, honourable, and generous, but passionate and inconsiderate."

At another time he wrote :—"He who does not know him intimately would hardly realise that at bottom he is one of the most good-natured and best fellows in the world."

It is somewhat remarkable that Wöhler, although trained in a school of which analysis was made the predominant characteristic, should have failed to discover any new elementary body, even whilst constantly occupied with the examination of rare minerals. We all remember the story of Vanadis and the "Schalk" Wöhler, who failed to woo her with proper assiduity. It now appears that the element thorium also slipped through his fingers unperceived. "Also," he wrote, "eine analoge Geschichte mit dem Gotte Thor, wie mit dem Göttin Vanadis." Wöhler's triumphs were won in organic chemistry. "The organic chemistry of to-day," he wrote in 1835, "is enough to make one quite dazed. It is like the primeval forest of the tropics, full of the most curious things ; an immense thicket without exit and without end."

One of the most historically interesting letters of the series is that in which he communicates to Berzelius his memorable discovery of the synthesis of urea—"ohne dazu Nieren oder überhaupt ein Thier, sei es Mensch oder Hund, nöthig zu haben." It now appears that the transformation of ammonium cyanate into a body which gave no reactions for either cyanic acid or ammonia was observed by Wöhler whilst in Stockholm, but the significance of the change escaped him for the time. How, almost accidentally, he returned to the subject, and how by three or four decisive experiments he establishes the nature of the new body, is shown in the letter. Berzelius had not then invented the word "isomerism." For a time, indeed, his conservatism rebelled against the conception. Wöhler's words in reference to urea—"This is therefore an incontestable example that two absolutely dissimilar bodies can contain the same proportion of the same elements, and that it is merely a difference in the mode of combination which brings about the dissimilarity in their properties"—must have paved the way for Berzelius's conversion. How strange, too, the following sentence must have sounded in 1828! "May not this artificial formation of urea be regarded as an example of the production of an organic substance from inorganic materials?"

The witty and sarcastic letter which appeared in the *Annalen* for 1840, in which "S. C. H. Windler, aus Paris," sought to ridicule the substitution theory of Dumas, was at the time generally ascribed to Liebig, but we know now that it was written by Wöhler for the amusement of Liebig, "ohne dass ich aber im Entfernsten daran dachte dass er so toll sein wurde ihn in den Annalen Abdrucken zu lassen."

Wöhler not unfrequently amused himself and his friends with *allotria* of this kind. The well-known flash which attends the crystallisation of plate sulphate of potash was on one occasion thus explained :—"Die Lichtfunken bei krystallisirenden Salzen hängen mit einer gleichzeitig im Krystall vor sich gehenden isomerischen Umsetzung der Bestandtheile zusammen, z. B. ein krystallisirtes Schwefelsaures Kali könnte eigentlich unter gewissen Umständen KSO_4 or KO_3SO geworden sein. Nun aber arrangiren sich plötzlich die Atome zu $KOSO_3$ und dabei blitzt es, weil in dem einem Falle Kalium zu Kali, und in dem anderen unterschweflige Säure to Schwefelsäure verbrennt. Ich will diese Idee an Kastner verschenken."

Berzelius died on August 7, 1848, after a long illness. Almost his last words had reference to Wöhler. Wöhler always spoke of their friendship as one of the brightest memories of his life, and we are told that even to the last the eyes of the old man would glisten when the name of Berzelius crossed his lips.

T. E. THORPE

AMERICAN STORM WARNINGS

THE Meteorological Office, through the co-operation of the Chief Signal Officer of the United States War Department, has commenced to issue notices of the current Atlantic weather, and it so happens at the very commencement of the system that the frequent occurrence of storms in the vicinity of the British Islands, as well as out in the open Atlantic, has afforded a favourable opportunity for testing the value of this extension of our weather knowledge. As a specimen showing the nature of the information, we append a copy of the notice issued on December 19 :—

"The Chief Signal Officer at Washington, U.S., reports that, at 4 a.m. on the 16th inst., in lat. 42° N., long. 60° W., with the barometer at 29·4 inches, there was a fresh gale from south, veering to west."

A subsequent notice was issued, showing that the same storm was met with eight hours later, and had advanced rapidly to the east-north-eastwards. It appears highly probable that the disturbance in question was the same

as that which passed swiftly across our islands during the night of the 19th to 20th, and had its centre off Yarmouth at 8 a.m. on the 20th, having travelled about 2600 miles in four days and four hours, or at the rate of twenty-six miles an hour. This rate is somewhat high for an average extending over so long a period, but it is in accordance with former experience for an isolated storm-centre, and is fully supported by the high rate of progress the storm had when traversing England. The barometrical gradients in the rear of this storm were very steep, and the difference of pressure was accompanied by a heavy gale on the 20th over the whole of the southern portion of our islands.

We are glad to see that the Meteorological Council are taking steps to ascertain the atmospheric changes which are going on over the Atlantic, since the weather of that ocean has such an important bearing upon that of the British Islands. It is now no longer a matter of speculation as to where the weather comes from which strikes our coasts, but the synchronous charts which have been prepared by the Meteorological Office, both under Admiral FitzRoy and the subsequent governing body, as well as by Leverrier, Hoffmeyer, Neumayer, and the Signal Service of the United States, amply prove that in the north temperate zone of the Atlantic, at least, there is a regular movement of the weather-systems from west to east, or, more strictly, from some point between west and south-west towards east and north-east. These weather-systems not only embrace storm areas, but, to a very large extent, all the ordinary weather changes. It is our intention here, however, to limit our remarks to the question of storms and unsettled weather, as not only being of primary importance, but the conditions with such weather will, although of a more pronounced type, illustrate in a very great measure almost all other meteorological changes.

Probably the enterprising proprietors of the *New York Herald* have done more of late years than all other authorities put together to popularise the fact that our weather changes traverse the Atlantic, but the notion, if nothing more, of the easterly translation was in existence 180 years ago, for Daniel De Foe, in his discussion of the great storm of 1703, inclines to the opinion that it came from America, since, as he says, "they felt upon that coast an unusual tempest a few days before the fatal 27th of November."

The United States Signal Service has for several years past published monthly track charts of all storm-centres in the North Atlantic, and the most cursory examination of these is sufficient to prove that very valuable information might be transmitted to Europe from America with respect to the weather experienced by trans-Atlantic steamers on their outward passage. Prof. Loomis, who has devoted considerable attention to the tracks of Atlantic storms, has calculated the average velocity of storm-centres in the Atlantic Ocean to be fourteen miles an hour, and has shown the rate of progress to be less over the sea than over either America or Europe. Some other authorities have given rather a higher rate of progress than Prof. Loomis, but when a large number of instances is taken it will not be found that the average rate exceeds twenty miles an hour, and probably this rate is the safest that our present knowledge of the subject will allow. The charts of the United States Signal Service for 1879, which exhibit the tracks of ninety-two distinct storm-centres in the Atlantic, show the average rate of progress of all these storms to be eighteen miles an hour. From this it will be seen that, with the speed now attained by many of our principal steam-vessels engaged in the trans-Atlantic trade, if a storm is met anywhere to the westward of the mid-Atlantic, a vessel can, on arrival at a port in the United States, transmit timely notice to Europe that a storm has been experienced, and such notice will serve as a caution to our home authorities to be on the alert for any evidence of our outlying stations indicating the approach of the storm until its subsequent arrival, or until ultimate proof is obtained that it will not strike our shores. The fact that a storm is blowing out in the Atlantic will also probably be valued by commanders of vessels who are leaving port bound westwards.

The Atlantic gales differ so materially from each other in their character that any information which will convey the nature of an impending storm, either to vessels outward bound or to those engaged on our coasts, will be of the highest importance. It sometimes happens that the whole of the northern part of the Atlantic is taken up with one vast disturbance, the wind blowing with the force of a gale over an area having a diameter of upwards of 1500 miles, and occasionally extending from the coast of America to Europe. On the other hand, several disturbances may exist at one time between the two continents, and in this case a vessel is no sooner out of one storm than she enters the margin of another, and these conditions may last throughout her passage. This will be readily seen from the synchronous weather work already referred to; and, if further proof is wanted, it is to be found in the frequency with which storm-centres pass either over our islands or in their immediate vicinity, and in sufficient proximity to influence our winds and weather, if not near enough to give gale force to the wind.

The British Islands are probably less favourably situated for the successful issuing of storm warnings to our own coasts than any other country, since they are in the direct path of the Atlantic storms, and they have not the advantage of any stations within reasonable distance to the westward beyond their limits by which they may be warned, so that it often happens that a storm is almost upon us before its approach is foreseen. An attempt was made some years ago to moor a vessel at the entrance to the English Channel and to connect it by a telegraph cable with our coast, but the attempt was a failure, and experience has shown that the step now taken by the Meteorological Office to obtain Atlantic weather information is the only one which promises success.

THE ACTINIÆ[1]

THIS is a work which contains far more than it promises. Though commenced with the intention of describing only the Actinians (sea-anemones) of the Bay of Naples, it has extended until it includes all the species known; and although at first sight it seems nothing more than an ordinary systematist's manual—a dry dictionary for the specialist—it turns out on closer examination to have a clearly-marked individuality of its own. In its preface the author remarks, with a tinge of dry humour which here and there ripples the clear precision of his style, that in these days of papers full of histological detail, or rich with plates of caryolitic figures, embryological sections, or genealogical trees, his big book, apparently so purely systematic, may at first excite among his scientific brethren a smile of compassion, if not indeed a word of contempt. Far, however, from renouncing his intellectual birthright of wider scientific aims, he claims with justifiable pride to have produced (and at a self-denying outlay of time and toil not excelled by that of any histological investigation) no mere arid catalogue of genera and species, but a summary of the whole past of actinology, and a new starting-point for the future. He promises, too, a second volume, in which the anatomy, histology, and development, the physiology, distribution, and phylogeny, will be discussed, and no doubt as exhaustively.

The bibliography alone is well worth notice, for its scholarly precision and thoroughness furnish a royal road

[1] "Fauna und Flora des Golfes von Neapel. Le Attinie." Monografia del Dr. Angelo Andres. Vol. I. Bibliografia, Introduzione, e Specigrafia. (Leipzig: Wilhelm Engelmann, 1884.)

to their next investigator, for whose benefit also the most elaborate system of general and special indexes is provided. The history of actinological progress is critically exposed, and even the humblest species-maker scrupulously receives his tiny share of immortality, while the veriest trifles of etymology, popular nomenclature, or culinary use, are not forgotten.

Far more important, however, is the clear schematic account of actinian anatomy, with a recast morphological nomenclature, and thereupon follows the plan of the monograph, where our author briefly outlines the general view of biology and of the relations of its sub-sciences which dominate the work. This agrees largely with that usually adopted in this country (cf. Prof. Huxley's article, "Biology," in the "Encyclopædia Britannica"), but differs from it in some important respects, notably in the separation of taxonomy into *Specigrafia* and *Sistematica*. Next follows a keen re-discussion of the conception of *species*, and the limits of *genus* and *variety*. The last he proposes admitting as a rule, and then by giving variety an analytic and genus a synthetic aim, and making both changeable as systematists find expedient, he hopes to keep the conception of species near a more constant average. After some useful remarks on nomenclature, the systematic detail is entered upon, and the known species (520 or more), with their endless varieties, described with exquisite minuteness. Numerous diagrams aid the work of identification, and the volume concludes with thirteen magnificent plates, which reflect the greatest credit alike upon the author's pencil and the care of his lithographers, Messrs. Werner and Winter. The classification differs so much from existing ones as almost to be new. Two new families, *Edwardsinæ* and *Stichodactylinæ*, are created; the *Ilyanthidæ* are almost abolished, the *Minyadinæ* wholly so.

If space permitted, one or two trifling criticisms might be offered, if only to accent the general praise; yet it is better to welcome the book unreservedly as a new sign of the scientific *renaissance* of Italy, and its author as henceforth one of its leaders, who has learned philosophic breadth from the "Origin of Species" without losing the detailed accuracy of the "Monograph of the Cirripedia."

A word finally as to the splendid series of monographs to which this belongs, and which, together with the *Challenger* volumes, mark an epoch in biology. Is it not lamentable that such works—which, if not yet indeed, in time-honoured phrase, "books which no gentleman's library should be without," are certainly needed in every public library, and which even no local natural history society can afford to be without—should be limited to an impression of, after all, only a few hundred copies by the apathy or ignorance of the scientific public? P. G.

THE EARTHQUAKE IN SPAIN

AN earthquake of wide extent and unusual violence took place on Christmas night in the southern provinces of Spain and in the neighbourhood of Madrid. The accompanying map may give some idea of its extent. As many of the towns and villages of Granada, Malaga, and Andalusia are unconnected with the capital by telegraph, the full extent of the damage is not yet known, but enough information has been received to mark the present as among the most destructive earthquakes of recent years. No precise observations as to time or direction have yet reached this country; and the officials at the Madrid Meteorological Observatory are reported to have made no observations at all, for there were no funds to purchase instruments for such a purpose. Madrid itself was within the disturbed area, but it was probably on its extreme north edge, for the effects of the shocks there were slight, and were confined to the rattling of windows, the ringing of bells, and the like. But in the three southern provinces the destruction was great and widespread, involving in many cases considerable loss of life. There were several shocks, overthrowing whole villages and burying the inhabitants in the ruins. In Arenas del Rey 40 persons were killed, in Albuequeros 150, in Olivar 10, and in Cajar 12, and similar numbers in many of the towns and villages of the three provinces. The number of killed on the whole is put down in Madrid, from the reports of the local officials, at more than 1000. Even in large cities such as Granada, Malaga, Jaen, and Seville great damage was done, and much excitement prevailed. The inhabitants encamped in the open air through fear of fresh shocks. At Granada the front of the Cathedral was seriously injured, but the Alhambra was untouched. There is much discrepancy in the reports as to the duration of the earthquake: some village authorities have reported ten distinct shocks, while in other cases it is stated that there were seismic disturbances intermittently on the 26th, 27th, and 28th, the three days succeeding the great earthquake. This is especially reported from Jaen, where there should be ample means of corroborating the statement. At Cadiz a panic occured in the theatre; in Malaga the Cervantes Theatre was much injured. It is noticeable that a sharp fall of the barometer was noticed all over the south of

Spain in the afternoon before the earthquake, and that there have since been frequent fluctuations. There is some doubt whether the number of persons who have lost their lives will not far exceed a thousand, inasmuch as the reports, as they grow more detailed, instead of diminishing, largely increase the original estimates. At Periana, in Malaga, a landslip on a mountain in the neighbourhood destroyed a church and 750 houses, from the ruins of which the dead and injured were being taken: similarly at Loja half the houses were overwhelmed. The town of Alhama in Andalusia is reported to have been completely destroyed, with 300 persons. A report is published with regard to Albunuelas, stating that 900 persons are believed to have been killed under the houses thrown down by the earthquake. This would be about one-half the population of the town. At Antequera the shocks have left three churches in a dangerous condition, and the inhabitants are camping in the fields; the Cathedral at Seville, especially the Giralda tower, is much damaged; at Granada the richer classes are living in their carriages, which are stationed on the public promenade; the others camp out in the squares and open spaces; at Cordova the inabitants are flying from the town. The loss in the town of Malaga is put down at 100,000*l.*, 227 buildings being injured. It would appear that five distinct shocks took place in this town on Christmas night, and three on the following morning. Five shocks on Friday and

Saturday are reported from Antequera, and nine from Archidona. That the disturbance has not yet ceased is shown by the report from Torrox that the shocks were renewed there on the morning of the 29th, shaking the foundation of the Town Hall, and causing cracks in the walls of other houses; while other violent shocks are reported from Malaga and Granada on the evening of the 30th, one at 7 and the other at 10 o'clock. In connection with these after-shocks, a report from Tarvis, in Carinthia, states that an earthquake was felt there on Sunday, which by the oscillation it caused cracked the walls of many houses. The Spanish earthquake was not felt in the north and north-western provinces. No precise information as to the times of the shocks at the various places has been received. At Xerez and Cadiz, according to one account, the first smart shocks occurred shortly before 9 o'clock, and other slighter shocks about midnight and 4 o'clock the next morning. At Ciudad Real no damage appears to have been done, beyond the alarm to the inhabitants, who passed the night in the open, fearing a recurrence of the shocks. At Velez Malaga and Malaga proper several shocks injured the theatre and the churches, the falling masonry killing several persons. The clocks are stated to have stopped in various parts of Andalusia at from ten to seven minutes before nine, which may therefore be taken as the time of the first shock.

We have received the following correspondence on the subject of the earthquake :—

YESTERDAY, 25th, at 8h. 53m. p.m., slight earthquake in Madrid : two distinct shocks in 3 to 5 seconds ; house bells set ringing and lamps and other suspended objects swinging ; the oscillations were almost due east and west, which gives north and south as the direction (rough) of seismic disturbance. This was evidently stronger in some parts of the town than others, as out here it produced no effect outside, whereas according to this morning's paper much alarm was produced in some streets by people rushing out of their houses. But earthquakes are very uncommon in Madrid, and this accounts sufficiently for the scare. There really was no particular cause for alarm. Official telegrams report shocks felt at about the same time in Cadiz, Malaga, Granada, and Cordova.

F. GILLMAN

Quintana, 26, Madrid, December 26, 1884

I HAVE reason to believe that this commotion extended to England. On the night of December 25 I left my family quietly seated round the fire at 10 o'clock. Being in bed myself at about 10.20, I perceptibly felt a shock of earthquake such as I have often experienced in the vicinity of Naples, and I said to my wife, who came up shortly afterwards, "I have felt a distant shock of earthquake. if there is nothing moving downstairs," which from the distance of the offices there certainly was not. The motion, we learn, was from south to north, and the usual rate of movement corresponds well with the time of the occurrence—say 6 minutes to 9 at Madrid.

The Rookery, Ramsbury, Wilts ALFRED BATSON

THE HABITS OF THE LIMPET

THE following observations upon the habits of the common limpet (*Patella vulgata*) were made during last July at the Scottish Marine Station, Granton, Edinburgh. I am much indebted to Mr. John Murray, the manager of the Station, for kindly placing its resources at my disposal, and also to Mr. J. T. Cunningham, B.A., the director, for much kind advice and assistance.

The *Ark* is moored in the centre of a flooded quarry, upon whose faces large numbers of limpets are to be found. As parts of these faces are almost or quite vertical, it was easy to take a boat round and make observations during all states of the tide. The few that were made bear on the feeding and locality-sense of the form in question.

By far the larger number of limpets "roost" upon rocks whose only covering consists of minute green algæ and nullipores, together with numerous acorn barnacles. These last are seen to be of very unequal degrees of "cleanness," some being covered with vegetable growth, others quite white and bare. Those immediately surrounding a limpet or group of limpets are invariably free from algæ. As might have been anticipated, Patella is the cause of this freedom. At low tide anyone on the look-out can hear a quick, regular, rasping sound in all directions, and see numerous limpets slowly crawling about. Scrutiny of any particular individual shows that the rasping noise is caused by strokes of the radula, which speedily scrapes away the incrusting algæ. Whilst "on the feed" a limpet moves steadily on, pretty much in a straight line, and continually sweeps its elongated snout from side to side, feeling out probably suitable patches whereon to graze. When such a one is discovered, it is gradually licked quite clean. If the patch happens to be the surface of a moderate-sized barnacle, the circular lip is completely spread over it, almost tempting one to believe that the crustacean is about to be "sawn out." Such, however, is not the case, "house-cleaning" being the sole end in view. Indeed, limpets are often serviceable to one another by thus clearing away esculents growing upon their shells. To secure a dinner, a good deal of licking is requisite, and perhaps this habit may help to account for the inordinate length of the tongue-ribbon. Certainly it must be used up at a very great rate.

But this is not the only, though I believe the chief, way in which the limpet feeds. Those individuals which live near large sea-weeds, such as Fucus, feed extensively upon them, as their gnawed condition testifies. I can speak confidently in this matter, having caught more than one limpet in the act. The operation was as follows :—The edge of a thick flat part of the thallus was seized by the lip (as a traveller might commence on a colossal sandwich), and being, I suppose, held firmly by the upper jaw, a semicircular "bite" was gradually excavated by successive scrapes of the radula, the edges of the bite being bevelled on the under side. So far as my observations extended, limpets do not feed when covered by water, but always settle down firmly before the rising tide reaches them. The intervals between which any particular limpet feeds seem to be very irregular ; but, as a rule, the largest limpets are apparently least fond of long fasts.

In regard to the second point, the locality-sense, great doubt seems to exist in the minds of naturalists as to whether limpets go back to the same place to roost. I believe the question was answered in the affirmative long since by a Mr. King, but, as far as is known to me, he did not publish any details of his observations, and this is my excuse for giving an outline of mine. Following a suggestion of Mr. Murray, I marked a number of limpets with white paint, and made corresponding marks near their "scars" with a view to "keeping my eye on them." As Dr. S. P. Woodward remarks, it seems probable from an *a priori* point of view, that limpets have a settled home, for they occupy scars, often sunk to a considerable depth, which *exactly* correspond to the outline of the shell. My observations, made on numerous specimens of various sizes, completely confirm Mr. King's opinion, and the method of marking rendered cases of "mistaken identity" quite out of the question. The greatest distance from its scar at which I noticed a marked limpet to be, was about three feet ; yet this distance, though extremely rough, and covered with barnacles, was re-traversed without difficulty. The excursions from the roosting-places were made in any direction where food offered ; so there were nothing like beaten tracks formed. But a limpet always returns home before the rising tide reaches it, and invariably

roosts with its snout pointing in the same direction. As might be expected, this direction is only constant for individuals. As the shape of the scar corresponds exactly with the shape of the shell, comfort, of course, could only be gained and a firm hold effected by limpets roosting permanently in the same direction on their scars.

The question now arises, What sense is employed by the limpet in finding its way back to its scar? The appreciation of locality displayed is certainly, for so simply-organised an animal, very keen. The sense of sight is evidently out of court, for an eye like the limpet's, consisting of no more than a sensitive cup, could do little if any more than distinguish between light of different degrees of intensity. The tentacles seemed at first sight to be extremely likely organs to use for the purpose, and to decide this I excised those of two marked individuals which were off their scars. One speedily found its way back; the other seemed confused by the operation for several days, but after that time was found on its scar. This shows a remarkable power of memory, unless the scar was found by accident, which is possible, as the individual was near home when the operation was performed. But even in that case the scar must almost certainly have been *remembered*. Thus, the tentacles do not seem to be the means by which home is returned to. The sense of smell then suggested itself, and it occurred to me that one reason why limpets kept on their scars when covered by the water was to prevent the "scent" of the track traversed from being washed off. With a view to determine this the space between a wandering limpet and its scar and the scar was carefully washed again and again with sea-water. In spite of this the limpet in question readily found its way back again. Further experiments are, however, needed on this head, for any ordinary washing would be very ineffective compared with the prolonged soaking the tide would effect in the case of a limpet (like the one just mentioned) living some distance below high-water mark. Still some limpets live so near this last that they are covered but a very short time, and yet these remain on their scars during that time. Hence I think some other motive probably induces them to remain firmly fixed to their scars when under water. Of course they can hold on best when so fixed, and this suggests the most likely reason for the habit, *i.e.* to avoid being washed off the rocks by the tide. I am inclined to think that the snout plays some part in helping the limpet to get home, as this organ is extremely sensitive, and certainly plays an important part in discovering suitable food. I intend carrying on more extended observations with a view to the more complete elucidation of this puzzling question in regard to the limpet's locality-sense, but this preliminary notice may possibly be of some interest.

J. R. DAVIS

University College of Wales, Aberystwith

THE MEDITERRANEAN FAUNA[1]

VERY welcome to all zoologists, especially to those living in Europe, will be the first part of what promises to be a most useful work on the animals known to inhabit the Mediterranean Sea. For more than twenty-five years Prof. J. Victor Carus tells us he has been collecting the materials for such a volume, and now that he has to be congratulated on the appearance of so much of it, we trust it may not be long ere we shall be enabled to announce that it is complete. The first part gives a list of the Cœlenterates, Echinoderms, and Worms. The next will treat of the Arthropods, Mollusks, and Vertebrates. The author on mature deliberation resolved to omit from the enumeration the Protozoa and Sponges, not seeing his way to give of these satisfactory detailed diagnoses, and also because, while Haeckel and others have done a good deal towards increasing our knowledge of the Mediterranean Protozoa, and Oscar Schmidt and others have done the same with the Sponges, yet the groups have not been rigidly systematised in the same way, for example, as the Cœlenterates.

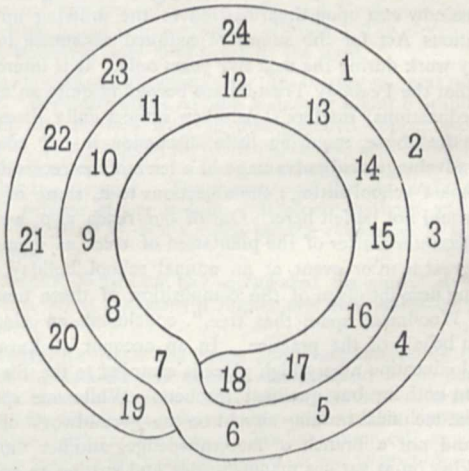
In the Prodomus, a diagnosis of each sub-order, family, genus, and species is given, with the synonymy of each species, its general distribution, and then its known habitats in the Mediterranean. When the species has been found only in the Mediterranean it is specially marked, the only exceptions we notice to this rule being in the case of the parasitic worms, and from the nature of their hosts they are just as likely as not to be found out of bounds. We have examined the list of the species with a good deal of attention, and have been greatly struck with the immense care that has been evidently used in its compilation. Many of the records and descriptions of these species are not to be found in monographs or special treatises on the fauna of certain well-known bays, like those of Naples, Marseilles, &c., but lie scattered over the numerous pages of our periodical literature, often difficult to be got at; indeed, in some few cases, we notice the record of the habitat is based on the authenticated examples in museums. In admitting some doubtful species on the authority of authors of good repute, Prof. Carus has acted wisely, for, should it be necessary, a stroke of a pen would suffice to reduce these to synonymic rank, while, should they be ultimately approved of, they are already in their places.

This Prodomus is dedicated to Sir Henry Wentworth Acland, K.C.B., who for these long years past has taken so much interest in zoology in connection with Christ Church, Oxford, and who well merits this tribute of respect and confidence from Prof. Carus. Those whose knowledge of zoology in Oxford only dates from the period of the New Museum, and who have no leisure for mastering the details of the past, may not be aware how much the collection of zoology and comparative anatomy owes to the labours of Victor Carus, who collected, we believe, for Sir Henry Acland during a great part of 1850, at the Scilly Islands, the series of British Invertebrates then placed in Christ Church Museum, and now Prof. Carus, having taken a larger area within his grasp, associates this Prodomus of its Fauna with our Oxford Professor, as a sign and token that he has not forgotten those earlier days.

[1] "Prodomus Faunæ Mediterraneæ, sive Descriptio Animalium maris Mediterranei incolarum quam comparata silva rerum quatenus innotuit adjectis locis et nominibus vulgaribus eorumque auctoribus in commodum Zoologorum congessit Julius Victor Carus." Pars 1. Cœlenterata, Echinodermata, et Vermes. (Stuttgart, 1884.)

OUR FUTURE CLOCKS AND WATCHES

IN connection with what we have said before on this subject we give a drawing of the new dial in use on some of the American railways where the new system is already



at work, the clocks indicating a certain number of hours plus Greenwich, according to the longitude of the section.

The intersection of the two circles of figures serves the purpose of giving day hours inside and night hours outside.

NOTES

THE Congress of the United States some time ago appointed a joint committee of senators and representatives to consider the organisation of the different bureaux of the Government. This special commission is now hearing the depositions of witnesses. The evidence of Major Powell, Director of the Geological Survey, has just been published. The principal feature of this document is the proposal to give the administration of the different bureaux to the Smithsonian Institution. It should be noted that the National Academy of Sciences passed some time back a resolution asking that a special administration should be created for the purpose. The Committee of the Academy recommended the establishment of a physical observatory to investigate the laws of solar and terrestrial radiation, and their application to meteorology, with such other investigations in exact science as the Government might assign to it; and they also recommended that the functions of the Bureau of Weights and Measures, now performed by the Coast Survey, be extended so as to include electrical measures.

THE Bureau of Navigation of the U.S. Navy Department announces that the computations and discussions of the observations and experiments for determining the velocity of light have been completed, and are being prepared for publication.

THE Fourth Circular of Information of the United States Bureau of Education reports the meeting of the Superintendents of National Education at Washington in February last, one of the largest of such meetings ever held. The principal papers read were on the subjects of Indian and Negro education. One speaker, who reported the former of these races to trust too much to memory and direct observation and too little to reasoning, nevertheless considered them worthy to be absorbed into the white population, though as an inferior element. This may be the best for the Indians, for the most hopeful view of another speaker who upheld the return of their educated youth to their old homes as a civilising power to the whole body, was that "not more than five out of thirty were given up as hopeless"! But as eminently qualified and well-paid men are required for even this result, and nature will probably protest strongly against the deterioration of a higher race by a lower one, the most satisfactory consideration seems that the Indian population is decreasing. But not so the Negro; and the inability of the Southern States to overcome the rapidly increasing mass of ignorance now cast upon them has led to the drawing up of a very cautious Act for the supply of national assistance to this necessary work during the next five years only. It is interesting to note that the Peabody Trustees are becoming quite an authority in educational matters. Another subject fully discussed, but, like the above, requiring little discussion in our country, was the advantage or disadvantage of a ten minutes recess during a three hours' school sitting; the objections to it, some of them social, would not be felt here. Out of our reach also, we fear, is the pleasanter matter of the plantation of trees as memorials of each great man or event at an annual school holiday. An interesting account given of the composition of those touching lines, "Woodman, spare that tree," concluded an eloquent paper on behalf of the practice. In an account of European technical education a very high place is awarded to the Swedes, who want nothing but qualified teachers. While one speaker urged that technical training should be the groundwork of education, and not a branch of fact-knowledge, another thought, that looking on at various manufactories and writing an account of what had been shown and explained to them, was of more general value. The immense increase of crime in the United States among educated young men was cited by one who expressed an enthusiastic belief that the greatest check to it would be the organisation among children of societies for the prevention of cruelty to animals. Dr. B. Joy Jeffries read a paper on colour-blindness, urging that the three primaries are red, green, and violet; that blindness to the latter is so rare that practically colour-blindness means blindness to red or green; urging also the danger of persons with such deficiency being employed in many occupations, and the necessity of an experimental method of finding it out. The Fifth Circular of Information consists of information and suggestions with regard to the great educational department of the New Orleans Exposition now opening, at which gathering the Superintendents of Education are to meet in the ensuing year.

HERR JADRINTSOW of St. Petersburg is about to publish, in Russian and German, a work on the Uralo-Altai, and Ugro-Turanian tribes of Siberia.

ACCORDING to the *Colonial Mail* a statement comes from the Cape Colony which is deserving the attention of botanists. It is alleged that insects shun the land on which tomatoes are grown; and the cultivation of the *Lycopersicon esculentum* is accordingly recommended in all cases where it is possible to grow it—under fruit-trees, for instance, since the tomato will thrive in the shade of other trees, which few other plants will do—for the sake of the virtues attributed to it as a prophylactic against the inroads of insect pests. It would be interesting to know whether the tomato has been observed to exercise any such effect on insects elsewhere—in Canada, for instance, where the fruit is so popular—or whether it is only in warmer climates, like that of the Cape, that its peculiar powers are brought into play.

M. MARCEI DEPREZ, the well-known electrician, is not confining his labours exclusively to the transmission of electrical force to distant places. In conjunction with others he has patented a new telephone based on a new principle of vibration, and dispensing with the use of voltaic elements. The lease of the Compagnie générale des Téléphones being about to expire, the Municipal Council of Paris have held a protracted sitting on the question whether the lease should be renewed or not. In the course of the discussion it was proposed to grant the renewal of the lease provisionally for a month, in order to give the new apparatus a fair trial. The further discussion of the question has been postponed to the next meeting.

THE last number of the *Mittheilungen der deutschen Gesellschaft für Natur und Völkerkunde Ostasiens*, Heft 31, contains a paper by Mr. Knipping, on weather telegraphy in Japan, which has already been referred to in NATURE. Besides describing the agencies at present at work in connection with the Central Meteorological Observatory, Mr. Knipping suggests a reorganisation of service, especially as regards the lighthouses; the number of stations would then be eighty in place of twenty-four, and the increased value of the service for practical as well as for scientific climatological purposes would be proportionate. Herr Mayet gives the first part of a full and interesting description of his visit to Corea with the German mission which went there last year for the purpose of making a treaty. If continued on the same scale, it will be the most comprehensive and accurate account of Corea, its Government, people, laws, &c., yet published. When at the capital, Seoul, the members of the mission noticed, from a hill in the grounds of their residence, the extraordinary sunsets of October in that year; but no special observations were made, because they believed that the beautiful phenomenon was the usual accompaniment of fine weather sunsets in Corea. It is described as sometimes resembling the aurora borealis. Frequently it was

only a uniform brilliant brightness, the centre of which was the spot at which the sun had gone down; other evenings the sun shot rays like long fingers, of a darker colour, athwart the glow, and in one evening the change of the light and darker colours of the evening red were like the incessant wavings of the folds of a perpendicular curtain. The effect of the phenomenon on the ignorant and superstitious inhabitants of Seoul, was of more immediate importance to the writer and his companions than its scientific aspects. They regarded it as a sign of trouble, war, and misfortune. Heavy rain which fell soon after averted any disaster from this cause.

A COMMISSION has been nominated by the President of the French Republic to investigate the archæology of Tunis, and report on the best method of preserving the ancient monuments of that country. A considerable number of specially-qualified French scholars have been appointed, and M. Ernest Renan has been named President of the Commission.

A SARCOPHAGUS with four face-urns has been recently found at Garzigar, near Köslin (Pomerania), and has been sent to the Antiquarian Provincial Museum of the Pomeranian Antiquarian Society at Stettin. A similar discovery was made last year at Klein Barkow (another Pomeranian village). Round one of the urns there was placed a bronze necklace, consisting of a stout bronze wire supporting eight so-called spectacle-spirals as ornaments. Prof. Berndt has proved in his work on Pomeranian face-urns, that they are really of Greek origin, dating from about the years 100 or 200 B.C., when Greek agents or factors went to live on the shores of the Baltic in order to trade with their home country in amber, furs, &c. Prof. Lindenschmidt (Mayence) and Dr. Schliemann indorse this opinion.

THE Imperial Japanese Meteorological Observatory has (according to the *Japan Mail*) issued a volume containing a series of monthly weather summaries for the months March to December 1883, each summary being accompanied by a map. The first weather map in Japan was issued on March 1, 1883, and the compilation therefore begins with that month. The greater part of the issue is occupied by twenty maps, indicating the tracks of centres of areas respectively of high and low barometers for the ten months dealt with, copious notes prepared from the daily telegrams being also furnished. For each month there is given the number of areas of high and of low barometer, with a short synopsis of the course of each, the place and date of highest and lowest temperature and barometric pressure, the number of gales, heavy gales, and hurricanes reported, with their localities, the occasions on which rain or snow fell, and the number of warnings issued. Lists are also given of the light-houses from which gales were reported. These summaries are followed by monthly meteorological tables and illustrative maps, commencing two months earlier, and extending therefore over the whole of the year 1883. In these we find the mean temperature, mean pressure, altitude and rainfall for each month at twenty-two stations, and at the end there is a similarly prepared table for the whole year. The series closes with maps indicating by different degrees of shading the rainfall over the various parts of the empire during the twelve months, the aggregate rainfall for the year being shown by similar means in a final map.

AT the meeting of the Royal Physical Society of Edinburgh, held on December 17, the following office-bearers were elected:—Presidents: Benjamin N. Peach, F.R.S.E., John A. Harvie-Brown, F.R.S.E., Rev. Prof. John Duns, F.R.S.E.; Secretary: Robert Gray, V.P.R.S.E.; Assistant Secretary: John Gibson; Treasurer: Charles Prentice, F.R.S.E.; Hon. Librarian: R. Sydney Marsden, F.R.S.E.; Council: Patrick Geddes, F.R.S.E., Frank E. Beddard, F.R.S.E., Johnson Symington, F.R.C.S.E., Andrew Moffat, John Hunter, F.C.S., Robert Kidston, F.G.S., A. B. Herbert, William Evans Hoyle, M.R.C.S., F.R.S.E., Prof. James Geikie, F.R.S., Prof. J. Cossar Ewart, F.R.S.E., G. Sims Woodhead, F.R.C.P.E., Hugh Miller, F.G.S.

WE have received the October number of the *Proceedings* of the Boston Society of Natural History. It contains a continuation of Mr. Crosby's paper, meeting the objections advanced by Dr. Wadsworth against the author's views of the stratigraphy of the Boston Basin. It also contains a description, by Q. E. Dickerman and Dr. M. E. Wadsworth, of an olivine-bearing diabase, from St. George, Maine; as also the beginning of a paper by Thos. T. Bouvé, on the genesis of the Boston Basin and its rock-formation.

MESSRS. MACMILLAN AND CO. will very shortly publish a translation of the work of Dr. Hertel of Copenhagen on Over-Pressure in Middle-Class Schools in Denmark, with an introduction by Dr. Crichton Browne.

THE additions to the Zoological Society's Gardens during the past week include an Indian Civet (*Viverricula malaccensis*) from India, presented by Mr. W. Getty; a Bengalese Cat (*Felis bengalensis*) from India, presented by Mr. G. T. Egan; a Grey Parrot (*Psittacus erithacus*) from West Africa, presented by Mrs. Whitelow; a Kestrel (*Tinnunculus alaudarius*), a Sparrow Hawk (*Accipiter nisus*), British, presented by Mr. T. E. Gunn; a Broad-fronted Crocodile (*Crocodilus frontatus*), a Nilotic Crocodile (*Crocodilus vulgaris*) from West Africa, presented by Mr. J. M. Harris; an Undulated Grass Parrakeet (*Melopsittacus undulatus*) from Australia, deposited; two Golden-winged Woodpeckers (*Colaptes auratus*), a Blue Jay (*Cyanocitta cristata*) from North America, a Black-tailed Hawfinch (*Coccothraustes melanurus*) from Japan, two Red-headed Finches (*Amadina erythrocephala*) from South Africa, two Banded Parrakeets (*Palæornis fasciatus*), from India, received in exchange.

PHYSICAL NOTES

SEVERAL new primary batteries are in the field, and there are more to come. An iron cell invented by Dr. Pabst of Stettin is finding great favour in Germany. Its electrodes are carbon and wrought iron dipping into a solution of ferric chloride. It is practically unpolarisable and self-regenerating. It works at the expense of iron and of the oxygen of the air, which is absorbed into the liquid, whilst ferric oxide is deposited at the bottom of the cell. Its electromotive force is about ·78 of a volt. The Pabst cell ought to prove of value for domestic electric lighting, as its internal resistance is low and its constancy remarkable.

ANOTHER primary cell has the peculiarity that the element consumed in the liquid is carbon. In this cell—the invention of Profs. Bartoli and Papasogli—the electrodes are platinum, and a compacted mixture of retort coke and Ceylonese graphite. The exciting liquid is hypochlorite of soda. The electromotive force is, however, only ·2 of a volt at the most.

M. JABLOCHKOFF announces another battery of great scientific interest. A small rod of sodium weighing about 8 grammes is squeezed into contact with an amalgamated copper wire and flattened. It is wrapped in tissue paper and then damped with three wooden pegs against a plate of very porous carbon. This completes the element. The moisture of the air settles on the oxidised surface of the sodium. It works without any other liquid. The E.M.F. is 2·5 volts, but the resistance is as great as 25 ohms.

M. LAZARE WEILLER has shown that the phosphide of tin, drawn into wires, possesses a higher electric conductivity than platinum or iron.

M. EMILE REYNIER has made some very interesting experiments on the maxima and minima electromotive forces obtained from cells of one electrolyte. For this purpose he constructed two cells, one for determining the maxima and one for determining the minima electromotive forces. His maximum cell consists in giving the positive electrode as large a surface as possible—about 30 square decimetres—while the negative electrode consisted of a wire of 3 mm. diameter. The positive electrode was bent round

in the form of a sharply corrugated circle, and the negative electrode was placed in the centre, so that the resistance should be low, it varied from ·2 to 4 ohms according to the liquid used. The E.M.F. was practically constant during its determination, as the current drawn from the cell was only about ·001 ampere. The minimum cell was of similar form to the maximum, only the positive electrode was in the centre and was a wire of about 0·5 mm. diameter, and the negative electrode was in the form of a cylinder. By using cells of these forms he was able easily to change either of the electrodes or the electrolyte. The method of determining the minima electromotive forces was to short-circuit the cell for several hours, and immediately on opening the circuit to determine the E.M.F. The following are some of the results that he obtained with an electrolyte of acidulated water, 2 parts in 1000 being sulphuric acid :—

Electrodes		E.M.F. in volts	
Negative	Positive	Maxima	Minima
Zinc, ordinary ...	Carbon	1·22 ...	0·04
,, amalgamated ...	Carbon	1·26 ...	0·226
,, ordinary	Lead	0·55 ...	0·144
,, amalgamated ...	Lead	0·684 ...	0·152
,, ordinary	Copper	0·94 ...	0·194
,, amalgamated ...	Copper	1·072 ...	0·272
,, ordinary	Iron	0·429 ...	0·309
,, amalgamated ...	Iron	0·476 ...	0·323
,, ,,	... Zinc, ordinary ...	—	... < 0·09
Iron	... Copper ...	0·49 to 0·51 ...	—

AN experimental reproduction on the screen of the phenomenon of the solar halo has been recently brought before the Physical Society of Paris by M. Cornu. M. Cornu also discussed the phenomenon of the pink corona which has been visible around the sun during the past few months. He thinks it has its seat in the atmosphere at an elevation considerably higher than the level of the cirrus clouds which give the common ring-halo of 22°. According to M. Cornu the polarisation of the sky has been "profoundly modified" by the present phenomenon, especially when viewed through red glass.

SIGNOR A. RICCO sends us a lengthy memoir on a new form of electro-magnet invented by him. It consists of a sheet of iron rolled into a spiral round an iron core, the convolutions being separated by oiled paper. The current traverses the coiled sheet, which thereby becomes powerfully magnetised. A spiral of forty turns of insulated copper wire is added outside. The lifting power of this magnet appears to be very great in proportion to its weight.

A PAMPHLET on the system of simultaneous telephony and telegraphy invented by F. van Rysselberghe has lately appeared from the pen of M. Ch. Mourlon, secretary of the Société belge d'Électriciens.

DR. E. VON FLEISCHL recently communicated to the Viennese Academy a paper on the double-refraction of light in liquids. Concentrated solutions of tartaric acid and of various sugars were employed, also certain active oils, in a compound hollow prism resembling a Fresnel's quartz combination in its general disposition. The research proves the existence of doubly-refracting liquids ; but they possess no optic axis. The wave-surfaces are in every case two concentric spheres.

CHEMICAL NOTES

ATTENTION was lately drawn in these Notes to Schiff's recent researches on the connections between the capillary coefficients of various liquid carbon compounds and the structure of the molecules of these compounds (see also NATURE, vol. xxx. p. 618). The same subject has very recently been examined by J. Traube (*Ber.* xvii. 2294). Traube thinks that the differences between the various capillary elevations observed by Schiff are too small to allow of trustworthy conclusions being drawn : he has therefore undertaken a series of observations with aqueous solutions of various classes of carbon compounds. Inasmuch as the capillary elevation of water in a tube of ·34 mm. radius is about 41·5 mm., while that of most liquid carbon compounds does not exceed 25 mm., Traube concluded that there will probably be well-marked differences between the capillary elevations of aqueous solutions, and mixtures of aqueous solutions, of definite concentration, of various compounds of carbon. The height in capillary tubes was determined for each solution for varying degrees of concentration, and the results are stated for equal weights of compounds in equal volumes of solution. From these results Traube draws the conclusions :—(1) The capillary elevation of the solution of a compound decreases as concentration increases ; the differences of elevation are not equal for equal increases in concentration. (2) The capillary elevations decrease in a homologous series of carbon compounds as molecular weight increases. (3) Isomeric compounds in solutions of equal concentration do not always exhibit equal capillary elevations. Schiff's generalisation, that the number of molecules of isomerides raised by capillary action is equal, does not hold good for aqueous solutions of isomerides. As in Traube's experiments the liquids examined were of equal concentration, it follows that the ratios of the capillary elevations are equal to the ratios of the masses of the dissolved compounds raised in the capillary tubes. Calling the capillary elevation h, and the specific gravity of the solution s, Traube considers the product hs, which he calls the capillary coefficient of the solution. The value of h is conditioned by the chemical constitution of the compounds examined. If m = molecular weight of compound in solution, then the difference between $\frac{h}{m}$ for solutions of two compounds, within certain limits of concentration, is a constant which depends only on the relative concentrations of the two solutions. The values of $\frac{h}{m}$ for an homologous series, dealing with solutions containing equal masses of the compounds in equal volumes, are referred to the value of $\frac{h}{m}$ for the first member of the series, and the differences thus obtained, when calculated for a tube 1 mm. radius, are called the *specific capillary constants* of the compounds in the series. The values of this quantity are almost wholly dependent on the nature of the solution, perhaps only on the nature of the dissolved substance, and are independent, within certain limits, for each homologous series, of the absolute concentration of the solutions, and are scarcely, if at all, dependent on temperature. Traube thinks he is justified from his experimental results in concluding that the differences between the capillary elevations of the solutions of two analogous compounds are in the same ratio as the molecular weights of the compounds. Thus, let h_a and h_{a1} represent the capillary elevations of two solutions, of different concentrations, of the compound with molecular weight m ; and let h_β and $h_{\beta 1}$ represent the capillary elevations of two solutions, of the same concentration as those of the former compound, of an analogous compound with molecular weight m_1. Then, according to Traube,

$$\frac{h_a}{m} - \frac{h_{a1}}{m_1} = \frac{h_\beta}{m} - \frac{h_{\beta 1}}{m_1};$$

therefore

$$\frac{h_a - h_{a1}}{h_\beta - h_{\beta 1}} = \frac{m}{m_1}.$$

If, therefore, h_a, h_{a1}, &c., are determined, the ratio $\frac{m}{m_1}$ can be found ; and if m is known, the value of the molecular weight of the second compound (m_1) can be calculated.

GEOGRAPHICAL NOTES

WE are glad to see that at last there is some probability of the almost unknown but certainly interesting country of Tibet being opened up to outsiders. We know the frequent but unsuccessful efforts which Prjevalsky and others have been recently making to penetrate to Lassa. But now the *Times* Calcutta correspondent informs us that the Regent of the Tashu Lama at Shigatze has sent a most cordial reply to the letter which Mr. Macaulay despatched to him from the frontier through the agency of the Governor of Kambajong, and has also addressed a letter to the Viceroy. With these letters, besides the silk scarves which ordinarily accompany Tibetan correspondence, the correspondent understands he has sent some relics of the late Tashu Lama himself, and has asked Mr. Macaulay to send him a Tibetan-English dictionary and phrase-book and some scientific instruments. This is the first official communication received from Tibet for about a hundred years. The correspondent suggests that the Government should put our relations on a firm footing by sending at once a friendly mission in connection with the identification which takes place this year of the infant in whom Tashu Lama is supposed to have been born again.

THE town of Bhamo, in Upper Burma, the destruction of which by the Kakhyen tribes is reported from Rangoon, is one well known in the exploration of South-Western China in recent years. The route so often traversed from Shanghai to Rangoon by the Yangtsze, Talifu, and the Irrawaddy passes through Bhamo. It is mainly a trading town, from which the caravans start into Yunnan, as here the navigation of the Irrawaddy ceases. The first modern explorer to visit it was Mr. Cooper, the traveller "in pigtail and petticoats," who journeyed so courageously throughout South-West China during the Mohammedan rebellion. The Indian Government was disposed at that time to pay more attention to a trade route into Yunnan than they appear to have been recently, and the importance of Bhamo on the route from British Burmah was recognised by the appointment of an agent to reside there, and gather information useful for commerce in these regions. Mr. Cooper, the most competent man for the post, was selected, but the good work which he was doing was cut short by his death one night in his tent near Bhamo, at the hands of one of his Burmese guards. At Manwyne, not far on the Chinese side of Bhamo, Mr. Margary was murdered in 1876, when on his way from the Yangtsze and Talifu, to meet Col. Browne's expedition, which advanced from Rangoon along the Irrawaddy, through Bhamo. A year later it was visited by the Commission of English officials under Mr. Grosvenor, which went to inquire into Margary's death; and, on account of the place being within easy reach of Rangoon and Mandalay by the river, it has been frequently visited by officials of the Indian Government, such as Cols. Browne and Fytche and Major Sladen. The latter's journey had for its object the removal of dangers to traders on the route from the Kakhyens, and he succeeded in coming to an understanding with the chiefs to keep the route open. Within the last few years McCarthy, on his way from Shanghai by the Japanese route, and Colquhoun from the capital of Yunnan, passed through the town. It was a small stockaded settlement of Chinese and Shan traders, with a lower order of Burmese, and there is a French missionary station at the place, while some Americans are also engaged in missionary work there and at Mauwyne. The Kakhyens inhabit the greater part of North-Eastern Burmah, between the Irrawaddy and Salween, and live mainly on the trade between China and Burmah, either as brigands and robbers or as carriers on the river and roads. In addition, they appear to trade a little on their own account. The grounds of their destruction of the town are unknown, but it is probably due to their predatory habits, the comparative wealth of the town as a central trading station in the region, and the weakness and incompetence of the native government of Upper Burmah, especially in a wild and remote border-land, such as that in which Bhamo is situated, and of which it is the capital.

AN interesting expedition has been undertaken by Mr. Shaw, a naturalist and artist of Sydney, New South Wales. He proposes to make a canoe voyage down the Lachlan, Murrumbidgee, and Murray rivers, his object being to enlarge our knowledge of the interior river-systems of Australia, and of natural history. The cost of the expedition is borne by the *Town and Country Journal* of Sydney, in which the artist's sketches will no doubt appear.

WE learn from the Australian papers that Mr. E. M. Curr of Victoria has been engaged on a work on the customs, language, and origin of the aborigines of Australia. Portions of the manuscripts were, early last year, sent to England to be submitted to the Council of the Anthropological Society. The Society has expressed the opinion that the Government of Victoria should publish the vocabularies and a record of the customs of the aborigines, as, otherwise, valuable information might be lost for ever. It is expected that arrangements will be made for the publication of the work at the public expense.

REPORT OF THE LONDON SCHOOL BOARD COMMITTEE ON TECHNICAL EDUCATION

WE are glad to publish the following Report on Technical Education which has been presented to the London School Board. The recommendations contained in it were passed on December 18, 1884, with a small modification in No. 5. The only one which received any serious opposition was No. 6, which relates to the Swedish Slöjd system, but this ultimately passed by a majority of two to one.

(1) *Constitution of Committee*

On February 1, 1883, the Board passed the following resolution:—"That a Special Committee be formed to consider and advise how far the Board may facilitate Technical Education, or co-operate with those bodies that are carrying it on."

On February 8, 1883, the Board resolved:—"That the Special Committee on Technical Education agreed to by the Board on February 1, 1883, consist of the following Members:—Mr. Roston Bourke, Mr. Bousfield, Mr. Bruce, Sir Edmund Currie, Miss Davenport Hill, Prof. Gladstone, Mr. Heller, Sir Arthur Hobhouse, Mr. Lucraft, Miss Muller, Rev. Henry Pearson, Mr. Lee Roberts, Mr. Whiteley, Mr. Mark Wilks, and *ex officio* the Chairman and the Vice-Chairman of the Board."

At the first meeting Prof. Gladstone was appointed Chairman of the Special Committee. Nine meetings of the Committee have been held.

(2) *Information from Gentlemen*

The Committee commenced their deliberations by endeavouring to obtain information from gentlemen who were interested in, and had studied, the subject.

The following gentlemen accordingly attended the Committee by invitation, and gave their views on the subject:—Dr. Silvanus P. Thompson, Professor of Natural Philosophy at University College, Bristol; Mr. H. Trueman Wood, Secretary of the Society of Arts; Mr. Philip Magnus, B.Sc., B.A., Director and Secretary of the City and Guilds of London Institute for the Advancement of Technical Education, and one of the members of the Royal Commission on Technical Instruction. The statements of these gentlemen are set out in detail in the Appendix to this Report.

(3) *Information from School Boards*

The Committee also obtained information from the clerks of the Glasgow, Manchester, and Sheffield School Boards respecting the steps taken by these Boards respectively for the instruction of children in technical education.

Glasgow, Allan Glen's Institution.—At the request of the clerk of the Glasgow School Board, Mr. A. Crum Maclae, Secretary of Allan Glen's Institution, Glasgow, replied, furnishing information respecting the technical instruction in that institution, and inclosing—(1) a prospectus of the school for 1883-84; (2) a report of the proceedings at the distribution of prizes and certificates in December, 1882; (3) a copy of a paper on the "Relation of the School to the Workshop," read before the Philosophical Society of Glasgow in December, 1882, by David Sandeman, Chairman of the Weaving Branch of the Technical College, and E. M. Dixon, B.Sc., Head Master of the Institution.

Manchester School Board.—The Clerk of the Board, in reply to the inquiry of the Committee, furnished information to the effect that the Board have no present intention of starting a technical school; that this work had been taken up by the trustees of the Manchester Mechanics' Institute, who have converted that institution into a technical school; that the Board have introduced a lathe and a group of joiners' benches into class-rooms of two of their schools, and each scholar in the higher standards of the school takes his turn at the manual exercises, receiving one or two lessons a-week, a joiner being present to give the instruction. No extra charge is made for the instruction. One of the schools is the lowest under the Board, where two-thirds of the children are admitted free, the other being attended by children of artisans and small shopkeepers.

Sheffield School Board.—The Clerk of the Board gave particulars respecting the admission, the examination, the fees, the subjects of instruction, and the results of the Central Higher School established in that town. In the workshop attached to the school the practical work contemplated will include—(1) the production of simple but perfect geometrical forms to teach accuracy and skill in the use of tools; (2) the construction of models in wood for use as examples in model drawing; (3) the construction of simple apparatus to illustrate, by actual experiment, the principles of levers, pulleys, wheel and axle, the crane and strain on beams with different positions of load; (4) the mechanics of the roof, arch, and bridge; (5) for more advanced pupils the construction of apparatus illustrating lessons in machine construction, applied mechanics, building construction, and mechanical engineering. It is added that there is a system of scholarships by means of which from fifteen to twenty specially clever boys and girls will be enabled to pass from the

ordinary schools to the technical instruction at the Central Higher School.

(4) *Action of British Association and Social Science Congress*

The Committee were officially informed by the chairman that a resolution had been passed in 1883 by the British Association for the Advancement of Science requesting a Special Committee "to consider the desirableness of making representations to the Lords of the Committee of Her Majesty's Privy Council on Education in favour of aid being extended toward the fitting-up of workshops in connection with elementary day schools or evening classes, and of making grants on the results of practical instruction in such workshops under suitable direction." The said Committee waited to see the Report of the Royal Commissioners, and expressed their approval of recommendation (*d*), which practically covers the same ground. The Social Science Congress has made a presentation to the Education Department to a similar effect.

(5) *Recommendations of the Royal Commissioners on Technical Education*

During the deliberations of the Committee the second Report of the Royal Commissioners on Technical Education, containing their recommendations, was published, and the Committee submit, for the information of the Board, the recommendations as to public elementary schools, as follow :—

(*a*) That rudimentary drawing be incorporated with writing as a single elementary subject, and that instruction in elementary drawing be continued throughout the standards. That the Inspectors of the Education Department, Whitehall, be responsible for the instruction in drawing. That drawing from casts and models be required as part of the work, and that modelling be encouraged by grant.

(*b*) that there be only two class subjects, instead of three, in the lower division of elementary schools, and that the object lessons for teaching elementary science shall include the subject of geography.

(*c*) That, after reasonable notice, a school shall not be deemed to be provided with proper "apparatus of elementary instruction" under Article 115 of the Code, unless it have a proper supply of casts and models for drawing.

(*d*) That proficiency in the use of tools for working in wood and iron be paid for as a "specific subject," arrangements being made for the work being done, so far as practicable, out of school hours. That special grants be made to schools in aid of collections of natural objects, casts, drawings, &c., suitable for school museums.

(*e*) That in rural schools instruction in the principles and facts of agriculture, after suitable introductory object lessons, shall be made obligatory in the upper standards.[1]

(*f*) That the provision at present confined to Scotland, which prescribes that children under the age of fourteen shall not be allowed to work as full-timers in factories and workshops, unless they have passed in the Fifth Standard, be extended to England and Wales.

(6) *The Slöjd System of Handicraft in Sweden*

The Committee have received valuable information respecting a system of instruction in handicraft, which is largely adopted in the elementary schools of Sweden. Two mistresses under this Board, Miss Warren, head mistress of the infants' department of the Carlton Road, Kentish Town, School, and Miss Clarke, head mistress of the infants' department of the Campbell Street, Maida Vale, School, were allowed an extended summer vacation, in order that they might visit Herr Abrahamson's Institution at Nääs, near Gothenburg, in Sweden, where instruction is given in handicraft. This institution is established and maintained by Herr Abrahamson on his own estate, for the purpose of training teachers in the system, in order that the teachers may be able to carry it out in their schools.

The Governments of some other countries were invited to send teachers to Nääs to learn the system, and through Miss Löfving, formerly Superintendent of Physical Education under the Board, the invitation was extended to two mistresses of the schools of the Board. Hence the visit of Miss Warren and Miss Clarke during last summer. These mistresses have returned with diplomas received from Herr Salomon, the Director of the "Slöjd" Seminarium at Nääs, for having successfully completed the set of articles required for the first course of the system.

Miss Warren stated that during the two months leave of absence which had been granted to her and Miss Clarke, they had, at the invitation of Herr Abrahamson, visited his institution, with the object of becoming acquainted with his system of instruction in handicraft. The work done is carried out in wood, and the general term of "Slöjd" is applied to it. Working in wood is considered the most useful, as by working in this material the advantages claimed for the system are obtained more easily and completely than by the adoption of any other material. Miss Warren exhibited to the Committee forty articles in wood, selected from the 100 articles, forming the course of instruction, which she had made during her visit. The system of instruction is divided into what is called the "Nääs" system, from the estate on which it is carried out, and the "Artisan" system. The "Nääs" system differs from the "Artisan" in that it is not called a trade, the work, mainly in wood, being carried out under the superintendence of a *teacher*, and not being sold.

The work is done in a room fitted with benches, the room being about the size of one of our smaller halls. Only one teacher is in this room. The tools used all come from England and America. The cost of the tools per child is about 30 kronor, or 32*s*. 6*d*. The cost of the wood for 100 models is, *in Sweden*, about 15 kronor, or 16*s*. A complete set of the tools required could be obtained for about 4*l*. 10*s*.

The object of the system is not so much to produce the articles as to educate and train the child itself. The promoters of the system claim for it five distinct advantages :—

(1) It produces in a child a love of manual labour.

(2) It promotes the development and training of a child's hands and fingers.

(3) The child learns order and exactness.

(4) It educates a child's observation and perceptive faculties.

(5) It teaches self-reliance.

The school hours in Sweden are from 8 a.m. to 1 p.m., with an interval of a quarter of an hour about eleven o'clock. The instruction in "Slöjd" is usually taken in the afternoon. About two and a half hours on three days a week are devoted to this work. "Slöjd" is encouraged and paid for by Government, but is not compulsory. Children begin the work at about ten years of age. It is a punishment for a child to be withheld from it. Everything made is a *useful* article, the making of toys being prohibited. The articles when finished are given to the children as an encouragement. The child who does not succeed in the ordinary subjects of study is frequently encouraged on being successful in "Slöjd."

(7) *The Peripatetic System of Science Teaching in Birmingham*

In the course of their deliberations the Committee have noted and carefully considered the system of science teaching adopted by the Birmingham School Board. This system is sometimes called the "peripatetic" system. The elementary science "is taught in accordance with a syllabus, by a practical demonstrator and assistant (who visit each boys' and girls' department once every fortnight), and by the teacher of the school. The Science Demonstrator for the Board (or an Assistant Demonstrator) gives one lesson fortnightly of about forty minutes' duration to the boys in the Fifth and higher Standards in each school. The lessons are illustrated experimentally by specimens and apparatus carried from school to school in a hand-cart. Between the visits of the Science Demonstrator at least one lesson is given to the same class by the teachers of the respective schools (as a rule by a teacher who was present at the Demonstrator's lesson, and took full notes of it), and a written examination on the subject-matter of the lesson is also held. The answers are corrected by the class teacher and submitted to the Demonstrator at his next visit to the school. A general examination in elementary science is held yearly." The syllabus for boys comprises demonstrations on force, the mechanical powers, machines, parallelogram of forces, &c.; and that for girls demonstrations on the structure of the human body, circulation and respiration, the organs of digestion, the nervous system, the nature of food and its preparation, apparatus for cooking, how to maintain the body in health, the sick room, diseases of children, accidents, &c.

(8) *Conclusions*

After considering in all its bearings the whole question of the introduction of technical education and training into the schools of the Board, the Committee are of opinion that there is at present too little instruction for boys which is calculated to train and exercise the hand and fingers, so as to fit lads more efficiently

[1] This recommendation will not apply to London schools.

for situations where skilled manual labour is required. In this respect boys are worse off than girls. It is only in the drawing lesson that the boys receive any training of the hand, whilst girls obtain it in the needlework and cooking lessons as well. The Committee do not consider it desirable to attempt to teach any special trade or handicraft in the schools of the Board; but they are of opinion that in boys' departments greater attention should be paid to the teaching of "elementary science" and to freehand drawings from models; that mechanical drawing and modelling in clay should be introduced; that the peripatetic plan of teaching mechanics should be tried as an experiment in some district in London; and that, as an experiment, arrangements should be made for the establishment of a class for the elementary instruction of boys in the use of tools as applied to working in wood, the attendance being voluntary and out of school hours.

The Committee desire to express their high appreciation of the services rendered by Mr. Thomas Smith, and the zeal with which he has assisted them in their work.

(9) *Recommendations*

The Committee accordingly submit for adoption the following recommendations, which are intended to apply to boys' departments only:—

(1) That it is not desirable to attempt to teach any special trade or handicraft in the schools of the Board.

(2) That the instruction in drawing commence with Standard I. and be carried out according to a graduated scheme laid down for each standard.

(3) That increased attention be paid to freehand drawing from models in all schools, and that mechanical drawing and modelling in clay be introduced into certain schools.

(4) That greater attention be paid to the teaching of "elementary science" in the schools of the Board.

(5) That the peripatetic plan of teaching "mechanics" be tried in some district or districts of London.

(6) That, as an experiment, arrangements be made for the establishment of a class for the elementary instruction of boys in the use of tools as applied to working in wood, the attendance being voluntary and out of school hours.

(7) That the above resolutions be referred to the School Management Committee, with instructions to carry them into effect.

(8) That the sum of 10*l.* be paid to Mr. Thomas Smith, Principal Clerk of the School Management Department, as remuneration for his extra services in connection with this Committee.

(Signed) J. H. GLADSTONE, *Chairman*
B. LUCRAFT
H. D. PEARSON

APPENDIX

Statements of Dr. Silvanus P. Thompson, Mr. H. Trueman Wood, and Mr. Philip Magnus

I. Statement of Dr. Silvanus Thompson, Professor of Natural Philosophy at University College, Bristol, made before an informal meeting of the Committee on Technical Education, April 17, 1883.

Prof. Thompson stated with regard to drawing, that in his opinion the drawing taught and paid for by results by the Science and Art Department was not of the character which he considered should be taught. The subject he wished to see taught was what he liked to call industrial drawing, by which he meant that a block of wood or metal being placed before the children, they should execute from it drawings showing it in two or three different ways, exactly in the fashion in which workmen's drawings are made. Drawings made to scale represented in the workmen's fashion would be very much more valuable than the drawings executed under the regulations of the Science and Art Department. Industrial drawing such as this may be made applicable to all kinds of work, carpentry, masonry, &c.

He then described a lesson on drawing given in Paris on the general mechanism of tools. The lesson consisted in the master sketching roughly on the blackboard the outlines of certain pieces of machinery. He had neither compasses nor ruler. Every line had a distinct meaning, and every single detail was labelled. The boys were then told to make proper working drawings from this sketch. This kind of training seemed to him a very valuable thing. To know how to "read" a drawing is much more important than to turn out a highly-finished work of art. The main difficulty in introducing such a system would be that it would have to be created. No instructor in technical education had yet made it worth his while to evolve a system.

Prof. Thompson suggested that a section of certain schools might be devoted to the teaching of handicrafts. Some of the ordinary handicrafts in wood or metal would be good subjects to commence with. It would be better to try the experiment in one small school unless the Board are prepared to go to a very great expense.

He considered that a good deal might be done in training the hand and the eye by the introduction of clay modelling. As illustrating the value of modelling in clay, he stated that in Paris the masters' union for the manufacture of jewellery had established a little school for teaching the knowledge and practice of art required in making jewellery. In this school there is modelling in clay and wax, drawing from the cast and from the flat, and also a little actual model work. Various works of art are hung round the room, and from the cast the pupils model in clay. After that there is a course of modelling in wax. The children are about nine or ten years of age. Some begin their attendance here as early as eight.

Cutting stone and carving in wood are good subjects. Plastering is merely pouring plaster into a mould, and mechanics is not of a very technical order. He doubted whether glass-blowing would be useful. The opinion of the union was greatly against the increase in the number of apprentices. Glass-blowing was taught at a disadvantage in England, because the union would not sanction each master having more than one boy.

The subjects that might be taught to girls are wood carving, vellum painting, the making of artificial flowers, and dress-making. Engraving would be expensive. A great deal of chain-making is done by female labour, but there is not much to learn in it.

He knew of no place where these handicrafts were carried on, with the exception of a few orphanages.

II. Statement of Mr. H. Trueman Wood, Secretary of the Society of Arts, made before the Special Committee on Technical Education, June 13, 1883.

Mr. H. Trueman Wood gave the Committee some information about the origin of the City and Guilds Institute for the Advancement of Technical Education, with the foundation of which he had been associated. The work which that Institute was now engaged upon the Committee would have more fully set before them by Mr. Magnus. He gave a brief sketch of the movement which, originating in a proposal to establish a Technical University in London, had resulted in the formation of the City Institute, with its "Central Institution" now in course of erection at South Kensington, and its Technical Schools in Finsbury and Lambeth. He also described the system of Technological Examinations which, originated by the Society of Arts, had been taken over by the Institute, and developed to its present condition by the aid of a scheme of payment on results, similar to that of the Science and Art Department.

Mr. Wood, in reply to various questions put by Members of the Committee, gave the following additional information:—As regards those who attended the school in Finsbury, he could not speak with any knowledge, but he did not think that the larger proportion of them were artisans; he believed they were chiefly clerks and young people of the usual science student class. Some of them, he understood, were boys from the Middle-Class School in Cowper Street. He did not know of any school where boys of the artisan class of twelve or fourteen years of age could go and learn the use of tools, and he was not aware of the existence of any such school in England. He stated that he was strongly of opinion that mechanical drawing should be taught in all elementary schools. The industrial training given in industrial schools was, of course, one form of technical education, but he should scarcely include this in what should be taught in elementary schools. He was of opinion that it was not possible to give definite technical instruction in elementary schools; the children were too young, and, in many cases, it could not be said which trade they would follow in after-life. He did not himself see how more could be done than was being done in Birmingham, where, he understood, practical teaching in elementary science was given to the children. Such teaching as this he believed to be most valuable, and the best possible preparation for the specialised technical instruction which would come later on. Elementary mechanics should certainly be taught and should be illustrated by suitable apparatus. He quite

agreed that general instruction in handicraft would be useful, teaching children the use of tools without reference to special trades, and, he believed, the experiment of fitting up a workshop in one school was one that was worth trying, and would not be, in his opinion, very costly. He left, as an open question, whether such workshop should be used in playtime, or during the ordinary school hours.

III. Statement of Mr. Philip Magnus, B.Sc., B.A., Director and Secretary of the City and Guilds of London Institute for the Advancement of Technical Education, and one of the members of the Royal Commission on Technical Instruction, made before the Special Committee on Technical Education, July 4, 1883.

Mr. Philip Magnus gave the following evidence :—

He stated that there is a double object in the establishment of the Central Institution, now in course of erection at South Kensington. On the one hand, it is intended to give the highest technical education to persons preparing to become engineers, manufacturing chemists, and managers of industrial works, and other persons engaged in scientific research in its application to particular trades. On the other hand, it is especially intended as a training school for technical teachers. The latter function of the institution is considered the more important, because the experience of all persons connected with technical education has shown that there is a great need of duly qualified technical instructors in all parts of the kingdom. It is very likely that arrangements will be made by which teachers will be able to come up to London in the summer months and to obtain lessons in applied science and in the best methods of technical teaching.

As regards the students who attend the Technical College, Finsbury, he wished to say emphatically that a large portion of them are artisans. There are indeed two classes of students who attend the Finsbury Technical College: one class coming in the daytime and the other in the evening. The evening students are almost all engaged in industrial work, and very few of them are clerks. Of those who attend in the daytime, he might say, none are clerks. A few have already been engaged in industry, and, feeling the want of technical instruction, have given up their trade to devote a year or two to study; but the great majority are youths who intend to follow industrial pursuits, and are carrying on their studies with that object. The total number of students in attendance at the College in the evening classes is 621, of whom 132 are apprentices admitted at half the usual fee. Of the day students there are at present about 100 in attendance, the school being opened under its present organisation only in February last. These students come from various middle-class and higher grade schools. A fair proportion of boys are expected to come from the Cowper Street schools, immediately adjoining the college. At the same time it is hoped that pupils will come to the College from other schools of the same grade. It is indispensable that the boys to be admitted should have a good knowledge of arithmetic and of the rudiments of mathematics; *i.e.* they should be able to solve simple equations and understand thoroughly the first book of Euclid.

In answer to the question whether the Finsbury Technical College could be made available to boys from elementary schools, Mr. Magnus said he saw no reason why boys from the higher grade of elementary schools, possessing a knowledge of elementary mathematics, should not be admitted into the College.

In answer to the Chairman, he said it would be well for candidates for admission to have some knowledge of the principles of science, although such knowledge is not absolutely necessary, as some of the Professors of the College stated that they would almost as soon commence the teaching of science as continue the instruction of badly taught students.

The limit of age for the admission of students is fixed at fourteen. Students entering at fourteen, having a fair knowledge of the elements of algebra and geometry, and an acquaintance with some of the principal facts of physical science, would be well able to go through the prescribed courses of the Finsbury College; and such knowledge might be acquired by boys who had passed through the higher Standards, and had taken mathematics and mechanics as specific subjects.

Mr. Magnus thought it would be preferable that boys leaving the Board Schools should be selected about the age of twelve or thirteen, and drafted into higher elementary schools where they might receive the necessary instruction in mathematics and science, and that they should be drafted from these higher elementary schools to the Finsbury Technical College.

The subjects taught at the Finsbury College are practical science, including physics, mechanics, mathematics, and chemistry, mechanical and freehand drawing, handicraft work, French or German, or both. In the workshops the students are taught to work in wood and metal at the bench and at the lathe. They learn not only the use of tools, but to chip, file, turn, and to con truct simple apparatus.

(Mr. Magnus here put in evidence his address at the opening of the Finsbury College, as well as the programme of instruction.)

Apprentices and workmen attend the evening classes to learn the more difficult operations of their trade, and to gain an insight into the processes of which they cannot always obtain satisfactory explanation in the shop. It is to correct the effects of extreme division of labour that evening technical classes are most needed.

As regards carpentry and joinery, the institute is now endeavouring to devise a scheme of evening instruction in connection with the technological examinations, which will probably lead to the establishment of evening classes in this subject in several provincial towns.

Having been asked how the School Board might aid in the development of technical education, Mr. Magnus said that the Board might aid in various ways.

Instruction could be given in the elementary schools in machine drawing. Better instruction might also be given in freehand drawing, of the defects of which the institute's examiners in technology generally complain. In a large number of schools workshops might with advantage be established, in which a certain number of the more advanced boys might have the opportunity of gaining instruction in the use of tools, in the same manner as is done in the primary schools in France under the new Act. It would be a great advantage to the boys on leaving elementary schools, be their occupation what it may, to have acquired the facility of using their hands, and to have gained a knowledge of the properties of different kinds of wood, as well as of iron and other metals, which could only be obtained by working these substances themselves. By the establishment of workshops in schools, the boys, when apprenticed, would advance more quickly in their career, and reality would be given to their scientific instruction as well as to their lessons in mechanical drawing. He considered the great want of this country to be higher elementary or intermediate schools of a technical character. As regards the scheme of education to be given in such schools, he referred to his address on "Technical Instruction in Elementary and Intermediate Schools," delivered before the Society of Arts. He thought that scholars who distinguished themselves at the ordinary elementary schools should be sent to technical schools of this description in preference to such schools as the City of London School or King's College School. Here, in England, education is too distinctly and exclusively literary. We want schools in which practical science, mathematics, and modern languages shall be the chief instruments of education. It has been the object of the City and Guilds of London Institute partly to supply the deficiency by supplementing the existing educational machinery. The Central Institution at South Kensington will, doubtless, exert considerable influence on all schools leading up to it. It will show that there is a school of the same grade as the ancient Universities, giving a practical scientific training instead of a literary or theoretical education. The selected boys from primary schools should be led up to the Technical University or Central Institution rather than to the existing Universities, where they are too often drafted into professional careers which are already overcrowded.

In answer to an inquiry as to the view Mr. Magnus held as regards the value of the study of English literature in schools, Mr. Magnus stated that he attached the highest importance to the study of English literature in higher elementary schools as developing the imagination and giving pupils a taste for reading.

Besides mechanical and freehand drawing, pupils having a taste for art should be taught modelling, the study of which is not sufficiently developed in this country.

He considered that geometry should be taught practically without Euclid; whilst Euclid is very valuable to those who wish to become thorough mathematicians, he thought that very few of those who learn the elements of Euclid derive any practical benefit from the study. Abroad, geometry is generally taught without Euclid.

As regards the technological examinations, Mr. Mangus said that four years ago the institute took over these examinations from the Society of Arts, which had previously conducted them under somewhat different conditions. The candidates have increased very much during these four years, especially those in mechanical trades. At the time of the transfer of the examinations, the number of candidates was 212, whereas this year, 1883, the number of candidates amounted to 2397.

The Council of the Institute are very desirous that scholarships should be established in connection with the Finsbury College and other similar technical Colleges throughout the kingdom, to enable promising pupils to carry on their education at the Central Institution. If children could be taught sufficient mathematics and elementary science to be transferred from the Board schools to the Finsbury College, or to some other technical school, and thence to the Central Institution, he considered the ladder of technical education would be complete.

He thought that the Board might further aid in assisting technical education by the loan of its rooms for the formation of evening classes, it being always understood that, in order that the instruction should be of any use, it must be of a practical character, and that the classes should be well furnished with all necessary models, apparatus, &c.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

MR. THOMAS PURDIE, Ph.D., B.Sc., Associate of the Royal School of Mines, has been appointed Professor of Chemistry in the University of St. Andrews, vacant by the retirement of Dr. Heddle.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, December 4, 1884.—William Carruthers, F.R.S., Vice-President, in the chair.—The following were elected Fellows of the Society:—The Hon. F. S. Dobson, W. A. Haswell, Geo. W. Oldfield, Dr. G. W. Parker, M. C. Potter, T. J. Symonds, W. A. Talbot, and J. H. Tompson.—Mr. W. T. Thiselton Dyer exhibited:—(1) Examples of leaves of *Sagittaria montevidensis* under different modes of cultivation, the changes thus induced as regards size and general facies being most remarkable, so much so that they might be deemed widely separate genera. The small leaves were from a plant raised from seeds collected in Chili by Mr. J. Ball, F.R.S., and sent to Kew in 1883, and grown in a pot half submerged in the *Nymphæa* tank. The enormously large leaf and spike were those of a plant raised from seeds, ripened at Kew, and sown in spring (1884). When strong enough the plant was planted in a bed of muddy soil, kept saturated by means of a pipe running from the bed to the *Nymphæa* tank. (2) A special and peculiar instrument called a "Ladanisterion," from Crete, it being a kind of double rake with leathern thongs instead of teeth, and used in the collecting of gum Labdanum, a drug now dropped out of modern pharmacy. The instrument in question was procured for the Kew Museum by Mr. Sandwith, H.M. Consul in Crete. (3) A collection of marine Algæ from West Australia, brought to this country by Lady Broome.—A paper was read by Dr. Francis Day on the relationship of Indian and African fresh-water fish-fauna. In this communication the author refers to certain papers of his, read before the Society on previous occasions, but he more particularly deals with the differences shown between his own statements therein and those subsequently given by Dr. Günther in his "Introduction to the Study of Fishes." Dr. Day is inclined to believe that in the consideration of Indian fish distribution there seems a possibility that certain marine forms, for example, the Acanthopterygian *Lates*, the Siluroid family Arünæ, and others have been included among the fresh-water fauna by Dr. Günther, whereas fresh-water genera, such as *Ambassis*, several genera of the Gobies, *Sicydium*, *Gobius*, *Eleoteris*, &c., have been omitted from the fresh-water fauna of India by Dr. Günther. Thus Dr. Day attempts to show that there may be less affinity between the African and Indian regions, so far as fresh-water fishes are concerned, than there is between his restricted Indian region and that of the Malay Archipelago. He adds that of 87 genera found in India, Ceylon, and Burmah, 14 extend to Africa, 44 to the Malay Archipelago, whereas out of 369 species only 4 extend to Africa and 29 to the Malay Archipelago.—On the growth of trees and protoplasmic continuity, was a paper by Mr. A. Tylor, giving his experiments in the curvature assumed by branches, particularly those of the horse-chestnut. He pointed out that the terminal bud is constantly directed upward, but is straightened out at a later stage of growth. Further, he found that terminal buds, when directed by being tied against a tree-trunk or plank, invariably turned away from the obstruction irrespective of the incidence of light. When the growing points of neighbouring branches were turned directly towards each other, they mutually turned aside or one stopped growth. Some co-ordinating system was necessary to enable the parts to act in concert, and he attributes this to a continuity of the threads of protoplasm.—A paper was read on *Heterolepidotus grandis*, a fossil fish from the Lias, by James W. Davis. The author describes the specialities of this form, and remarks that the genus had been instituted by Sir Philip Egerton for certain forms closely related to Lepidotus, but differing in their dentition and scaly armature. The *H. grandis* has interest, among other things, in the attachment of the dorsal and anal fins with the series of well-developed interspinous bones, in the peculiar arrangement of the articular apparatus of the pectoral fins, and in the heterocercal form of the tail.

Chemical Society, December 18, 1884.—Dr. Russell, F.R.S., in the chair.—The following gentlemen were elected Fellows:—W. P. Ashe, Sir B. V. S. Brodie, Bart., J. F. Ballard, W. Briggs, M. T. Buchanan, W. G. Brown, H. M. Chapman, W. H. Eley, J. Frost, T. P. Hall, H. J. Hodges, H. Jackson, F. Johnson, J. D. Johnstone, G. F. Kendall, C. W. Low, F. M. Mercer, P. C. Porter, V. E. Perez, A. Rickard, K. B. B. Sorabji, R. B. Steele, H. Smith, E. G. Smith, G. Thorn, W. Tate, P. C. Thomas, T. Wilton, J. H. Worrall, W. C. Wise, W. H. Wood.—The following paper was read:—Chemico-physiological investigations on the cephalopod liver and its identity as a true pancreas, by A. B. Griffiths. The author could not detect any bile acids or glycogen in this organ, but a ferment obtained from it by glycerine converted starch paste into sugar, and formed from fibrin, obtained from the muscular fibres of a young mouse, leucin and tyrosin, the latter body giving, with a neutral solution of mercuric nitrate, a red precipitate. It was announced that at the next meeting, January 15, Prof. Thorpe would read a paper on the atomic weight of titanium, and that Dr. Frankland would give a lecture in February on chemical changes produced by micro-organisms.

Royal Microscopical Society, December 10, 1884.—Rev. Dr. Dallinger, F.R.S., President, in the chair.—Mr. Crisp exhibited Dr. Cox's radial microscope, a simplified form of Mr. Wenham's stand.—Mr. J. Mayall, jun., exhibited a new stage which he had devised, in which the thin upper plate was abolished and a frame to hold the slide substituted, which is not liable to flexure.—Mr. Crisp also exhibited Ward's eye-shade, Bausch's adapter for a spot lens, and Kain's mechanical finger.—Mr. Rosseter's paper on the gizzard of the larva of *Corethra plumicornis* and its uses, and one of Mr. G. F. Dowdeswell, on variations in the development of a Saccharomyces, were read and discussed.—A communication was read from Dr. Cox, the President of the American Society of Microscopists, expressing scepticism as to the possibility of making sections of diatoms so thin as those claimed by Dr. Flögel, as recently published in the Society's *Transactions*.—Mr. Parsons exhibited the hydroid form of *Limnocodium Sowerbii*, the fresh-water Medusa which he had found in April last at the Botanic Gardens, Regent's Park.—Dr. Zenger's method of mounting diatoms so as to show both sides was explained, and some mounts exhibited.—Mr. Cheshire gave a *résumé* of his paper on some new points in the anatomy of the bee. It has long been known that the queen bee, in common with many insects, stores the spermatozoa she receives from the male in a small sac, which is called the spermatheca. A long chain of evidence has also satisfied entomologists that in some way these spermatozoa are transferred to those eggs which are to be converted into undeveloped females known as workers, but the manner of this fertilisation has not hitherto been demonstrated. By carefully dissecting out a spermatheca with its attachment to the oviduct unbroken, and then by needle-knives cutting through the trachea which incloses it completely, the spermatheca and its valve may be isolated. It is then seen to be accompanied by a long double gland having a centrally-placed duct, provided with a sphincter muscle near its junction with the aperture of the spermatheca. The spermatheca itself carries a sphincter and three muscles, two to aid and

one to antagonise its action. The glandular secretion acts as a vehicle for carrying the spermatozoa, as liberated, towards the oviduct. Another gland, previously unknown, now adds its secretion, and serves to bring the spermatozoa into proper separation from each other. The common oviduct is not a simple tube, as formerly supposed, but carries in its centre a pouch of delicate membrane, and very like the recurved tail of a lobster. Two muscles, having for their especial purpose the direction of the egg in transit to the ovipositor, carry the egg, if a worker is to be produced, into this central pouch, and bring it into contact with the spermatic fluid, when a spermatozoon enters its micropyle. If a drone or male is to be produced, it takes a lower path in the right or left oviduct, and a side path to the ovipositor, and so avoids the pouch and escapes fertilisation. Siebold's theory of parthenogenesis in the bee is thus anatomically demonstrated to be accurate.—Dr. Van Heurck's paper on the resolution of *Amphipleura* into "beads" was read, and gave rise to a long discussion.—The meeting resolved to send a contribution to the memorial now being raised in America to the late R. B. Tolles, the eminent optician.

Royal Meteorological Society, Dec. 17, 1884.—Mr. R. H. Scott, F.R.S., President, in the chair.—Mr. C. H. Cotton, Mr. S. A. Jolly, L.R.C.P., and Rev. C. J. Taylor, M.A., were elected Fellows of the Society.—The following papers were read:—On the reduction of temperature means for short series of observations to the equivalents of longer periods, by Dr. Julius Hann, Hon.Mem.R.Met.Soc. The author has recently carried out an investigation into the climate of the Alpine districts of Austria, and in doing so he has endeavoured to reduce the monthly and annual means of all the temperature observations from the districts in question during the interval from 1848 to 1880, and in some places to 1884, to the mean for the thirty years' period 1851 to 1880. In this paper Dr. Hann describes the methods he adopted to reduce observations at mountain stations for short periods to the equivalents of longer periods.—The diversity of scales for registering the force of wind, by Charles Harding, F.R.Met.Soc. The object of this paper is to call attention to the confusion that exists in the systems in use by various countries for registering wind-force, whether instrumentally or otherwise, and to show the need of action for improvement.—Report on the phenological observations for the year 1884, by the Rev. T. A. Preston, M.A., F.R.Met.Soc. The salient features of the weather during the period embraced in this report, viz. October 1883 to September 1884, were: the mild winter, the cold April, the hot August, and the long period of drought, which at the end of September began to be seriously felt. The general effects on vegetation have been: the prolonged existence of many of the autumn species, the great loss of wall-fruit, the failure of bush fruits, the plentiful supply of strawberries as long as they lasted, but the time was short; the good hay harvest, although it was light in quantity; the good corn crop, the unusually plentiful potato crop, and the great abundance of wild fruits.

EDINBURGH

Royal Society, December 15, 1884.—Mr. Robert Gray, Vice-President, in the chair.—Dr. Sang read the first part of a paper on the theory of the tides.—Mr. J. T. Cunningham gave a communication on the nature and significance of the structure known as Kupffer's vesicle in teleostean embryos.—Prof. Turner discussed the relation of the alveolar form of cleft palate to the incisor teeth and the intermaxillary bones.—Mr. T. Andrews, F.C.S., gave a paper on the apparent lines of force on passing a current through water.

Royal Physical Society, Dec. 17, 1884.—B. N. Peach, F.R.S.E., F.G.S., President, in the chair.—The following communications were read:—On *Loligopsis* and allied genera, by W. E. Hoyle, M.A. (Oxon), F.R.S.E., &c. The author reviewed all the species which have at various times been referred to the genus *Loligopsis*, and indicated the different genera to which they should be relegated; the genera *Leachia*, Lesueur, and *Taonius*, Steenstrup, were fully characterised; *Desmoteuthis*, Verrill, was considered, and shown to be synonymous with *Taonius*.—Mr. Hoyle also exhibited, with remarks, a specimen of *Strongylus contortus* (Rud.).—Mr. J. R. Henderson, M.B., of the Scottish Marine Station, Granton, read a communication on additions to the fauna of the Firth of Forth. Specimens were exhibited of forty-five species new to the district, including the following:—*Astrorhiza limicola*, *Halecium* sp. (probably new), *Ascandra variabilis*, *Tomopteris* sp., *Nymphon hirtum*, *Corophium tenuicorne*, *Nyctiphanes* (*Thysanophoda*) *Norvegica*, and *Podopsis Slabberi* (new to Britain).—Mr. F. G. Pearcey explained a method of hardening friable and decomposed rocks, sands, clays, &c., so that sections may be made of them for microscopical purposes. During the cruise of the *Challenger*, he said, there was obtained a large collection of oceanic deposits, whose structure could not be accurately determined without making transparent sections. On account of their extreme friability this was found impossible by the usual methods, and it was therefore necessary to find a mode of rendering them hard and compact. After many experiments and much labour, a method was devised which had proved successful, and which would be found of great service to mineralogists, geologists, and others, in the investigation of soft rocks. It consisted in the introduction of a foreign substance to cement the grains together, and so render the material capable of being cut into sections. The substance used for this purpose was a solution of gum copal in ether, the ether being evaporated after the material had been soaked in the preparation, and the residuum carefully dried. Mr. Pearcey minutely described the various processes to be followed, and exhibited specimens illustrative of the results obtained. Mr. Hoyle spoke of the necessity of having mud and ooze examined by the polariscope, and bore testimony to the value of the method of doing this, which was due to Mr. Pearcey's patience and perseverance.—A note on the breeding of the Marsh Tit (*Parus palustris*, L.) in Stirlingshire during the present year (1884), with exhibition of nest and eggs, was read by Mr. William Evans, F.R.S.E.—On abnormal dentition in a Dingo (*Canis dingo*), specimen exhibited, by Andrew Wilson, L.D.S.—Mr. A. Gray exhibited, with remarks, a live specimen of the Water Spider (*Argyroneta aquatica*) from Luffness Marshes.

DUBLIN

Royal Society, Nov. 17, 1884.—Section of Physical and Experimental Science.—Prof. J. Emerson Reynolds, F.R.S., in the chair.—After an introductory address by the chairman the following communications were read:—Notes on the aspect of the planet Mars in 1884, by Otto Boeddicker, Ph.D., communicated by the Earl of Rosse, F.R.S. The notes are accompanied by thirteen drawings of the planet, representing the following longitudes of Mars' central meridian:—(1) 12°·6 (March 23), (2) 24°·9, (3) 28°·3 (March 22), (4) 38°·0 (March 23), (5) 73°·0 (March 17), (6) 137°·8 (March 10), (7) 261°·8, (8) 267°·4 (April 2), (9) 279°·4 (April 1), (10) 286°·7, (11) 303°·2 (February 24), (12) 307°·6 (April 1), (13) 317°·4 (February 24). When compared with Schiaparelli's charts they admit of the identification of the following spots:—*South:* Sabæus Sinus, Deucalionis Regio, Thymiamata, Margaritifer Sinus, Auroræ Sinus, Mare Cimmerium, Hesperia, Syrtis Minor, Syrtis Major, and a trace of Œnotria or Japygia; *North:* Lacus Niliacus, Nilus, Alcyonius Sinus, Astapus; on the *disk-middle* traces of these canals: Gehon, Indus, Hydaspes, Ganges, Cyclopum, Phison, Euphrates. Sketches Nos. 1 to 4 show when the markings in longitude 10° lie on the disk-middle, the sp–nf direction of Deucalionis Regio, but when they lie near the preceding limb the sf–np direction of Thymiamata prevails so considerably that the angular shape of the two Sinus Sabæus and Margaritifer may be entirely overlooked, and only the one or the other direction perceived and ascribed to them. Lacus Niliacus is seen interrupted on Nos. 1 and 4, so as to resemble its appearance on Schiaparelli's chart of 1882; and Nilus is seen double on No. 13—which makes it probable that a trace of Schiaparelli's gemination of lines was perceived at Birr Castle. During the time between Nos. 7 and 8, Syrtis Minor became much darker, and Syrtis Major became visible; this, as it cannot be due to the planet's rotation, is probably due to changes in its own atmosphere. Alcyonius Sinus appeared much darker than either in 1879 or 1881. Sketch No. 5, which at time of drawing was considered difficult but fairly good, does not show any spots capable of certain identification. A comparison with other drawings of the same period may explain this.—On the volatilisation of zinc from German silver alloys at high temperatures, by A. R. Haslam; communicated by Prof. C. R. Tichborne. Alloys of known composition were heated in a current of hydrogen, and weighings taken at intervals of one hour. The chief loss in weight was found to take place in the first hour, and the loss was greatest in the alloys that were poor in nickel. The author concludes that nickel has the effect of retarding the volatilisation of the zinc.—On the analogy between heat and electricity, by Prof. G. F. Fitzgerald, F.R.S. It was

pointed out that the analogy, as usually drawn between heat and electricity, namely, to liken temperature to potential and quantity of heat to quantity of electricity, is not the true analogy, inasmuch as the product of temperature and quantity of heat is not of the nature of energy, and that the true analogue of quantity of electricity is quantity of entropy. In this case a non-conductor of electricity is a non-conductor of entropy, *i.e.* a non-conductor of heat. As the quantity of electricity is the same at all parts of a circuit, and as it requires a perfect heat-engine to transfer entropy from one temperature to another undiminished, conductors must be of the nature of perfect heat-engines. It was further pointed out that a molecular structure of ether similar to that of a gas could be assumed, the motions of whose molecules might be polarised in such a way by differences of temperature that, although no heat was conducted, it would be thrown into a state of stress which would explain electrostatic phenomena. It was explained that this was a step beyond that made by Maxwell in his "Electricity and Magnetism," where he avoids any hypothesis as to how electric displacement produces mechanical stress. The author stated, however, that the object of this communication was not to bring forward this doubtful hypothesis, but, by drawing attention to this analogy between heat and electricity, to prevent the danger at present imminent of its being supposed that the analogy between electric displacements and the motions of an incompressible fluid is the only analogy possible, and of this mere analogy being consequently mistaken for a likeness.—Howard Grubb, F.R.S., exhibited a star map photographed by the Rev. T. E. Espin.

Natural Science Section.—V. Ball, F.R.S., in the chair.—On a new species of *Halcampa*. This is the first recorded example of the genus in Ireland, and it proves to be a new species, for which the name *H. Andresii* is proposed. It was found at Malahide, Co. Dublin.—Mr. G. Y. Dixon exhibited a living and some preserved specimens of *Peachia hastata* from Dollymount Strand, Dublin Bay. This is the first Irish locality.—The Chairman exhibited geological maps of Canada and of the United States, with specimens of Laurentian rocks and minerals.

PARIS

Academy of Sciences, December 22, 1884.—M. Rolland, President, in the chair.—On a new method of measuring the heat of combustion of carbon and organic compounds, by MM. Berthelot and Vieille. The present paper is limited to the determination of the heat of combustion for cellulose (coton) and the various carbons used in the manufacture of gunpowder.—Description of a microscopic element by means of which it may be possible to determine the various groups of Cynthiadæ, by M. de Lacaze-Duthiers.—Remarks on the "Cours d'exploitation des Mines," presented to the Academy by M. Haton de la Goupillière.—Remarks on the volume of the *Connaissaance des Temps pour* 1886 and the *Annuaire pour* 1885, presented to the Academy in the name of the Bureau of Longitudes by M. Faye.—Note on the indeterminate equation

$$x^2 - Ky^2 = z^n,$$

by M. Maurice d'Ocagne.—On the thermodynamic potential and the theory of the voltaic pile, by M. P. Duhem.—Description of a diffusion photometer, by M. A. Crova.—Note on the heat of combustion of the ethers of some acids of the fatty series, by M. W. Louguinine. The author's experiments lead to the general conclusion that the heat of combustion of an acid is perceptibly equal to that of the ether of the same acid, less the heat of combustion of the corresponding alcohol, regard being had to the number of molecules of alcohol in reaction.—Note on the α-ethylamidopropionic acid, by M. E. Duvillier.—Observations on the optic activity of cellulose in connection with M. Béchamp's recent communication, by M. Alf. Levallois.—On the cutaneous anæsthetic action of the hydrochlorate of cocaïne, by M. J. Grasset. It is shown that the hypodermic injection of 0·01 gr. of the hydrochlorate of cocaïne produces in man a sharply limited zone of cutaneous anæsthesis without general phenomena, and with slight local consequences, although lasting long enough to perform a certain number of surgical operations.—Influence of the variations in the centesimal composition of the air on the intensity of the respiratory functions, by M. L. Frédéricq.—On the spinal bone in the series of vertebrate animals, by M. A. Lavocat.—Note on the constitution of the reticulate rhizopods, by M. de Folin.—On the Acari dwelling in the quill of birds' feathers, by M. E. L. Trouessart.—On the existence of phanerogamous Asterophyllites, by MM. B. Renault and R. Zeiller.—On the Kersanton formation in the Croisic district, Loire Inférieure, by M. Stan. Meunier.—On a phenomenon of crystallogeny in connection with the fluorine of the Cornet rock near Pontigabaud, Puy-de-Dôme, by M. F. Gonnard.—Results of the analysis of the masses of boiled beetroot, made with a view to determining the quantity of chloride of potassium and nitrate of potassium contained in it, communicated by M. H. Lepley. The quantity of these salts in 100 kilogrammes of root was found to be :—

	Max. Gr.	Min. Gr.	Mean. Gr.
Nitrate of potassium	342	43	131
Chloride of potassium	217	65	143

BERLIN

Physical Society, Nov. 21, 1884.—Prof. Neesen reported on a case of magnetisation produced by a stroke of lightning, the distribution of which had been examined by a former pupil of the speaker. The lightning had struck the clock of a church tower, and so strongly magnetised it that it was only by great force that the pendulum could be moved from its position of rest, while the clock had to be taken to pieces and the magnetised iron parts demagnetised by means of heat. The most strongly-magnetic part was a U-shaped piece of cast-iron, the two perpendicular and downward-directed legs of which bore the edges for the pendulum. The distribution of the magnetism in this piece of iron was as follows :—Not far from the lower ends (at about a third of the height) was a neutral point on both sides, the inferior piece on one side being north polar, on the other side south polar. On the side having the north pole, south polar magnetism was found above the neutral point, extending above the middle line and beyond, so as to take in about the upper third of the other leg. Thereupon followed an upper neutral point, between which and the lower neutral point of this side was found north polar magnetism. The two lower neutral points were the spots where the two legs of the U-shaped piece of iron were connected by a horizontal iron pin. Other effects of the lightning were not to be found either in the clock or on the church tower.—Prof. Neesen further produced a galvano-plastic high relief of iron, of a dull silver-gray, which in fineness of detail far surpassed the productions of the silver galvano-plastic art. The method by which this was produced was still kept secret by the manufacturer.—Prof. Lampe communicated some interesting results arrived at by his pupils in exercises in calculation. One problem was to calculate the attraction of a homogeneous mass of certain form on a material point of its surface, if the attraction of the same mass in globular form on the pole was equal to 1. The calculation was first made for a flattened ellipsoid, in which the attraction on the polar point was known to be greater than 1. With increase of oblateness the attraction increased up to a maximum, for which the magnitude of the attraction and the eccentricity of the meridian curves were calculated. After this maximum the attraction abated, with further increase of oblateness, and the eccentricities of those meridian curves were calculated for which the attraction was equal to 1, as also of those for which it was equal to 0·5. Similar calculations were made for the elongated ellipsoid. In this case the attractions on the polar point became continually less, and only the eccentricity of the meridians was calculated, in which the attraction was equal to 0·5. Another exercise was to calculate the attraction of a circular cylinder on the middle point of a terminal plane, when the relation of the radius, r, of the terminal plane to the height, h, changed. In this case, too, with a certain relation of h to r a maximum of attraction was found, which was more than 1 but yet less than the maximum in the case of the flattened ellipsoid. After this maximum the attraction declined as well with increasing h as with increasing r, and the two relations of h to r, in which the attraction was equal to 1, were found. Finally, in the case of the circular cones, the attraction on the apex was calculated, and here, too, the maximum was determined, being, however, less than 1, and the cone was determined in which the attraction on the apex was equal to the attraction on the centre of the fundamental plane.—Prof. Landolt described a simple contrivance used by him for recovering the products of sublimation. A test tube, of glass in the case of bodies easy to sublime, of platinum in the case of bodies difficult to

sublime, was closed at the top by a stopper through which passed two small tubes, one reaching to the bottom, the other coming out below the stopper. The first small tube was connected with the condenser, and by this means the tube became permanently cooled. The cold tube was let down into the vessel in which the substance to be sublimed was being heated, and the products were obtained on the outside of the little tube, from which they could be easily removed. By a platinum tube in the platinum retort the speaker received molybdenous acid crystals, and, by the heating of lime, microscopic lime crystals.—Prof. Landolt further described an arrangement of a sodium lamp for a polarimetric apparatus in which a uniformly bright flame was produced, and he also showed a theodolite with a glass scale, which could be read by transmission of the incident light, thus facilitating observation.

Physiological Society, November 29, 1884.—Prof. Waldeyer exhibited a microscope-stand which he found very practicable, both for the ease and security with which it enabled a microscope to be turned in any direction, and for the way in which it allowed the use of any system of lenses.—Prof. Du Bois-Reymond spoke on the difficulty of determining the blood-pressure in the capillary vessels, and discussed the method he had adopted in his lectures for the presentation of correct views on this matter. As was known, the blood-pressure in the capillary vessels had hitherto been determined by placing a small glass plate on a spot of skin and then estimating the pressure that was necessary to render this spot void of blood. By this method, however, the elasticity of the inter-capillary tissues was left out of account, and the results were therefore vitiated, so far as the determination of the pressure in the capillaries was concerned. The exact state of the case, which it was difficult for any experimental examination to come at, was, in the first place, able to be determined only under ideal conditions. In the current of an incompressible and inexpansible fluid through a system of pipes under a given propelling force the rate of current was always in inverse proportion to the cross section, while, with the distance of the propelling force, the pressure abated at a rate proportionate to the resistance, *i.e.* it sank more rapidly in narrow, and more slowly in wide, tubes. If a tube were widened by splitting it into two branches of equal calibre, the proportions between lateral section, rate of current, and pressure remained the same. If, on the other hand, the bore became as large again as before, the rate of current sank to a half, while the pressure decreased but little. If, again, a capillary network were intercalated into the system of pipes, the rate of current fell only in proportion to the enlargement of the total cross section; the pressure, on the other hand, sank considerably on account of the resistance presented by the capillaries, and the curve of pressure showed a very steep decline in relation to the abscissæ of the zero-line. If the capillaries again merged into simple tubes, the cross section became less, the rate of current proportionally greater, while the pressure again sank but slowly. In the middle of the capillary system the pressure, in accordance with known laws, amounted to half the initial pressure. In the circulation of the blood the cross sections of only the larger arteries and veins were known; the cross section of the capillary system was unknown. Under the ideal conditions, however, which formed the basis of the above scheme this cross section might be calculated from measurable rates of current. Suppose the rate of current of the blood in the capillary vessels equal to 0·8 mm. per second, and that in the aorta equal to 500 mm. per second, then the current in the latter was 625 times as swift as that in the capillaries, and the cross section of the whole capillary system must be 625 times as large as that of the aorta, or the diameter of all the capillaries was twenty-five times as large as the diameter of the aorta. The curve of pressure sank slowly in the arterial system. In the capillaries the great resistance required a very considerable difference of pressure, and the curve of pressure sank, therefore, very considerably; to sink more slowly in the veins down to beneath the abscissa line, *i.e.* the pressure in the veins in the neighbourhood of the heart became negative. In the middle of the capillary system the pressure, in accordance with this view, was equal to half the pressure in the ventricle. Should the arteries in consequence of the contraction of their smooth muscle-fibres become narrower, the point where the pressure in the capillaries was equal to half the heart's pressure shifted nearer to the arterial system. If, on the other hand, contractions or obstructions occurred in the veins, this point came closer to the venous system. Such a presentation of the case gave a view of the conditions of cross section and pressure in the capillaries, and offered a basis for experimental investigations. A scheme of the same kind might be applied to the system of lymphatic vessels, for which the average pressure in the blood capillaries must be taken as starting pressure.—Prof. Fritsch related an optical phenomenon he had perceived during the microscopical examination of certain objects, a phenomenon he described as due to monocular stereoscopic vision. Certain pictures, in particular those of the transverse section of the principal nerves of the electric organ, made a decided impression of a funnel-shaped depression such as was otherwise obtained only in the binocular contemplation of the well-known stereoscopic figures. It was especially easy for him to receive this impression on moving his eye from side to side. By producing the arrangement he had referred to at the next sitting of the Society, he would ascertain whether other eyes received the same impression of the picture.

VIENNA

Imperial Academy of Sciences, December 4, 1884.—On the scientific usage of orthogonal axonometers, by C. Pelz.—On the mechanical theory of electricity, by T. Tanuschke.—On energy and coercive state in the magnetic field, by G. Adler.—On the consumption of some foods in the intestinal tract of man, by H. Malfatti.—Contribution to a knowledge of some hydro-products of cinchoninic acid, by A. Weidel and K. Hazura.—On the action of the sun-spectrum on the haloid compounds of silver, and on the raising of their sensibility to some parts of the spectrum by colouring-matters and other substances, by T. M. Eder.—Computation of the orbit of the planet Russia 232, by N. Herz.

December 11, 1884.—On morin, part 2, by R. Benedikt and K. Hazura.—Communication on the determination of nitrogen, by G. Czeczetka.—Studies on the compounds prepared from animal tar; part 5, on collidine, by H. Weidel and B. Pick.

December 18, 1884.—On deformation of the plane of light-waves in the magnetic field, by E. von Fleischl.—Contributions to the explanation of cosmic-terrestrial phenomena; part 2, on aurora borealis, by T. Unterweger.—On Kjehldahl's method for determining nitrogen, by G. Czeczetka.—On central eclipses of the sun of the twentieth century, by E. Mohler.

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