THURSDAY, APRIL 2, 1914.

THE SYRIAN GODDESS.

The Syrian Goddess; Being a translation of Lucian's "De Dea Syria" with a Life of Lucian. By Prof. H. A. Strong. Edited with notes and an introduction by Dr. J. Garstang. Pp. xiii + 111. (London: Constable and Co., 1913.) Price 4*s.* net.

IN view of recent excavation upon sites in Syria, and of the increased interest the ancient cults of that region have for the archæologist, it was well worth while to produce an annotated edition of the well-known treatise "De dea Syria." The editors accept the traditional ascription of the work to Lucian, and there is much to be said for this view; for, although the rest of Lucian's works are written in pure Attic Greek, he may well in his early youth have adopted the Ionic dialect for this treatise in imitation of Herodotus. We should then assign its composition to the middle of the second century B.C. In any case, the record is that of an intelligent traveller who is anxious to make known the facts he has been able to ascertain as to the strange Oriental rites of Syria, and as such it has the very greatest value for the archæologist. Its author describes the cult and temple of the goddess of North Syria, Atargatis, and that of her male consort, at Hierapolis, near Mumbij, on the Euphrates. It has long been recognised that Atargatis was a combination of the Cilician goddess Atheh with Athar, the Aramaic form of the goddess Astarte or Ishtar.

In his introduction Prof. Garstang would trace her descent from a still more remote antiquity, connecting her with the chief goddess of the Hittites, the great nature-mother who appears in the Anatolian rock-sculptures. One of the earliest of her images may well be that mysterious and gigantic figure carved in the living rock on Mount Sipylus, near Smyrna. The fact that Atargatis of Hierapolis is always represented as robed upon coins from the site is in favour of the Hittite comparison; and the descent of her consort from the Hittite and Mitannian weather-god Teshub is rendered probable by the fact that the author of the treatise, "De dea Syria," identifies him with the Syrian Adad. Thus it may well be that much of the cult the author describes had been inherited from the ritual of the Anatolian deity as practised fifteen centuries before he wrote.

Prof. Garstang's notes and introduction give evidence of wide reading in the course of his study of this interesting theme, and the book will form a useful supplement to the collection of material he has already published in his larger work on "The Land of the Hittites." L. W. K.

STONES AND SUPERSTITIONS.

The Curious Lore of Precious Stones. By Dr. G. F. Kunz. Pp. xiv + 406 + 63 plates, and numerous illustrations in the text. (Philadelphia and London: J. B. Lippincott Company, 1913.) Price 21*s.* net.

DR. KUNZ'S wide knowledge and experience in connection with precious and semi-precious stones, and his familiarity with the voluminous literature dealing with the subject, afford a sufficient guarantee to all interested in gems and their "curious lore," that the work he has now produced is one of exceptional value. On the title-page of this handsome volume the subjects to be dealt with in relation to gems are enumerated as "their sentiments and folk-lore, superstitions, symbolism, mysticism, use in medicine, protection, prevention, religion, and divination, crystal-gazing, birth-stones, lucky stones, and talismans, astral, zodiacal, and planetary"—and this long list is far from exhausting the mass of extraordinary and fanciful ideas treated of in the book, and constituting one of the strangest illustrations of human credulity and love of the marvellous.

With regard to the disputed question as to whether precious stones first came to be prized as ornaments or talismans, our author does not attempt to give a decision; he justly points out that the absence of precious stones in the oldest known interments, where shells, etc., appear to be used as ornaments, may be accounted for by the hardness of the stones which prevents easy perforation. Jet ornaments, however, occur with Palæolithic remains, both in the caves of Belgium and Switzerland, and harder stones are found in Neolithic graves. Of the early use of stones as fetishes there is no doubt; life, sex, powers of reproduction, and many extraordinary virtues and influences were ascribed to them at the dawn of history. Magic formulæ concerning stones are found alike in the clay tablets of Sumero-Assyrian age and in Egyptian papyri of very early date. The earliest engraved cylinders of Babylon are ascribed to 4000 B.C., and scarabs of Egypt to 2000 B.C., while amber was found in abundance in the graves of Mycenæ. In classical times magical influences were ascribed to the beautifully engraved gems, partly on account of the materials of which they are composed, and partly

from the figures and inscriptions which they bore, and when in medieval times the art of gem-engraving was lost, the gems were still made serviceable by the representations of Greek deities being regarded as those of Christian saints, liturgies being composed by means of which—the old love of ornament and mysticism remaining—the heathen relics were reconsecrated for Christian use.

Of the persistence to recent periods, and even to our own day, of fanciful and superstitious beliefs concerning precious stones, Dr. Kunz gives many amusing illustrations. In a book published in Frankfort as late as 1718, an "airship" is represented which is raised by the supposed action of sunlight upon the "coral-agates" in its roof, a "magnetic action" being thus produced! Napoleon, when in Egypt, found a carnelian seal engraved with Arabic characters, which he wore as a talisman until his death, and it was equally treasured and carried at all times by Napoleon III. The ill-fated Prince Imperial had it on his person in South Africa, and it appears to have been carried off by the Zulus who stripped his body. It is asserted that a well-known noble lady, still living, believes that her diamonds not only have life and sex, but are capable of reproduction; while a recent trial in Paris showed that a wealthy lady became suddenly so overcome by fear of the evil influences of an opal-ring she wore that she slipped it off and put it on the finger of a poor girl who was passing. It is declared that a well-known authoress confesses that she habitually resorts to "crystal-gazing" to recover the thread of a story that she has temporarily lost.

Many very interesting extracts are given by Dr. Kunz from curious and little-known works, which illustrate alike the wildly absurd views held in all ages concerning the various influences exercised by different precious stones on those who wear them, and the cures and other wonders wrought by them, these ideas prevailing not only among the poor and ignorant, but among the educated of all classes and religions. The book, which is admirably illustrated, is as entertaining as it is instructive. J. W. J.

ANIMAL MORPHOLOGY AND EMBRYOLOGY.

(1) *A Text-book of General Embryology.* By Prof. W. E. Kellicott. Pp. v+376. (New York: Henry Holt and Co., 1913.) Price 2.50 dollars.

(2) *Zellen- und Gewebelehre Morphologie und Entwicklungsgeschichte.* Unter Redaktion von E. Strasburger und O. Hertwig. Bearbeitet von E. Strasburger, W. Benecke, R. Hertwig, and others. I. Botanischer Teil. Unter Redaktion von E. Strasburger. Bearbeitet von E. Strasburger und W. Benecke. Pp. vii+338. Price 10 marks. II. Zoologischer Teil. Unter Redaktion von O. Hertwig. Bearbeitet von R. Hertwig, H. Poll, O. Hertwig, and others. Pp. vii+538. (Berlin and Leipzig: B. G. Teubner, 1913.) Price 16 marks.

(3) *Elementares Praktikum der Entwicklungsgeschichte der Wirbeltiere mit Einführung in die Entwicklungsmechanik.* By Dr. Oscar Levy. Pp. viii+183. (Berlin: Gebrüder Borntraeger, 1913.) Price 5.60 marks.

(1) THIS is an excellent book to place in the hands of intermediate students of zoology; it gives a clear and interesting account of the more general aspects of embryological science. If the hypercritical reader regards it as somewhat scrappy and superficial, it must be answered that this is unavoidable in a book of its size dealing with so large a subject. The book does not pose as a work of reference; its function rather appears to be to give the student an idea of the present-day point of view of biologists towards the various problems of which it treats, to arouse his interest, and to direct his steps towards the fuller expositions to be found in contemporary literature.

An introductory chapter upon ontogeny is followed by excellent chapters on the cell and cell-division, the germ cells, and the process of maturation or meiosis. In regard to the last-mentioned phenomenon a very good and clear account of modern views is given. A few obvious slips will, no doubt, be corrected in a new edition, *e.g.*, in the legend attached to Agar's figure illustrating the spermatogenesis of Lepidosiren the last six words convey an erroneous statement, and should be excised. Again, in the description of tetrad formation the student will be liable to be puzzled, if not misled, by the wording of the statement that "each of the newly-organised bivalent elements comes out in the form of four small bodies, the tetrads." He may find himself in a similar position when he reads that in cases where tetrad formation takes place "the secondary spermatocytes have the diploid number." Good accounts are given of fertilisation, and of the general features of segmentation, including "cell-lineage," and these are followed by an excellent chapter on the differentiation of the embryo, heredity, and sex determination. In this chapter we welcome particularly the short and clear and critical account of the hypothesis of "organ-forming substances," which will act as a useful corrective to the somewhat prevalent teaching of this hypothesis by uncritical teachers as a well-estab-

lished theory. As the author puts it, the localised distribution of substances in the egg, upon which this hypothesis is based, is to be regarded rather as a process or result of development than as a primary determining factor of the course of development. A good account is given of the idiochromosome and its relation to sex, and the book ends with a chapter on blastula, gastrula, and germ-layers.

The book is excellently written, and clearly illustrated; it fills an obvious gap in the teaching literature of zoology, and it deserves to have a wide circulation amongst students of that science.

(2) The two biological volumes here under discussion fully maintain the high standard of the great series of volumes entitled "Die Kultur der Gegenwart." The botanical volume is composed of an excellent section on plant histology from the pen of the late Prof. Strasburger, followed by one on plant morphology and development by Benecke.

The zoological volume forms an interesting text-book which will be of use to the senior student as a help towards getting a grip of the current views regarding some of the more important problems of morphology. The volume opens with a charming essay by Richard Hertwig upon unicellular organisms, which gives an excellent sketch of present-day ideas, together with valuable indications regarding future work. Hertwig's essay is followed by a useful sketch of modern histology by Poll, and this in turn by an admirable chapter by Oscar Hertwig on general and experimental morphology and embryology. This commences with a masterly account of the main features of gametogeny and fertilisation—one of the most interesting sections being that in which is given an account of recent experiments in which gametes or zygotes have been subjected to the influence of such substances as radium and mesothorium. An excellent chapter is devoted to parthenogenesis, and the suggestion is brushed aside with scant ceremony that the production of parthenogenesis by artificial means—whether chemical or mechanical—gives any clue whatever to the ultimate nature of the fertilisation process. A witty paragraph is quoted from Bolzmann as to Loeb's work and the exaggerated claims based upon it. How important was the discovery that a process believed to be so essentially vital in its nature was merely chemical! What important consequences the discovery might have when future developments rendered possible its application to the human race—the emancipation of woman to a degree undreamt of by the greatest enthusiast for women's rights! The mere man becomes superfluous; he is replaced by a flask of chemical solution; sex-determination by chemical means follows, and males, now mere useless curiosities, are produced only as occasional specimens for zoological gardens!

A general description is given of the processes of segmentation and gastrulation, and the chapter concludes with a short sketch of the chief results of experimental embryology.

About 150 pages are occupied by a really admirable account by Heider of the morphology of the invertebrate metazoa. It is most clearly and interestingly written, and is illustrated by excellent figures. Naturally, views are occasionally expressed to which some may take exception, but, on the whole, we know of no better general account of the morphology of invertebrates. The subject-matter of the chapter is rightly termed morphology rather than comparative anatomy, confining itself as it does to really important features and ignoring those masses of unimportant detail that so usually make a modern text-book of zoology an effective stifler of all interest in the subject. We notice very few slips. The familiar German misuse of the word splanchnopleure when splanchnic mesoderm is meant catches the eye of the English reader. The frequent reference made to the trochosphere type of larva as an evidence of phylogenetic affinity will not altogether appeal to those who suspect the various larvæ of this type of being simply convergent adaptations to a pelagic existence, while some morphologists of the Cambridge school will look askance at the not unfamiliar attitude towards the primitive and ancestral nature of the lower platyhelminths. But the general opinion will be that Heider has produced a very admirable sketch of his subject.

The remaining two chapters—on vertebrate embryology by Keibel and on vertebrate morphology by Gaupp—are less satisfactory. It seems an error in planning the book to have two such separate chapters, as there can be no morphology worth the name without embryology, and no embryology worth the name without morphology. We are glad to see that Keibel is not overawed by the sanctity of that—in some respects—most highly specialised vertebrate Amphioxus, and that he takes the common-sensible position in regard to the greatly degenerate character of its head region, though we fail to follow him in his somewhat derogatory remarks regarding its gastrulation processes. It seems, by the way, regrettable that Keibel, like many others who are specially interested in the embryology of the higher vertebrates, uses the word gastrulation in a sense which does not seem to be justified. Strictly

speaking, the term gastrulation should only be used of forms in which an undoubted gastrula has been shown to be present; to use it in reference to the two-layered condition of a bird or mammal in which there is the greatest reason to doubt that a true gastrula stage exists at all, is simply to court confusion, and leads to such absurdities as the statement that "endoderm," or "ectoderm," is not homologous throughout the series of vertebrates. To give a cell-layer, the name endoderm in the various types of vertebrates is, of course, merely a short way of stating that it *is* homologous in these various types!

(3) Dr. Levy's book affords a short sketch of vertebrate embryology written from a practical point of view. Simple instructions as to laboratory methods are given, stress being very properly laid on the preparation of thick, free-hand sections of embryos—the great instructiveness of which is too often ignored. The chapter on technique is followed by an account of gametes and gametogenesis, then by chapters on early development in amphibia and in the chick, while the remaining half of the book is devoted to organogeny and a short chapter on developmental mechanics.

OUR BOOKSHELF.

The Change in the Climate and its Cause. By Major R. A. Marriott. Pp. 94. (London: E. Marlborough and Co., n.d.) Price 1*s.* 6*d.*; cloth 2*s.* 6*d.*

THIS book is a contribution to the great Drayson Myth, and as such it may appeal to those with whom it is a fair presumption that any theory of orthodox science is wrong, and also to those who take a curious interest in the vagaries of that class of mind.

Major Marriott, like Sir A. de Horsey in "Draysonia," complains that Drayson was not taken seriously. The fact is perfectly true, but the complaint is unjust precisely because General Drayson (not without professional precedents) failed to take seriously the position he was assailing. Astronomy is unique among sciences in its dependence on a single controlling principle, gravitation. It is open to anybody to abolish that principle and coordinate the facts otherwise—if he can. Or he may question the accuracy in detail of a mathematical deduction or demonstrate a false assumption. What he cannot do is to isolate a piece of the whole doctrine, reject the operation of the general law in the particular case on insufficient grounds, and ignore the effect of what he is doing on the whole related theory.

It would be unprofitable to comment on the errors (as we deem them) of the present work. It is pleasanter to mention the one pertinent remark which we have come across. This is the reference to the theory of "planetary inversion" (p. 66). It is quite possible that tidal friction is slowly changing the obliquity of the ecliptic, and thus exercising a secular influence on climate. But the effect is very slow; it is not periodic; and there is little in common between the methods of Mr. Stratton and those of General Drayson and his followers.

The book deals largely with changing climatic conditions, the evidence of geology, and the bearing of the so-called astronomical theory of an ice age. But why are the possibilities limited by the tacit assumption that the radiation of the sun has been constant through geological ages, an assumption not merely unproved, but even improbable? H. C. P.

Perspective made Easy by Means of Stereoscopic Diagrams. By C. E. Benham. (Colchester: C. E. Benham, 28 Wellesley Road.) Price (post free) 6*s.* 2*d.*

THIS set of fifteen stereograms is intended as a substitute for models as used by teachers and students in illustration of some of the rules and principles of perspective projection. When viewed in a stereoscope the diagrams exhibit in relief, amongst other things, the principle of the convergence or parallelism of the projections of parallel lines in space; and the rotation into the picture plane of horizontal and vertical vanishing planes, thus illuminating the constructions relating to vanishing and measuring points for horizontal and inclined lines. An explanation is given in a sixteen-page pamphlet which accompanies the stereograms.

The idea of the author is good, but it is not very efficiently carried out. The views are not always so convincing as they might be, and the descriptions are occasionally lacking in mathematical precision. We also think that the price has been fixed too high. Nevertheless, a teacher would receive some useful suggestions by a study of the diagrams.

A Laboratory Manual of Organic Chemistry for Beginners. By Prof. A. F. Holleman. Edited by Dr. A. J. Walker. Second edition, partly re-written. Pp. xvii+83. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 4*s.* 6*d.* net.

A REVIEW of the first edition of Dr. Walker's translation of Prof. Holleman's little book appeared in the issue of NATURE for May 11, 1905 (vol. lxxii., p. 28). New experiments have been incorporated in the present edition, and some obsolete reactions have been omitted.

Engineering Workshop Exercises. By Ernest Pull. Pp. viii+80. (London: Whittaker and Co., 1914.) Price 2*s.* net.

THIS little book provides instructions to enable technical students and apprentice engineers to perform their workshop experiments and exercises intelligently, and to obtain practice in the use of ordinary engineering tools and appliances. Prominence is given to the value of working drawings, and accuracy is insisted upon consistently. A chapter on screw-cutting and notes on materials are included in the book.

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 intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Doppler Effect and Carnot's Principle.

IN my letter of March 19 I endeavoured to show that the latent heat absorbed in the production of unit volume of stationary vibration of a particular frequency in a mixed beam of radiation, is not equal to $4q/c$ (where q is the energy stream per sq. cm. per sec., and c the velocity), as would naturally be supposed, but, in consequence of the Doppler effect at the moving mirror or piston, takes the form $T(dp/dT)$, as required by Carnot's principle, where p is the pressure, or the mechanical work per unit volume, and is equal to $2q/c$ for a directly reflected beam under equilibrium conditions. The latent heat, $T(dp/dT)$, may be represented as the sum $(u+p)$ of the intrinsic energy or internal latent heat u and the external work p. As a matter of interpretation, u was identified in my letter with some form of stationary vibration which continued to exist in the medium at the frequency at which it was emitted. Further analysis shows that this is not the case, but that the energy left in the medium conforms exactly to the distribution required by the theory of exchanges. The energy density is $2q/c$ in a directly reflected beam, and is equal to the pressure, but differs from the energy absorbed on emission or evolved on condensation, namely, the latent heat, $T(dp/dT)$, which is the quantity measured experimentally, as previously explained (*Phil. Mag.*, October, 1913, p. 787).

Similarly in the case of full radiation where the energy stream is Q per sq. cm. per sec. in all directions, the energy density is $4Q/c$, and the pressure $4Q/3c$ *for each frequency*, but the latent heat per unit volume is still $T(dp/dT)$ (in place of $16Q/3c$) on account of the Doppler effect, and the energy stream *as measured experimentally* is not Q but $\frac{1}{4}T(dQ/dT)$. With a slight change of viewpoint the consideration of the Doppler effect leads to the exact formulæ and numerical relations already detailed in my previous note (*loc. cit.*), which are now seen to be no longer in conflict with the electromagnetic theory as was at first supposed.

H. L. CALLENDAR.

Imperial College of Science, South Kensington, March 30.

Lead and the Final Product of Thorium.

IT is now practically certain that the final product of the uranium family of radio-elements is isotopic, or chemically identical, with lead. The constancy of the ratio between lead and uranium, Pb/U, in the case of primary rock-forming minerals of the same geological age, and its sympathetic variation in the case of minerals of different ages, go far to establish this important conclusion. The recent discovery that all the final products of radio-active disintegration fall into Group iv. B of the periodic classification has naturally led to the further suggestion that each one is isotopic with lead.

If lead, or one of its isotopic equivalents, is the final product of the thorium series, then the estimates of geological time hitherto based on the lead-uranium ratio stand in need of a ruthless revision.

Fortunately this does not appear to be necessary, for mineralogical evidence clearly indicates that the presence or absence of thorium in a uranium-bearing mineral does not affect the lead content, which can generally be adequately accounted for by the uranium alone.

It is easy to calculate the relative rates at which uranium and thorium generate their final products, and assuming that the latter are isotopic, to express a given amount of thorium in terms of uranium, and so to arrive at a "total equivalent quantity of uranium," U_e, which also takes thorium into consideration. If then lead is, chemically speaking, the final product of thorium as well as that of uranium, the ratio Pb/U_e ought to be constant for minerals of the same age, and ought to vary in sympathy with the ages if these should differ. I have examined a large number of analyses of radio-active minerals from this point of view, and neither of the above criteria is found to hold. In many cases a large percentage of thorium may be present, but unless uranium is also present, lead is nearly always absent. In the few examples where lead and thorium occur alone, the ratio Pb/Th is variable and bears no relation to the geological age of the minerals.

However, more fully to demonstrate the bearing of evidence of this kind on the problem, Mr. R. W. Lawson, of the Radium Institute, Vienna, and myself are at present estimating the thorium content of a series of Norwegian minerals of Devonian age which had already been analysed for lead and uranium (Proc. Roy. Soc., A, vol. lxxxv., p. 248, 1911). Other workers are busily engaged on determinations of the atomic weights of the lead from uranium and thorium bearing minerals respectively, and there is therefore some likelihood in the near future of a final settlement of the question whether lead is an end-product of thorium or not.

ARTHUR HOLMES.

Geological Department, Imperial College of Science, London, March 18.

Thermions and the Origin of Solar and Terrestrial Magnetism.

PREVALENT opinion seems to favour decidedly the hypothesis that the chief part of the magnetism of the earth or sun is due to the rotation of all, or a considerable portion of, the matter of which it is constituted. Theories of the magnetisation of matter by rotation fall into two classes: one (*a*) assuming that the substance is magnetic but not necessarily charged, the other (*b*) assuming that the substance is charged but not necessarily magnetic.

(*a*) If the matter is magnetic, consisting of molecular systems with individual magnetic moments differing from zero, rotation about a given axis will, on the electron theory, produce a torque on each individual system, causing it to contribute a magnetic moment parallel to the axis of rotation, and thus magnetising the whole body, if originally neutral, along this axis.

(*b*) Gravitation, or electrical forces, acting differentially on the positive and negative constituents of the matter, or differential centrifugal action, or some other cause, may give rise to a volume-density of electrification throughout the mass of a rotating body, in which case magnetisation, or at least a magnetic field, must result from the convection currents thus formed.

The particular kinds of differential action just mentioned have been proposed before, but I have seen no reference to the fact that an essentially steady electric volume-density must long ago have been produced by the emission of negative electrons from the heated matter of which the earth and sun are composed, and the resulting internal electric field. As the emission increases with the temperature, which increases from the surface inward, it is clear that the volume-density must be of the proper size to account for the polarity of solar and terrestrial magnetism.

It seems probable that both classes of effects are involved in the actual magnetisation in question, though experiment has shown that any effect of class (*a*) is at least exceedingly minute unless the magnetic behaviour of the interior parts of the earth and sun is quite different from that of matter at ordinary temperatures on the surface of the earth.

S. J. BARNETT.

The Ohio State University, Columbus, Ohio, U.S.A., March 12.

A Triangle that gives the Area and Circumference of any Circle, and the Diameter of a Circle equal in Area to any given Square.

IT is not possible to measure *exactly* the interminable fraction required for the line BZ in the following figure, but it is quite easy to draw it so nearly that the error is practically immensurable.

First Method.—Draw a line AB=44, and make BZ=23. $\frac{23}{44}$=0·5227272..., which is a little too long.

AY will then be short, about 1 in 600,000.

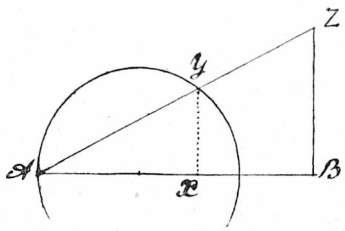
AX will also be short, about 1 in 300,000.

Second Method (with the familiar ratio $\frac{355}{113}$). Make a circle with diameter AB=11·3, and let AX=$8\frac{7}{8}$. Draw a perpendicular from X to cut the circle in Y. Join AY, and continue the line to Z.

Then the error in AX, the $\frac{1}{4}$ circumference, will be less than 1 in 11,780,000 *in excess*.

The true angle for the line AZ lies between the lines found by the two methods, but the difference is too small for measurement, and in any accurate drawing the lines will appear to coincide.

AX being found, equal to an arc of 90°, a line for any other arc may be found; and the triangle once drawn on a sufficiently large scale, is true for all circles.



Let AB=1, and at right angles BZ=0·5227232008+, join AZ } Angle A. 27° 35′ 49·6″+

Then, any circle with diameter upon AB and one extremity at A, will cut the line AZ (or AZ produced) in a point Y, making AY the side of a square equal in area to the circle.

Also, a line from Y perpendicular to AB will cut the diameter in a point X, making AX equal to $\frac{1}{4}$ circumference of the circle.

Again, any square with base upon AB and a corner at A, will, with its side opposite to A, cut AZ in a point Y, making AY the diameter of an equal circle.

T. M. P. HUGHES.

5 The Croft, Tenby.

THE following remarks may help to explain Mr. Hughes's constructions :—

Let AY be a chord of a circle of which AD is a diameter, and let ∠DAY=θ. Then if the square on AY equals the area of the circle, $(2r\cos\theta)^2=\pi r^2$, and therefore $\cos^2\theta=\pi/4$, $\tan^2\theta=(4-\pi)/\pi$, and

$$\tan\theta=0{\cdot}5227232,$$

very nearly, as stated. Now if we express this approximate value of $\tan\theta$ as an ordinary continued fraction we find the successive convergents,

1/1, 1/2, 11/21, 12/23, 23/44, etc.,

where the first of those not written has four digits in numerator and denominator. Hence, as Mr. Hughes has discovered, 23/44 is a very close approximation to the transcendent number $\sqrt{(4-\pi)}/\sqrt{\pi}$. It seems absurd to speak of a mathematical accident, but we do seem to have something of the kind here. Supposing that a/b is a rational approximation to $\sqrt{(4-\pi)}/\sqrt{\pi}$, we should not expect beforehand a solution correct within about $4\cdot10^{-6}$ for values of a, b, each less than 100.

The second construction is obtained by putting, as an approximation,

$$AX : AD=\pi/4=355/4\cdot113=710/8\cdot113=8\tfrac{7}{8}/11\cdot3.$$

It would be easy to make a set-square with its shorter sides in the ratio 23 : 44, and this could be used for the approximate quadrature and rectification of any given circle. It is interesting to see how the same figure solves both problems to the same degree of exactness (practically). I suppose the error in the set-square could be reduced to 0·1 per cent., or less; the question is, what percentage of error is likely to occur in using it. For the rectification we have to draw the perpendicular YX; it seems to me that for the quadrature we are likely to obtain the most accurate results by using a straight edge as well as the set-square; that is to say, we should not try to adjust the set-square without first placing a straight edge along a diameter of the circle. If this is so, the graphical solutions of both problems are likely to be affected by the same percentage of error; because to obtain X, after marking Y, we have only to slide the set-square along the straight edge until a shorter side goes through Y; and if we repeat the manipulation several times, I do not think the error in finding X, regarded as a distance from the true position, can be so much as five times the error in finding Y, or conversely. Of course, by "the same percentage of error" I mean here that the two errors, on the same scale, are of the orders $\pm a\cdot10^{-n}$, $\pm b\cdot10^{-n}$, where a, b both lie above 1, while neither of them is equal to, or exceeds, 5.

G. B. MATHEWS.

New Units in Aerology.

WITH reference to Prof. McAdie's letter in NATURE of March 19, p. 58, I should like to point out that throughout my "Thermodynamics," published in 1878, a megadyne per square centimetre is used as the unit of pressure, and it is termed a c.g.s. atmosphere. Ever since 1888, when the B.A. committee (of which I was a member), adopted the barad, I have employed in my lectures the above pressure unit under the name of megabarad. The corresponding unit of work, and also of heat, adopted in the book is the megalerg. Megerg to my ear is too cacophonous for use.

ROBERT E. BAYNES.

Christ Church, Oxford, March 25.

PROGRESS IN WIRELESS TELEPHONY.

THE attention of telephonic engineers has of late years been very closely directed to the improvement of the line wire in ordinary telephony. Apart from the imperfections of the telephone transmitter and receiver, *per se*, a very considerable effect is produced on the transmitted speech by the line itself if it is at all long. This action, from an electrical point of view, consists in the distortion of the wave form of the current

as it travels along the cable, and its rapid attenuation or diminution in amplitude.

When speech is uttered to the mouthpiece of the transmitter, the current flowing into the line is modulated in a complicated manner, but this variation in virtue of Fourier's theorem can be analysed into the sum of a number of currents of simple harmonic or sine wave form placed in certain relative phases and having certain amplitudes. The velocity W, with which any simple harmonic current travels along a cable having a resistance R ohms, an inductance of L henrys, a capacity of C farads, and a dielectric leakance of S mhos per unit of length, provided that the quantities R/pL and S/pC are small compared with unity, can easily be shown to be expressed by the formula :—

$$W=\frac{1}{\sqrt{CL}}\frac{1}{\sqrt{1+\frac{1}{p^2}\left(\frac{R}{2L}-\frac{S}{2C}\right)^2}},$$

where $p=2\pi$ times the frequency.

Accordingly, the greater the frequency, the greater will be the wave velocity. In other words, short waves travel faster than long. The short waves, having also the least energy, attenuate most rapidly.

The result of this is that in the case of telephony along wires the different harmonic constituents of the current get out of step, and degrade unequally. Hence the wave form, and the quality of the received sound, is altered after the wave has travelled a certain distance along the wire or cable. The result is to diminish the loudness and reduce the clearness of the speech heard. Therefore, beyond a certain distance the articulate sound becomes unintelligible.

On the other hand, it is well known that the velocity of electromagnetic waves through space is independent of the wave length, and there is, therefore, in this respect a marked difference between the transmission of electromagnetic waves guided along wires, and free electromagnetic waves diverging through space. As soon as the telephonic or aural method of receiving Morse signals in wireless telegraphy was substituted for the method of employing some form of coherer as a relay to actuate a Morse inker printing them in *dot* and *dash* on paper tape, the suggestion was made that it might be possible to transmit articulate speech by space electromagnetic waves, and not merely Morse signals composed of long and short sounds; and hence to conduct a wireless or lineless telephony.

It was at once recognised that before this could be done it would be necessary to provide a generator of electromagnetic waves giving truly continuous waves, and not merely intermittent groups or trains of rapidly decadent waves. The discovery of the power of the continuous current arc between carbon electrodes to create high-frequency oscillations in a condenser circuit connected between the carbons, held out hopes of making such a generator. It was not, however, until Poulsen discovered the peculiar properties of an electric arc formed in hydrogen or coal gas to enable very high-frequency oscillations to be so generated that progress began to be made. The Poulsen arc-generator consists, as is well known, of a direct-current arc formed with an electromotive force of about 500 volts between a carbon and a copper electrode in an atmosphere of hydrogen or coal gas. A strong transverse magnetic field is also applied to the arc. An inductive circuit, consisting of a coil of wire having in series with it a capacity, the capacity and inductance being so adjusted that the natural frequency of this oscillation circuit is not less than about 50,000, or preferably much higher, even up to 250,000, is then connected between the carbon and copper electrodes. Powerful continuous electric oscillations are then set up in this condenser circuit. These oscillations can be made to set up similar oscillations in an open radiative circuit or antenna, which is inductively connected with the condenser circuit, as in the case of an ordinary wireless telegraph transmitter.

In this manner continuous or uninterrupted electric waves of a wave length which is anything between 1 and 4 or 5 miles, can be radiated from the aerial wire. The reason the hydrogen or coal gas is effective in enabling the arc to create more powerful high-frequency oscillations is that it increases the steepness of the characteristic or volt-ampere curve of the arc, and hence increases the energy which is conveyed to the condenser at each oscillation.

To transmit speech we have then to modify the amplitude of these radiated continuous electric waves sent out from the sending station antenna in accordance with the wave form of the speaking voice. This is done usually by some form of carbon microphone inserted in the base of the sending station antenna. When the diaphragm of the microphone is acted upon by the voice, the carbon granules in it are more or less compressed, and the electrical resistance thereby altered. If then the high-frequency current in the antenna is made to pass through this microphone, the amplitude of the radiated continuous waves will be varied by making speech to the microphone, in such a way as to create waves upon waves, or to alter the wave amplitude in accordance with the wave form of the speaking voice.

At the receiving end all the arrangements are identical with those required in wireless telegraphy when using a telephone and rectifier of some kind to receive audible Morse signals. The receiving antenna is coupled to a closed condenser circuit, and to the terminals of this condenser is attached a Bell receiving telephone in circuit with some oscillation rectifier, such as a crystal or constant detector, viz., carborundum, perikon, or zincite-chalcopyrite, or an ionised gas rectifier such as a Fleming glow-lamp valve. The telephone is then not affected by the rectified continuous oscillations *per se*, but it is affected by the variations in their amplitude produced by the microphone in the transmitter circuits.

Audible and intelligible speech can thus be reproduced at the receiving end. The limitations that present themselves in this transmission are

wholly connected with the creation and modulation of the electric waves emitted by the sending station, and chiefly due to the difficulty of designing a microphone which can carry a sufficiently large current without heating. An additional trouble is that of devising a generator which shall be as simple and easily managed as that of a wireless telegraph plant.

As regards the microphone, most workers have employed a number of carbon microphones joined in parallel so as to enable a high-frequency antenna current of, say, 4 or 5 amperes to be passed through them without overheating any one. It is not easy, however, to divide the current equally between the microphones, or to keep them absolutely in step with each other. Another type is the liquid microphone of Majorana, and of Vanni. In Dr. Vanni's microphone a jet of water rendered slightly conducting by acid or salts is allowed to fall on a fixed inclined metal plate, B, and then

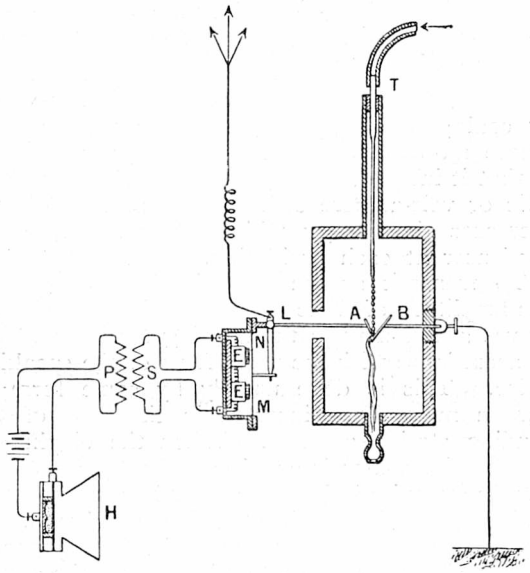


FIG. 1.—The liquid microphone of Dr. J. Vanni.

bounces off on to another inclined metal plate, A, which is in mechanical or electrical connection with the diaphragm of a speaking mouthpiece (see Figs. 1 and 2). Speech, therefore, made to it sets the last-named plate vibrating, and thus breaks up and varies the resistance of the film or column of liquid connecting the two plates. Hence, if this liquid column is in the circuit of the transmitting antenna, any speech made to the diaphragm will vary the electrical resistance in the antenna circuit, and change in a similar manner the amplitude of the radiated electric waves.

W. Dubilier has also invented a water-cooled carbon granule microphone, the main diaphragm being moved by the current through a relay microphone to which the speech is actually made. This microphone can pass 700 watts with clear articulation (see Fig. 3). Then with regard to generators, a good many modifications of the arc generator have been produced. The Moretti arc consists of a copper tube kept supplied with water, and another copper rod is brought down so as to strike the arc against the water. When the arc is formed with a continuous current, and is also shunted as above described with a condenser inductive circuit, high-frequency oscillations are set up in the latter. There is a very rapid extinction and re-ignition of the arc, possibly due to some action like that in the Wehnelt interrupter. The writer of this article has also devised recently a new form of arc generator which requires no transverse magnetic field, nor supply of hydrogen or coal gas, as in the Poulsen apparatus. We have, then, in addition, the high-frequency alternator method of creating the oscillations. Fessenden experimented at one time very largely with such machines, devising a form of Mordey alternator which could give a frequency of 80,000 or 100,000. The invention by R. Goldschmidt of a means of multiplying frequency by means of a

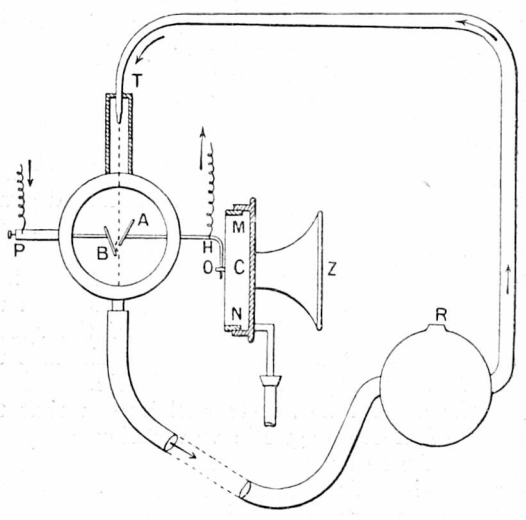


FIG. 2.—Arrangements for circulating the liquid by a rotary pump R in Vanni's microphone.

rotating field alternator made a new departure. By this machine high-frequency continuous oscillations are mechanically created, and their amplitude can be controlled by a microphone placed in the exciting circuit of the machine, so that it is not traversed by the main current.

Furthermore, we have the high speed, smooth disc generator of Mr. Marconi as a means of creating undamped oscillations, and, in addition, a telephonic transmitter has been invented by him which has not yet been described in detail, but was mentioned by him in a recent lecture in Rome. It is known that he has recently directed his attention closely to invention in connection with wireless telephony.

It is also possible to employ spark discharges of a very high spark-frequency, above the limit of audition, as a means of creating what are practically unintermittent oscillations, the separate trains of oscillations being practically in contact with each other. This method depends upon the

self-extinguishing power of electric arcs produced between certain metals which are good conductors, such as aluminium and copper. If a pile of plates of these metals with very small air-gaps is built up, and a high electromotive force applied to it, discharges will take place, or small arcs which, when the discharger is shunted by a condenser, can generate high-frequency oscillations. By the aid of these appliances, their inventors and other workers have conducted wireless telephony up to a distance of 1000 kilometres, or, say, five hundred or six hundred miles.

Thus, Dr. J. Vanni, working at Rome, and using a Moretti arc generator, his own liquid microphone, and a form of Fleming oscillation valve as a receiver, has transmitted and received articulate speech between Rome and the Island of Ponza (120 km.), to Maddalena (260 km.), to Palermo (420 km.), to Vittoria (600 km.), and finally between Rome and Tripoli, a distance of 1000 km.

The speech is said to have been clear and singularly free from evidence of distortion of wave form. In addition to this, successful experiments in wireless telephony are said to have been conducted between Berlin and Vienna, a distance of 375 miles, by the Telefunken Company. The stations were the German high-power station at Nauen, to the west of Potsdam, and a receiving station on the roof of the Technological and Industrial Museum at Vienna. The experiments were so promising that it is expected much greater distances can be covered. A very inviting field of work seems to be opening out in connection with the alternator method of generation. With a suitably designed Goldschmidt high-frequency alternation it is said that a small variation in the exciting current will produce very large variations in the amplitude of the radiated waves. Hence the microphone can be placed in the excitation circuit, and need only have a current-passing capacity of a few amperes to be able to modulate a radiation representing a very large horse-power. To transmit articulate speech across the Atlantic will necessitate the power of varying the amplitude of continuous wave radiation representing at least 50 or 100 horse-power. This must be done by means of some microphone which passes not more than, say, 10 amperes. These conditions are not impossible of attainment. Hence Transatlantic wireless telephony may be said to be within the range of practical politics, whilst no improvements yet made in submarine telephonic cables hold out hope of being able within any reasonable time to speak through an Atlantic cable.

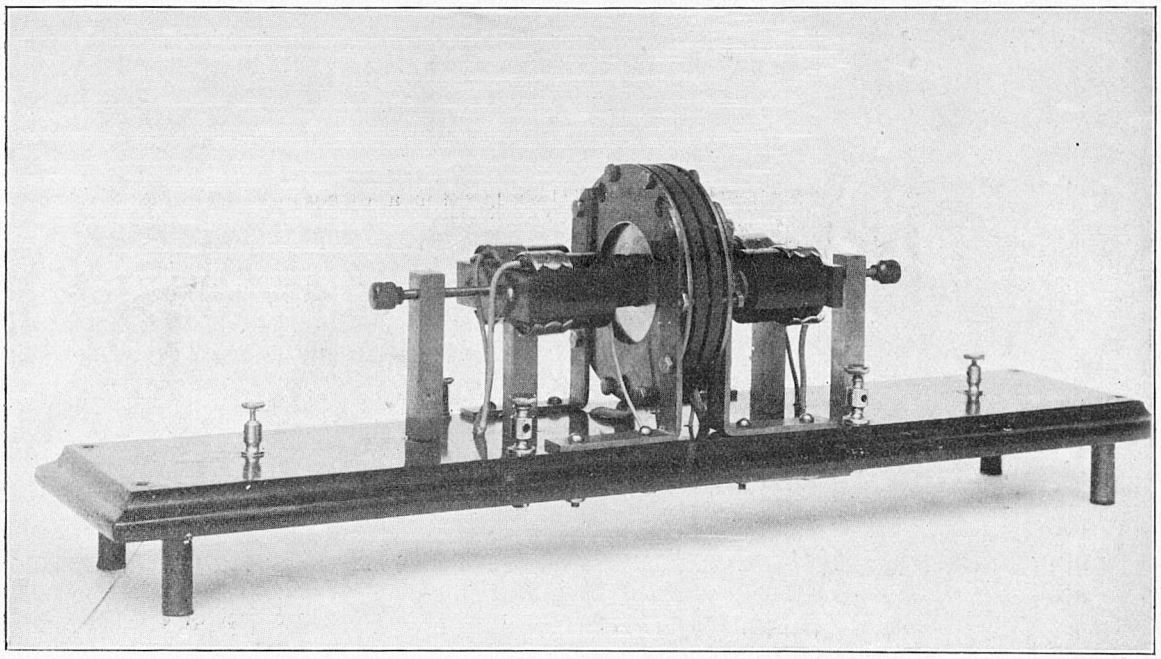


FIG. 3.—Dubilier water-cooled large current microphone.

The subject of wireless telephony is, therefore, one which holds out much promise for future achievement, and it is not surprising that it is attracting the attention of some of the leading workers in radiotelegraphy. J. A. FLEMING.

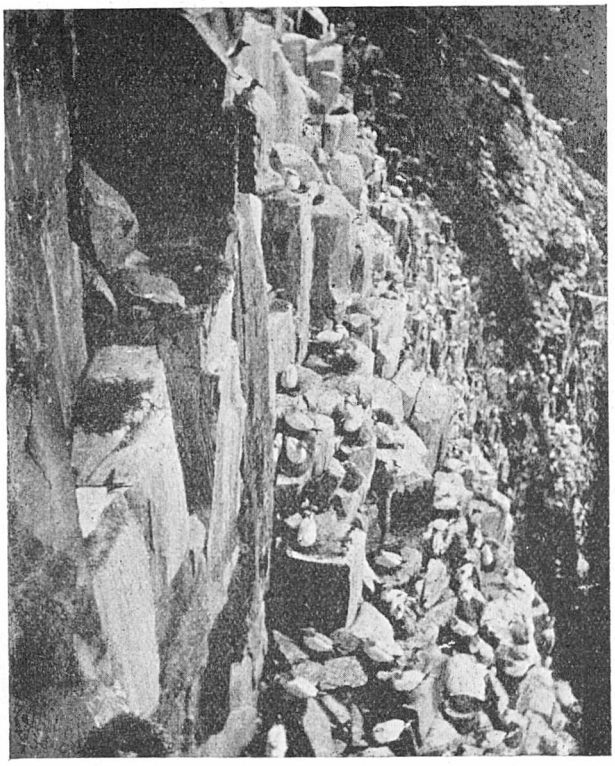
A BIRD WITH A HISTORY.[1]

A WELL-KNOWN ornithologist here gives us the fruits of many years of careful study devoted to a single species. His study has been diverse: at times it has lain among etymological dictionaries and curious old works on natural history, at times among the publications of

1 "The Gannet: A Bird with a History." By J. H. Gurney. Pp. li+567+plates. (London: Witherby and Co., 1913.) Price 27*s.* 6*d.* net.

modern scientific societies and technical anatomical descriptions, and again in the open air on those rocky islets where the birds congregate in their thousands during the months of the long nesting season.

It is not every bird that deserves to be made the subject of a handsome and expensive monograph, but the gannet, as our author shows, makes more than ordinary claims on the interest and attention of the naturalist. And it is only just that a British naturalist should be the historian in this case, for of the fifteen breeding localities of the gannet, no fewer than nine lie off the coasts of our islands. Moreover, of the estimated total gannet population of 101,000



Gannets on the Bass Rock. From "The Gannet: a Bird with a History."

birds (exclusive of nestlings), 75,000 are allotted to these nine haunts. The British colonies are Lundy Island (recently abandoned); Grasholm, off Pembrokeshire; the Little Skellig and the Bull Rock, off the south-west of Ireland; Ailsa Craig, in the Firth of Clyde; St. Kilda (three colonies); Sulisgeir, to the north of the Lewis; the Stack of Sule Skerry, to the west of Orkney; and the Bass Rock. In the Færöes there is a colony on Myggenæs, while off Iceland there are colonies in the Vestmann Islands and the Eldey group, and a very small one on Grimsey, which is on the north coast, and lies within the Arctic Circle. Across the Atlantic there are colonies on Bonaventure and the Bird Rocks, in the estuary of the St. Lawrence; while there, as here, former sites, long since abandoned, are also known.

Mr. Gurney points out that these colonies, without exception, are on rocky islands, and that no mainland site, past or present, is anywhere known. Furthermore, the great majority of those on this side of the Atlantic lie off westerly coasts; the Bass Rock is, indeed, the only British exception. Apart from these points, there is an interest even in the purely statistical side of the careful census, which Mr. Gurney has been able to make. There are few species the numbers of which can be estimated even approximately, and the figures given in this volume should form an interesting basis for comparison in the future.

The book opens with a discussion of the various vernacular and scientific names which the species has received: both "gannet" and "solan" are dealt with at length. Then come many interesting pages quoting historical references to the gannet, illustrated by quaint figures taken from the works of the early naturalists. The species is justly called "A Bird with a History."

Mr. Gurney devotes a chapter to each of the important colonies, and shows personal familiarity with them in many cases, and an exhaustive knowledge of their literature in all. History is then left for a discussion of the general habits of the gannet, its nidification and incubation, the growth of its nestling, its food and its manner of fishing, its powers of diving and its seasonal movements, and many another question. Nor is its relation to man neglected—its effect on fisheries and its use as food. Finally, the plumage, osteology, and general anatomy are discussed, and appendices are added dealing with its allies, its parasites, its fossil remains, and the like.

We may note the omission from the bibliography of Mr. Kirkman's recent important contribution ("The British Bird Book") to the study of the gannet's habits, but Mr. Gurney has missed little that throws light on the interesting bird which he has made the object of enthusiastic and fruitful study. Many useful maps and beautiful photographs are scattered throughout the work.

A. L. T.

DR. G. J. BURCH, F.R.S.

FEW men of science have had such a varied career as Dr. George James Burch, whose death we announced with regret last week. Born in 1852, he went in 1873 to Cheshunt College to study for the Nonconformist ministry, and in due course became a minister first at Leeds, and later at Oxford. But at Oxford his duties became to some extent uncongenial to him, and this fact, coupled with a very bad breakdown in health, induced him to give up his pastorate, and take up the study of science for which he always had a natural inclination. He was hampered by pecuniary difficulties which would have deterred most men from such a course, and only by the most heroic struggles could he and his newly-

married wife keep their heads above water. As a means of livelihood he worked for six hours every day on the subject catalogue at the Bodleian Library, and only after this work was over was he free to study Chemistry for his Oxford degree course. In spite of this double call on his time, he found opportunity to carry out research, and in 1886 he began his work on the capillary electrometer with the late Sir John (then Dr.) Burdon Sanderson, the Professor of Physiology. From 1887 onwards they did a good deal of electro-physiological work together, the mechanical details of the apparatus used being gradually improved by Burch until the final present day form was evolved.

Burch also worked out a method for analysing the electrometer curves, and in December, 1887, wished to publish an account of his discoveries. Burdon Sanderson, who was always cautious about committing himself, dissuaded him from doing so: hence a description of the method was not actually published until 1890, when Einthoven independently described his method, and so deprived Burch of some of the credit of the discovery. In 1892 Burch published a more elaborate paper on the time relations of the excursions of the capillary electrometer in the Philosophical Transactions of the Royal Society, and other papers were published later in the Proceedings of the society.

Meanwhile, Burch in 1891 took up lecturing under the Oxford University Extension Delegacy, and in 1892 he became lecturer, afterwards professor, of Physics at University College, Reading. He still lived in Oxford, and went backwards and forwards to his work daily. This was a great strain on his health, so that in 1909 he broke down and had to resign his position, though he continued to teach in Oxford.

In the last eighteen years of his life Burch devoted most of his spare time to research in colour vision. Among his observations regarding the physiology of vision were a number bearing on the vexed problem of colour sensations. He was a convinced adherent of the Young theory of colour sense. He subjected himself to a series of severe experiments in which the eye was fatigued to certain colours by prolonged intense stimulation by appropriate parts of the prismatic spectrum, and the alteration in the colour of other parts of the spectrum when observed by the fatigued eye was examined. He supplied an interesting memorandum on this subject to the Board of Trade Committee on Sight Tests three years ago. A small book presenting a practical course of instruction in visual physiology embodied the class-work he conducted in the subject at the Physiological Laboratory at Oxford. It is not only extremely lucid, as was everything he wrote, but is strikingly original in scope and treatment, and contains a number of exercises, as, for instance, one on the measurement of visual acuity, devised entirely by the author. His combination of first-hand knowledge of physical and physiological experimentation fitted him to a degree which is quite exceptional for success in this branch of scientific study.

Dr. Burch was elected a Fellow of the Royal Society in 1900. H. M. V.

PROF. G. M. MINCHIN, F.R.S.

THE death of Prof. George M. Minchin, F.R.S., on March 16, at sixty-eight years of age, has deprived science of an earnest and versatile investigator, and a wide circle of friends of a companion who will be greatly missed. Always active in body and alert in mind, Prof. Minchin caught the fire of life with both hands, and conveyed its benefits to all around him.

Prof. Minchin was appointed to the chair of mathematics in the Royal Indian Engineering College, Coopers Hill, in 1875, when he was in his twenty-ninth year; and he remained at the College until it closed, when he removed to Oxford, where he died. He took a leading part in the movement for the improvement of geometrical teaching in schools; and his little book "Geometry for Beginners" published in 1898, was an early and very favourable specimen of the methods of the reforming party. He was also the author of works on "Statics," "Uniplanar Kinematics," and "Hydrostatics"; and his treatment of all these subjects was original and distinctive. Less well known in scientific circles, perhaps, except among his friends, is a little volume of verse and prose entitled "Naturæ Veritas" published in 1887. His skill in writing verse was of no mean quality; and a humorous example of it will be found in NATURE of April 14, 1898, in a poem entitled "Balnibarbian Glumtrap Rhyme." He was a lover of good English; and this regard for the purity of the language made his many contributions to our columns clear in expression as well as authoritative in opinion.

Probably the work by which Prof. Minchin will best be remembered is that on photo-electricity and selenium cells. He began his experiments on these subjects in 1877, and was led by them to the discovery of many interesting phenomena. He observed that electric currents are produced by the action of light on silver plates coated with collodion or gelatin emulsions of bromide, chloride, iodide or other silver salts, or with eosin, fluorescein, or other aniline dyes, when the plates were immersed in a suitable liquid and one plate was illuminated while the other was screened. In 1891 he exhibited these cells to the Physical Society, and also cells made by spreading melted selenium on metal plates and immersing them in liquids together with an uncoated plate. He found that some cells, termed by him "impulsion cells," had their sensitiveness altered by slight impulses or taps, and also by electro-magnetic impulses, such as are given by electric sparks or a Hertz oscillator at a distance; so that the cells embodied the principle of the coherer used for the reception of Hertzian waves.

The form of photo-electric cell afterwards

adopted by Prof. Minchin consisted of two selenium-coated aluminium wires dipping into certain solutions. His "Seleno-aluminium Bridges," described in a paper to the Royal Society in May, 1908, consisted of two plates of aluminium separated by a very thin flake of mica and having a thin layer of sensitive (or conducting) selenium spread across one edge of the mica and the two adjacent portions of the aluminium plates. This further development of his photo-electric work was carried out in the electrical laboratory at Oxford.

Prof. Minchin's application of selenium cells to the measurement of starlight was a notable extension of his experiments. In 1894, in conjunction with Mr. W. E. Wilson, he used his cells to obtain measurable electro-motive forces from the light of planets and stars; and he was thus able to determine the relative intensities of the light of Jupiter, Venus and Sirius. Shortly afterwards, an improvement in the construction of the cells enabled measurements to be made of the E.M.F.'s of the light of Vega, Arcturus, Regulus, Procyon and other stars. A comparison of the results obtained by photo-electric measures with those of photometric measures of stellar magnitude showed close conformity.

Prof. Minchin was an M.A. of Dublin and a member of Queen's College, Oxford. He was elected a fellow of the Royal Society in 1895, and his many friends within the society and without join with the widow and his two children in sympathetic sorrow that the finger of death has touched one who was so rich in the physical and intellectual attributes of life. R. A. G.

NOTES.

WE announce with deep regret the death on March 30, in his sixty-second year, of Prof. J. H. Poynting, F.R.S., professor of physics in the University of Birmingham.

PRINCE ARTHUR OF CONNAUGHT has been elected a fellow of the Royal Society, under the statute which provides for the election of Princes of the Blood Royal.

WE record with regret the announcement of the death on March 30, in his sixty-fifth year, of the Hon. Rollo Russell, author of a number of works on meteorology and other scientific subjects.

THE death is announced, at eighty-one years of age, of Mr. G. Sharman, for more than forty years palæontologist to H.M. Geological Survey at the Geological Museum, Jermyn Street, London.

A HANDSOME brass tablet to the memory of Captain Scott and the southern party of the British Antarctic Expedition was unveiled at St. George's Chapel Royal, Naval Barracks, Chatham, on March 29, by Admiral Sir Richard Poore, Commander-in-Chief at the Nore, and dedicated by Archdeacon H. S. Wood, Chaplain of the Fleet.

DR. C. H. BROWNING has been appointed first director of the new Institute of Pathology of the Middlesex Hospital, which has been erected as the gift of Sir J. Bland-Sutton at a cost of between 15,000*l.* and 20,000*l.* Dr. Browning is at present director of the clinical research laboratories in connection with the University of Glasgow.

A STRONG committee, with the Speaker as president, has been formed in Cumberland, according to the *Times* of March 27, with the object of affording protection to the local fauna. Wherever possible tracts of natural ground will be set apart as reserves, one such tract, Kingmoor, near Carlisle, having been already secured. A "watchers' fund," to provide keepers for such reserves, is being formed, and a close watch is to be kept on nesting ravens, peregrines, and buzzards throughout the county.

IN the *Times* of March 27 attention is directed to the lateness of the arrival in this country of spring migratory birds. This lateness is specially notable in regard to a great spring flight of immigrants from Central Europe, which, as recorded by a Norfolk correspondent in the same journal a few days previously, reached Yarmouth on March 11. In normal seasons such flights are usually over by the beginning of the month. A partial explanation may be found in the great drop in temperature which occurred on the Continent between March 10 and March 11, when there was a fall of 13° in the minimum.

THE President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant in aid of scientific investigations concerning the causes and processes of disease:—(1) An investigation by Dr. Eardley Holland into the causes of still-births; (2) a continuation of the Board's inquiry into the cellular contents of milk, by Prof. Sims Woodhead; (3) a continuation of the Board's inquiry into the causes of premature arterial degeneration, by Dr. F. W. Andrewes; (4) an investigation by Dr. M. H. Gordon and Dr. A. E. Gow into the etiology of epidemic diarrhœa in children. Announcement of further investigations will be made at a later date.

A WISH has been expressed in many quarters that the distinguished services which Prof. Charles Lapworth, F.R.S., has rendered to geology should be commemorated in some permanent manner. The council of the Vesey Club, Sutton Coalfield, of which Prof. Lapworth has been a vice-president for more than twenty-five years, proposes to make a donation from the funds of the club towards such a memorial, and to enable members of the club who desire to be identified personally with the project to participate also, a small committee has been appointed to collect subscriptions. The amount subscribed by members will be handed over in one sum with a list of names only of subscribers. Donations may be sent to Mr. H. H. Sherwood, 109 Colmore Row, Birmingham.

IN honour of the memory of the late Henri Poincaré, and in order that his name may be associated with a fund for the encouragement of research in science, the president of the Institute of France, on behalf of the institute, is inaugurating an international

subscription with the approval of the family, friends, and admirers of the great French mathematician. It is proposed to arrange for a medal with Poincaré's portrait inscribed on it, and to secure a fund, the proceeds of which will be employed to encourage and assist young men of science engaged in those branches of knowledge with which Poincaré's name is chiefly associated. Donations may be sent to M. Ernest Lebon, secretary and treasurer, 4*bis* Rue des Ecoles, Paris, V.

THE tragic death of the late Dr. H. O. Jones and his wife in the Alps in August, 1912, was recorded in these columns at the time (vol. lxxxix., p. 638). We note with interest that a tablet bearing the following inscription has been placed on the walls of Lewis's School, Pengam:—"In affectionate remembrance of Humphrey Owen Jones, M.A., D.Sc., F.R.S., Fellow of Clare College, Cambridge. A distinguished worker in the field of physical chemistry—a former pupil of the school—who while on his honeymoon in the Alps was killed with his wife by falling from the Aiguille Rouge de Peteret on the 15th August, 1912, at the age of 34 years. This tablet is by the staff, boys, and friends of Lewis's School sorrowfully inscribed." In memory of his wife (whose maiden name was Muriel Edwards), who was a distinguished student of the University College of North Wales, a fund of about 70*l.* has been raised by her fellow-students and handed over to the college to found a "Muriel Edwards's Prize" for distinction in chemistry or physics.

THE annual general meeting of the Ray Society was held on March 26, the president, Prof. W. C. McIntosh, in the chair. The report of the council commenced with an appreciative notice of the late president, Lord Avebury, and an expression of regret at his death, and stated that three volumes, a "Bibliography of the Tunicata," by the secretary, and vols. i. and ii. of the "British Parasitic Copepoda," by T. and A. Scott, for 1912 and 1913, had been issued during the past year; that the volumes for the present year would be vol. iii. of the "British Freshwater Rhizopoda," by G. H. Wailes, and vol. v. of the "British Desmidiaceæ," by W. and G. S. West; and that the issue for 1915 would be vol. iii., part 1, of the "British Marine Annelids," by the president. The account of income and expenditure showed that the finances of the society were satisfactory. Prof. McIntosh was re-elected president, Dr. DuCane Godman treasurer, and Mr. John Hopkinson secretary.

THE following are the lecture arrangements at the Royal Institution, after Easter:—Dr. W. Wahl, two lectures on problems of physical chemistry; Prof. W. Bateson, two lectures on (1) double flowers, (2) the present state of evolutionary theory; Prof. D'Arcy W. Thompson, two lectures on natural history in the classics; Prof. A. Fowler, two lectures on celestial spectroscopy: experimental investigations in connection with the spectra of the sun, stars, and comets; Prof. Svante Arrhenius, three lectures on identity of laws in general and biological chemistry; Prof. Silvanus P. Thompson, two lectures on Faraday and the foundations of electrical engineering; Dr. T. E. Stanton, two lectures on similarity of motion in fluids; Prof. C. J. Patten, two lectures on bird migration; Prof. J. W. Gregory, two lectures on (1) fiords and their origin, (2) fiords and earth movements. The Friday evening meetings will be resumed on April 24, when the Astronomer Royal, Dr. F. W. Dyson, will deliver a discourse on the stars around the north pole. Succeeding discourses will probably be given by Prof. Karl Pearson, Prof. F. Keeble, Mr. R. Mond, Prof. J. C. Bose, and Prof. W. H. Bragg.

IN the *Times* of March 25 is announced the discovery at Kolophon, in Ionia, of a remarkable collection of Greek surgical instruments. They exhibit a type of workmanship unequalled in any other extant specimens, and generally reveal the high progress in surgery which the ancients achieved. With two exceptions all the instruments are of bronze, and even in the case of those made from steel a piece of bronze is added, preserved, apparently for ceremonial reasons as a mystic, sacred metal. The collection includes polypus pincers for the removal of growths, an elevator for raising a piece of depressed bone in the skull, a drill-bow for trephining the skull to produce an exit for the evil spirits which were believed to cause madness and epilepsy, a scoop or cuvette for gynæcological work, a cautery and probes of modern type, scales, and cupping vessels. It is to be regretted that this valuable collection has been secured for the Johns Hopkins University, and will shortly be taken to America. Models, however, are being made, and will be on view in London within a few weeks.

THE royal medals and other honours of the Royal Geographical Society have been awarded this year as follows:—The Founder's medal to Prof. Albrecht Penck, professor of geography at Berlin University, and director of the Oceanographical Institute; the Patron's medal to Dr. Hamilton Rice, of Boston, U.S.A., who for ten years has been closely investigating a little-known part of the large region of northern South America drained by the headwaters of the Orinoco and of the northern branches of the Amazon; the Murchison grant to Commander H. L. L. Pennell, R.N., who was a member of the Antarctic expedition of 1910, and was specially selected by Captain Scott to command the *Terra Nova* after the landing of the shore party; the Gill memorial to Mr. A. E. R. Wollaston, who has made extensive journeys in many parts of the world for zoological and other work; the Cuthbert Peck grant to Dr. J. Ball, of the Geological Survey of Egypt, who has carried out a large amount of scientific geographical work; and the Back grant to Mr. J. N. Dracopouli, for his careful survey and other work in the Sonora desert of Mexico in 1911–12, and his expedition to the Lorian Swamp and neighbouring regions in 1912–13.

THE annual report of the council of the Institution of Mining and Metallurgy was presented at the annual general meeting of the institution on March 26. The report refers to the purchase of the freehold of No. 1 Finsbury Circus, as a permanent home for the institution, and states that the stability of the institution

and its future progress have been materially assisted by the gift of 5000*l.* by Lady Wernher, and the further gift of 5000*l.* by Lady Wernher and her co-executors. This sum of 10,000*l.* has been invested as the "Sir Julius Wernher Memorial Fund," and the interest accruing is available for the ordinary purposes of the institution. The council has established as a personal memorial, a "Sir Julius Wernher Memorial Lecture," to be delivered and published triennially. The first lecture will be delivered before the International Congress of Mining, Metallurgy, Engineering, and Economic Geology, to be held in London in July, 1915. The subject of the lecture will be "The Metalliferous Mining Industry in its Relation to the Development of the British Empire," and the name of the lecturer and other particulars will be duly announced. The total membership on December 31, 1913, was 2372, as compared with 2258 in the previous year. "The Consolidated Gold Fields of South Africa, Ltd.," gold medal has been awarded conjointly to Mr. A. J. Clark, and Dr. W. J. Sharwood, for their paper on the metallurgy of the Homestake ore, and its premium of forty guineas to Mr. L. H. Cooke.

A FEW days before his death Sir John Murray was gathering material in the library of the Royal Society of Edinburgh in preparation for his presidential address at the Meteorological Congress, which is to be held in Edinburgh during next September. The sudden and tragic end of a project just begun is infinitely lamentable, and one naturally asks what will become of Medusa Villa as a centre of scientific activity. The terms of Sir John Murray's will have been so far made public as to bring a great relief to all who knew and appreciated the work which was always being carried on under his direct supervision. The books and collections, especially those bearing on deep-sea deposits, oceanography, and limnology, are to be kept together, along with furniture, instruments, fittings, etc., in the Villa Medusa, so that scientific work may be carried on there for twenty years. A certain number of shares in the Christmas Island Phosphate Company (Limited) are to be devoted to this purpose, the dividends being applied in scientific research or explorations or investigations which are likely to lead to an increase of natural knowledge, particularly along the lines indicated above. The carrying out of this project is left in the hands of his children. Very liberal powers are given in regard to special schemes, such as a scientific exploration of Canadian lakes or oceanographic expeditions. Should a case of substantial expenditure arise, it is suggested that the Challenger Society or the Royal Society of London or the Royal Society of Edinburgh might be consulted. Provision is made for the disposal of the collections and the library and the Christmas Island shares after the lapse of twenty years; or the arrangement may be brought to an end at an earlier date if the dividends should seriously decrease. In the obituary notice last week reference was made to the bathymetrical survey of the fresh-water lochs of Scotland. It should have been said that while Sir John planned, directed, and assisted financially the survey of the lochs, a large part of the expense was defrayed by Mr. Laurence Pullar, as a memorial to his son.

FOLLOWING an article on "The Spider Sense," several letters upon this subject have appeared in the *Times* (March 18–26). Certain people, we are told, are able to detect the presence of a spider (or cat) by means of a "sixth sense." The use of the term "sixth sense" indicates the complete innocence of psychology that characterises the whole correspondence. As to the fact, Prof. Meldola (March 26) is fully justified in pointing out that the neglect of the "negative instance" makes the proffered evidence totally unconvincing. Probably many people believe they can tell when they are being stared at from behind, but a recent experimental test revealed no such ability. On the other hand, such sensitivity does not seem *a priori* impossible. Sensory acuity varies greatly in different individuals and in special conditions. Thus some blind persons can perceive objects at a distance. This seems to be an abnormal development of a normal form of cutaneous sensitivity, the sense-organ being the skin of the face and the drum of the ear. Again, remarkable degrees of hyperæsthesia occur in certain stages of hypnosis, and in the present instances there may possibly be something of the nature of hypnotic auto-suggestion. That smell may play some part, as suggested by Mr. Ponder (March 25) is possible. This sense is imperfectly understood; how, for instance, is a hound able to avoid "back-tracking"? Even in the human its potentialities seem very elastic. Helen Keller, having lost her sense of smell for a few days, says: "A loneliness crept over me as vast as the air whose myriad odours I missed." But the existence of the "sense" and its nature should be quite simply determinable by experiment. Mr. C. Sully, assistant lecturer in psychology at King's College, London, will be glad to hear of a suitably endowed person willing to act as subject.

THE *National Geographic Magazine* for February reprints an important report by Mr. F. K. Lane on the conservation of the national undeveloped resources of the United States, particularly in connection with Alaska. This State contains the largest area of unused and neglected land in the country. Its resources are enormous in minerals, forests, and land available for cultivation. Hitherto lack of organisation has impeded development; but if the scheme now formulated is adopted this great national estate will become highly valuable.

THE fourth part of vol. i. of the Sarawak Museum Journal is devoted to an elaborate paper by Mr. Sidney H. Ray on the languages of Borneo. This collection of tribal glossaries was begun by Mr. Ray when he visited Sarawak on his return from the Cambridge Anthropological Expedition to Torres Straits in 1898–9. Additions were made to these by Dr. A. B. Meyer, whose papers on his death in 1911 came into Mr. Ray's possession. He has now published these glossaries with notes on the geographical distribution of the tribal dialects. It may be hoped that these collections will form the basis of a comparative study of this little-known group of languages. The value of the collection, not only to philologists, but also to anthropologists, is much increased by the addition of an extensive bibliography of books and papers on the Borneo tribes and their dialects.

IN the Report of the Indian Museum, Calcutta, for 1912–13, Dr. Annandale is enabled to record an increase in the number of visitors, and likewise to chronicle the occupation and installation of the new laboratories and offices on the top of the Chowringhi side of the main building. The whole of the old building has been made over to the Geological Survey.

IN vol. x., part 7, of the Annals of the South African Museum, Mr. K. H. Barnard continues his account of the crustacean fauna of South Africa, dealing in the first instance with the marine Isopoda, of which two genera and numerous species are described as new. Of much more general interest is his description of a new species of the genus Phreatoicus from Table Mountain; the genus being the typical representative of a southern terrestrial and fresh-water family of the Isopoda, containing three other genera. Hitherto the Phreatoicidæ have been known only from Australia, Tasmania, and New Zealand, and it is therefore of great interest to find it represented in South Africa, and that, too, by a member of the typical genus. Whether the group will ultimately turn up in South America remains to be seen, but the new discovery affords additional evidence of the community of the fauna of the old "Gondwanaland."

WE have been favoured with a copy of a summary, by Dr. Max Fürbringer, of the scientific results of Prof. R. Semon's zoological expedition to the Malay Archipelago and Australasia, as worked out by specialists in the six volumes of the well-known "Zoologische Forschungsreisen," to which this "Schlussübersicht" forms an appendix. Prof. Semon started on his journey from Jena in June, 1891, remaining from the following September until January, 1892, in Australia, and spending from February until May in visiting Easter and other islands, and the south coast of British New Guinea. At the end of October, 1892, he arrived in Java, whence he proceeded to the Mollucas, Celebes, etc., finally returning homeward in April, 1893. On his arrival scientific work was commenced with the least possible delay, so that the "Reisen" embodies the results of some twenty years' labour. How greatly these labours have augmented our knowledge of marsupials, monotremes, Ceratodus, and many other groups, to say nothing of their bearing on the problems of distribution in the Austro-Malay area, is well known to every working zoologist.

AN instructive account of experiments on the manuring of grass land in Oxfordshire has been prepared by Mr. G. R. Bland (Bulletin 15, University College, Reading). The work, which was commenced in 1909, has been carried out with special reference to the conditions obtaining with soils of different geological formations, and, in order to allow of comparison in other cases, a geological and a rainfall map of the county are included. The scheme of manuring is, if anything, rather limited in scope, but the general character of the account with regard to yields, profit and loss, botanical composition of the herbage and photographs of certain of the plots, is of great value, and is worthy of imitation by other county workers.

IN a contribution to the *Journal of Agricultural Research*, Mr. G. N. Collins describes a drought-resisting adaptation in maize which appears to possess considerable economic value for conditions in semi-arid regions. Experience has shown that, in the case of common varieties, if the seed is planted at the customary depth, many seeds fail to germinate from insufficient moisture; if planted deep enough to come in contact with moist soil, the plants may fail to reach the surface. A study of the varieties grown by the Hopis and other agricultural Indians shows, however, that these varieties possess two special adaptions: (1) a greatly elongated mesocotyl that permits of deep planting, and (2) the development of a single large radicle that rapidly descends to the moist subsoil and supplies water during the critical seedling stage. The productive power of some of these varieties compares favourably with that of ordinary "improved" varieties even when grown under irrigation conditions. On these grounds a further study of some of these special varieties seems desirable.

TO restrain a horizontal pendulum from executing its own oscillations during the passage of earthquake-waves, some method of damping is usually resorted to, either the electromagnetic method of Galitzin, the air-damping of Wiechert, or the liquid damping of other seismologists. After three years' work in experimenting with free and damped pendulums, Dr. A. Cavasino concludes (*Boll. Soc. Sism. Ital.*, vol. xvii., pp. 89–101) that a damped pendulum still tends to oscillate with its proper period; that except with violent earthquakes the beginning of the movement is retarded, it may be for several minutes, as compared with that indicated by a free pendulum; and that less than one-half of the earthquakes recorded by a free pendulum are registered by a corresponding damped pendulum.

IN the Proceedings of the American Philosophical Society, Philadelphia (vol. lii., No. 208, pp. 31–162), Mr. J. J. Stevenson brings to a conclusion his lengthy monograph on the formation of coal beds. Parts i. and ii. appeared in vol. l., and part iii. in vol. li., of the same journal. Whether geologists accept his views or not—and many geologists will do so—all will be grateful to him for his great labour in gathering together the opinions of others on this much-discussed subject, and for the pains he has taken in collecting evidence from modern deposits of carbonaceous material and from Coal Measures of all ages in all parts of the globe. The author concludes:—"The coal beds and the associated rocks are of land origin; the detrital deposits are those made by flooding waters on wide-spreading plains; the coal beds, in all essential features, bear remarkable resemblance to peat deposits, sometimes to the treeless moor, more frequently to the Wald moor." But, as he very truly says, many matters still await explanation, and he emphasises the fact that no extensive coalfield has yet been closely studied, for in spite of the imposing array of skeleton sections there is an astounding lack of detail respecting many matters which appear to have no important bearing on commerce. Until the topography and geography of the Coal Measures land have been worked

out, geologists must be content merely with probabilities concerning the remarkable bifurcation of some coal beds, the variations in subordinate intervals between two approximately parallel coal beds, the presence of huge blocks of transported rock in coal and the associated rocks, the immensely long periods of stable conditions indicated by the thickness of some coals, and with similar problems.

AN article, entitled "The Meteorological Service on Mercantile Vessels," appears in vol. ix. (1913–14) of the Italian *Annali Idrografici*. The author, Prof. L. Marini, chief of the meteorological branch of the Hydrographical Institute, points out that although meteorological observations have not been neglected by vessels belonging to the several important shipping companies, they have not hitherto been dealt with on the same scale as observations on land. The publication of pilot-charts of the Mediterranean has been left to other countries, *e.g.* the United States, Germany, and this country. It is now intended that Italy shall take her proper place in such work, and with this view an earnest appeal was made in a circular to the national navigation societies on June 1, 1912, by the Minister of Marine, in which he points out the provisions made for the successful working of the service. A long list of registers received by the institute during the succeeding half-year clearly shows that the appeal has met with a very favourable reception among the seafaring community; we may therefore confidently look forward to some valuable contributions in due course to the meteorology of the Italian seas and adjacent regions.

IN the *Popular Science Monthly* for March Dr. P. G. Heineman advances the view that development of automobile traffic will be beneficial to public health in two ways: first, by the provision of dust-proof roads, thus minimising the diffusion of disease germs which are commonly associated with dust, and secondly by doing away with stables which are fertile breeding grounds for flies that act as carriers of disease.

READERS of the *Cornhill Magazine* for March will derive considerable enlightenment from the article entitled "After the Death of Euclid," in which Mr. C. H. P. Mayo endeavours to compare the advantages and disadvantages of the old and new methods of teaching geometry. While admitting that the new method is beneficial in many respects, the author evidently considers that the sacrifice of logical training involved in the change may seriously impair its educational value.

THE March number of the Transactions of the Institution of Engineers and Shipbuilders of Scotland contains an important paper by Mr. H. Ollendorff on the utilisation of ground adjoining harbours and railway stations. He shows that by the use of suspension railways enabling the goods unloaded from ships at the wharf to be taken direct into the factory, the cost of transport is so far reduced that the "hinterland" of a harbour can be profitably utilised to about ten times the extent it is at present. On this ground he advocates the provision of suspension railways by public authorities, which at the present time provide cranes for service at harbours.

A PAPER by Hiromu Takagi on the thermomagnetic properties of magnetite, which appears in the third part of vol. ii. of the Science Reports of Tohoku University, Japan, casts some doubt on the accuracy of the results obtained by Prof. Weiss and Foex for the variation of the magnetic susceptibility of magnetite with temperature. They found that at about 680° C. the susceptibility showed a sudden decrease which they attributed to some change in the internal state of the artificial magnetite used by them. Such changes led Prof. Weiss to postulate the existence of the magneton or atom of magnetism which a substance can possess only in integral multiples. The present experiments on natural magnetite show that the substance neither follows Curie's law—susceptibility inversely as the absolute temperature—nor are there any sudden changes in the curve of susceptibility as a function of the temperature.

IN the current number of the *Comptes rendus* MM. Charles Moureu and A. Lepape discuss the cause of the constancy of composition of crude nitrogen (nitrogen with the rare gases) from various sources. The ratios between the nitrogen, argon, krypton, and xenon have been found to be the same in gases derived from fire-damp, thermal springs, petroleum, volcanic gases, or the atmosphere. This constancy of composition of nitrogen from natural sources is regarded by the authors as having existed from the nebular stage of the solar system. The same number also contains some measurements by Georges Claude on the amounts of hydrogen, helium, neon, and nitrogen absorbed by charcoal at low temperatures, $-182{\cdot}5°$ for nitrogen, $-195{\cdot}5°$ for the other gases. The amounts of helium and neon absorbed are much smaller than the absorptions of hydrogen and nitrogen. The position of hydrogen is anomalous, since it deviates from the rule that the lower the boiling point the smaller the charcoal absorption.

RAILLESS electric traction systems, otherwise designated the "trolley-bus" or "trackless-trolley," already form in several cities extensions to the tramways systems, and there are numerous applications to Parliament for the authorisation of similar lines. Mr. T. G. Gribble, in a paper on these systems read at the Institution of Civil Engineers on March 24, says that it requires no more current to carry the passenger by railless electric traction than it does by a tramway. The author shows that with a traffic density represented by a $2\frac{1}{2}$ minute service, the economy of construction in favour of railless electric traction is about 44 per cent., and in cost of operation about 7 per cent. The economy increases inversely with the traffic density; with a 30-minute service the economy of construction is about 70 per cent., and that of operation is about 36 per cent.

THE annual volume of *Knowledge* for 1913 is now available. The twelve monthly issues of our contem-

porary together form a handsome book which makes a special appeal to readers interested in nature knowledge. Attention may be directed to the excellent illustrations, the plates particularly being well produced. The price of the volume is 15*s.* net.

SOON after the death of Prof. Henri Poincaré, four appreciative notices of his work in various departments of knowledge were contributed to the *Revue du Mois* by Profs. Vito Volterra, Jacques Hadamard, Paul Langevin, and Pierre Boutroux. These studies have now been published together in a volume entitled "Henri Poincaré: L'œuvre scientifique, l'œuvre philosophique" (Paris: Félix Alcan; price 3.50 francs).

THE annual report of the Board of Scientific Advice for India for the year 1912–13 has been received from Calcutta. The report is divided into sections dealing respectively with applied chemistry, astronomy, and meteorology, geology, geodesy, botany, forestry, zoology, veterinary science, and medical research work. An appendix by Dr. W. R. Dunstan contains the report on the scientific and technical investigations conducted for India at the Imperial Institute during the year ended June 30, 1913.

DR. W. LEIGHTON JORDAN writes, with reference to a paragraph on the origin of planetary surface features and the "heart-shaped" figure of the earth, which appeared in our issue of March 19 (p. 69), that in 1866 he applied the term "cardioid" to the earth's shape, and pointed out that the motion of the earth through space tends to create high land in the Antarctic and deep water in the Arctic region. A description of Dr. Jordan's views upon this subject will be found in his work entitled "The Sling" (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.).

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR APRIL:—

April 3. 15h. 6m. Mars in conjunction with the Moon (Mars 2° 0′ S.).
4. 4h. 28m. Neptune in conjunction with the Moon (Neptune 4° 30′ S.).
5. 23h. 0m. Neptune stationary.
6. 19h. 0m. Mercury at greatest elongation W. of the Sun (27° 46′ W.).
10. 15h. 0m. Mars at quadrature to the Sun.
15. 19h. 0m. Neptune at quadrature to the Sun.
17. 22h. 50m. Uranus in conjunction with Moon (Uranus 2° 20′ N.).
18. 12h. 13m. Jupiter in conjunction with the Moon (Jupiter 1° 50′ N.).
20. 22h. 24m. Mars in conjunction with Neptune (Mars 2° 34′ N.).
23. 2h. 33m. Mercury in conjunction with the Moon (Mercury 5° 30′ S.).
26. 18h. 20m. Venus in conjunction with the Moon (Venus 4° 52′ S.).
28. 11h. 11m. Saturn in conjunction with the Moon (Saturn 6° 22′ S.).

A NEW COMET.—A telegram from Prof. Kobold at Kiel reports the discovery of a new comet by Dr. Kritzinger at Bothkamp. The comet is of magnitude 9·5, and was picked up on March 29 at 15h. 29·1m. Bothkamp mean time. Its position is given as R.A. 16h. 11m. 40s., and declination 9° 31′ S., and the daily motion as +3m. 8s. in R.A., and −32′ in declination. It is described as having a tail.

JUPITER VISIBLE BEFORE SUNRISE.—The planet Jupiter can now be well seen in the mornings, and it is important that telescopic observers examine his disc carefully and note the chief features. Last year the equatorial current had increased its rate of movement, its rotation being 9h. 50m. 11s. from a number of spots on the south edge of the northern equatorial belt. Are these markings still visible, and what is their velocity as compared with that determined during the previous opposition?

The great red spot also exhibited a quickening of speed in 1914, the rotation period being 9h. 55m. 35s. It is probable that at the present time the red spot precedes the zero meridian of System II. (see ephemeris for physical observations of Jupiter in Nautical Almanac) about 3h. 40m. It is impossible to tell exactly, however, because the planet has been too near the sun during the past winter for corrective observations to be made. Transits of the red spot and hollow in the southern belt may, however, be looked for at the following times:—

	h.	m.		h.	m.
April 14	14	27	May 3	15	6
16	16	5	8	14	14
21	15	12	15	14	59
26	14	20			
28	15	58			

Some estimated transits would be valuable in order to determine what the rate of rotation has been during the last six months.

The great south temperate spot now precedes the red spot. The former was no less than about 135° in length during last opposition, and it may ultimately extend all round Jupiter and darken the previously brilliant south tropical zone.

A PROPOSED TOWER TELESCOPE.—From Modena we have received a pamphlet describing a tower telescope to be erected to the memory of Secchi. It is proposed to build at Reggio-Emilia in reinforced concrete a pyramidal structure 35 m. high. Its memorial character is to be expressed by making the work, decorated in what is described as the Chaldeo-Babylonian style, serve as a canopy to a seated effigy of Secchi, whilst at the four corners of the base will be placed gigantic statues of Copernicus, Galileo, Kepler, and Newton. The scientific purpose is to make the tower carry the heliostat and objective of a vertical telescope of the type so successfully employed at Mount Wilson. A sum of 500,000 lire (20,000*l.*) is required, of which about 150,000 lire had already been collected by a permanent committee.

This is not the only project now on foot to perpetuate the memory of an astronomer. An influential international comité d'honneur is inviting subscriptions for the erection of a monument to the memory of Laplace, at his birthplace, Beaumont en Auge (Calvados), Normandy.

ANNUAL REPORT OF THE HAMBURG OBSERVATORY IN BERGEDORF.—The report for 1912 of the Hamburg Observatory in Bergedorf has just come to hand. It shows that great strides have been taken since this site was occupied, in spite of various hindrances regarding the larger instruments. Thus the large reflecting telescope had to undergo a change in the method of mounting the mirror, that used by Common

and Ritchey being finally adopted. The report gives a brief *résumé* of the work of the various branches accomplished during the year, and an appendix contains a table giving the corrections to the Norddeich and Eiffel Tower wireless time signals. The report is accompanied by some good reproductions of some of the larger telescopes, and two pictures of the annular solar eclipse of April, 1912, secured by Prof. A. Schwassmann with the Lippert astrographic instrument.

OPTICAL ROTATORY POWER.

THE Faraday Society has adopted in recent years the policy of organising a series of general discussions on physico-chemical subjects, to which investigators of all countries are invited to contribute. The ninth of these discussions, on optical rotatory power, was held in the rooms of the Chemical Society on Friday, March 27. At the afternoon session the chair was occupied by Prof. Armstrong, who contributed an introductory address; the evening session was presided over by Prof. Frankland. Papers were read by Prof. H. Rupe, of Basle, on the influence of certain groups on rotatory power, by Prof. H. Grossman, of Berlin, on the rotatory dispersion of tartaric and malic acids, by Dr. T. M. Lowry and Mr. T. W. Dickson, on simple and complex rotatory dispersion, by Dr. T. M. Lowry and Mr. H. H. Abram on an enclosed cadmium arc for use with the polarimeter, by Dr. R. H. Pickard and Mr. Joseph Kenyon, on the rotatory powers of the members of homologous series, and by Dr. T. S. Patterson, on the dependence of rotation on temperature, dilution, nature of solvent, and wave-length of light. Papers were also communicated by Prof. L. Tschugaeff, of St. Petersburg, on anomalous rotatory dispersion, by Dr. E. Darmois, of Paris, on the existence of racemic tartaric acid in solution, by Dr. G. Bruhat, of Paris, on the rotatory power of tartaric acid, and by Prof. A. Cotton, of Paris, on the constitution of liquid mixtures and their rotatory power.

Two distinct schools of research were conspicuous in the papers and in the discussion. The attempts to find a relationship between chemical constitution and the rotatory power of compounds for sodium light received its greatest impetus from the theory put forward in 1892 by Crum Brown and Guye, to whom, at the suggestion of Prof. Armstrong, greetings were sent from the meeting; this school of research was well represented by Prof. Frankland, who had no difficulty in showing that results of very great value had been obtained from observations made with light of one colour only, that of the sodium-flame. Prof. Rupe gave a masterly summary of his work on the influence of unsaturated groups on rotatory power; this work had also been done mainly with sodium light, but there was no reason to suppose that the results would have been essentially different if light of other colours had been used. Dr. Patterson, in describing his observations on the influence of temperature and of solvents on the rotatory power of the tartrates for sodium light, was able to show that there is an essential unity in the effects produced by these two widely different factors; this unity could be extended to include some features in the behaviour of these liquids towards light of different colours, as recorded by Winther and others.

An element of novelty attached to the description of several series of researches which depended on the measurements of rotatory dispersion—a subject which has come suddenly to the front, both in England and on the Continent, during the course of the last two or three years. The apparatus required for measuring rotatory dispersion was exhibited by Mr. Abram, who also succeeded in showing an enclosed cadmium arc in actual operation. This arc is likely to be of great value in experiments on rotatory dispersion, because it provides a pair of lines, Cd 5086 (green) and Cd 6438 (red), which can be read with the same accuracy as the mercury lines, Hg 4359 (violet) and Hg 5461 (green). Thus it has been used to prove that α-methylglucoside, a compound which contains five asymmetric carbon atoms, obeys strictly the simple dispersion law given by the formula,

$$\alpha = \frac{k_0}{\lambda^2 - \lambda_0^2}.$$

This law also holds good for a long series of alcohols prepared and described by Dr. Pickard and Mr. Kenyon, the dispersive power of which remains constant over wide ranges of temperature, and may persist almost unchanged throughout the whole range of a homologous series.

Rotatory dispersion has usually been classified as *normal* when the rotation increases steadily as the wave-length diminishes, and as *anomalous* when in any part of the spectrum the rotation diminishes with the wave-length. The most familiar examples of anomalous rotatory dispersion are (i) tartaric acid, for which a remarkable series of data were recorded in M. Bruhat's paper; (ii) ethyl tartrate, studied exhaustively by Dr. Patterson; and (iii) methyl malate, which has been examined by Grossman in nearly one hundred different solvents. More recently Dr. Pickard and Mr. Kenyon have detected the same phenomenon in the simple esters of their optically active alcohols, and also in the α-naphthylmethylcarbinol,

$$C_{10}H_7.CH(OH).CH_3,$$

when this is examined in the superfused state.

Dr. Patterson protested against a classification which represented ethyl tartrate as showing "normal" dispersion in some solvents and "anomalous" dispersion in others. He argued that it was merely a matter of accident whether the maximum of optical rotation occurred within or without the region of the spectrum used for the polarimetric observations. This contention was supported by Dr. Lowry and Mr. Dickson, who were able to quote cases in which the camera had revealed a maximum beyond the limits of visual observation. They proposed to describe as *simple rotatory dispersion* all those cases to which the formula,

$$\alpha = \frac{k_0}{\lambda^2 - \lambda_0^2}$$

can be applied. All cases in which two or more terms are required to express the dispersion, thus—

$$\alpha = \frac{k_1}{\lambda^2 - \lambda_1^2} \pm \frac{k_2}{\lambda^2 - \lambda_2^2},$$

were to be described as *complex rotatory dispersion*, whether the curves were anomalous or apparently normal in the region investigated. Simple rotatory dispersion may be detected very easily by plotting $1/\alpha$ against λ^2, when the experimental data are found to fall on a straight line. When two terms, with constant values of λ_1^2, and λ_2^2, are sufficient to express the rotatory dispersion of a substance over a wide range of experimental conditions, the "characteristic diagram" of Armstrong and Walker will plot out to a series of straight lines, but this will no longer be the case if three "dispersion-constants," λ_1^2, λ_2^2, λ_3^2, are required.

The cause of anomalous rotatory dispersion was discussed by Prof. Tschugaeff. It can be produced by mixing two substances of opposite rotatory power and unequal dispersion (Biot) or by superposing two

partial rotations, as in the camphorsulphonate of menthol (Tschugaeff). It may also be produced by an absorption-band in the visible spectrum (Cotton's phenomenon), or, as R. W. Wood has pointed out, by a band in the infra-red region. The view that anomalous rotatory dispersion is usually caused by the presence of two species of optically active molecules in the liquid was adopted by Armstrong, Grossman, Pickard, and other speakers; in support of the same view, it was stated in the discussion that nitrocamphor, which exists in two isodynamic forms, gives anomalous rotatory dispersion in acetone, and that ethyl tartrate may be fractionated into portions which differ very widely in their rotatory power for violet light, although the differences are small when green or yellow light is used.

LIZARD VENOM.[1]

THE results of a comprehensive study of the poison of Heloderma, undertaken by several observers, under the direction of Prof. Leo Loeb, at the laboratory for experimental pathology, University of Pennsylvania, are published by the Carnegie Institution of Washington in the volume before us.

Heloderma, or the Gila monster, is a lizard attaining the length of 2 or 3 ft., which inhabits the dry regions of Mexico and Arizona. It is of alarming appearance, and regarded by the natives with the utmost dread, although the results of a bite from this reptile are not very serious to man. The two species of the genus are peculiar in that they are the only reptiles other than snakes which possess poison glands in relation to some of their teeth. Unlike the poison glands of snakes, those of Heloderma are situated in the lower jaw, and consist of four independent sacs on each side, which open into separate cup-like depressions of the mucous membrane just external to the anterior mandibular teeth. When the jaw is closed the corresponding teeth project into these depressions and thus both upper and lower sets become bathed with the secretion.

The first article contains a good account of the anatomy and histology of the poison gland, and is followed by one on the histological changes in the gland after stimulation by pilocarpine. Then follow papers on the general properties and action of the venom and on some experiments in immunisation. The general lines followed in these studies are those previously traversed by various observers with snake-poisons, with which Heloderma venom has many similarities. The venom is an albuminous fluid, but the albumen can be coagulated by boiling without destroying the toxic principle. The latter is, however, carried down in the precipitate, to which it apparently adheres. This toxin seems, in fact, to adhere to almost any kind of fine precipitate, and this property has led to difficulty in all attempts to separate the essential poison.

The main poisonous constituent of the venom is a neurotoxin, and death is caused by gradual paralysis and ultimate cessation of respiration. From experiments upon isolated strips of cardiac muscle, the heart does not seem to be directly affected and the fall of blood pressure following the injection of the venom is presumably due to paralysis of the vasomotor centres. The nerve cells of animals killed by the venom show chromatolytic changes similar to those observed by Kilvington and Lamb and Hunter in snake poisoning. The venom has no influence on the coagulation of blood, nor does it produce hæmorrhages. It does not itself hæmolyse blood corpuscles, but, if mixed with lecithin it gives rise to a hæmolytic substance. This, as has been shown to be the case with cobra venom, is presumably due to the action of the lipase it contains upon the lecithin. The subcutaneous injection of subminimal lethal doses is followed by a considerable but temporary leucocytosis. Admixture of the venom with leucocytes and staphylococci does not hinder phagocytosis.

The memoir concludes with an account of attempts to separate an active principle from the venom, using the methods by which Faust obtained a non-nitrogenous active body in the case of cobra and crotalus venoms. These methods proved to be unsuitable, but by dissolving the venom in glacial acetic acid and precipitating, first with weak alcohol and then with stronger alcohols, and ultimately with ether, it was found that the successive precipitates with alcohol contained less protein and more active substance, and that the final precipitate with ether was protein free, but very active.

The above short *résumé* gives some idea of the extent of these researches, although a number of papers included in the volume, of less general interest, have not been referred to.

The work seems to have been carefully planned and performed, but the statements about snake venoms are occasionally inaccurate, as, for instance, the affirmation on p. 56 that the venoms of Hoplocephalus and Pseudechis may be heated without injury, and on p. 60, that the "venom of Viperidæ" does not pass through a Chamberland filter.

C. J. MARTIN.

[1] "The Venom of Heloderma." By Leo Loeb, with the collaboration of a number of workers. Pp. vi+244. (Washington: Carnegie Institution of Washington, 1913.)

CHINESE PALÆONTOLOGY.[1]

THE volume before us contains the palæontological results of the Carnegie expedition to China in 1903–4, and is an important contribution to our knowledge of the Palæozoic faunas of eastern Asia. The principal memoir is by Dr. Walcott, and deals with the Cambrian fossils which were found in large numbers. A total of sixty-three genera and 245 species are described and figured, and of these thirty-six genera and 175 species are trilobites (including five genera peculiar to China) and thirteen genera and thirty-six species are brachiopods. The oldest fossiliferous rocks are referred to the upper part of the Lower Cambrian and contain the Redlichia fauna, so that we are now acquainted with this fauna from Shantung, Yun-nan, Spiti, and western and southern Australia, as well as from the Salt Range where it was first found. It is, however, from the Middle Cambrian that the richest and most varied fauna was obtained in the Chinese provinces of Shantung, Shen-si, Shan-si, and in Manchuria, as was the case in the central Himalayas. A rapid process of evolution under new conditions of environment was originated at this period, accompanied by the more or less complete isolation of parts of the marine area, leading to the formation of local faunas. But on the whole the affinities of the Asiatic Cambrian fauna prove to be with the Cordilleran Province of western North America, and with the Upper Mississippian Province of the United States rather than with Europe. This is emphasised by the absence of the genus Paradoxides in western North America, China, and India, though other genera connect these areas with the Atlantic Province. In the Upper Cambrian a similar relationship is noticeable. From the evidence now available Dr. Walcott recognises three faunal provinces in Asia

[1] "Research in China." Vol. iii., The Cambrian Faunas of China, by C. D. Walcott; A Report on Ordovician Fossils Collected in Eastern Asia in 1903–4, by S. Weller; A Report on Upper Palæozoic Fossils Collected in China in 1903–4, by H. Girty. Pp. vi+375+29 plates. (Washington: Carnegie Institution of Washington, 1913.)

in Cambrian times, and these he terms respectively the Shantung Province (including Manchuria and Shan-si), the Punjab Province (including Yun-nan), and the Siberian Province.

Passing to the description of the new genera and species from China, we cannot help regretting that there is a general absence of individual comparison of the new forms with previously established or well-known species from other lands. It would have been especially valuable to have had their affinities discussed by Dr. Walcott, with his ripe experience and world-wide knowledge of Cambrian fossils. He indeed expresses the opinion that the excellent illustrations of the new species will enable other investigators to pursue such a study as occasion requires; but no plates or figures, however good, can remedy such a defect in the original descriptions, and this omission robs the memoir of much of its value.

The Ordovician fossils described in the second section by Dr. Weller, have been obtained partly from Shantung and partly from Ssï-ch'uan. The former are very poor and few in number, and no specific determinations were found possible, but their stratigraphical horizon is believed to be Middle Ordovician. The fossils from eastern Ssï-ch'uan are quite different in character and in much better preservation. They were obtained from a thick limestone resting conformably on the Cambrian, and consist chiefly of brachiopods and trilobites, some species of which were described in 1901 by Martelli from Shen-si. Richthofen's Ordovician fossils from northern Ssï-ch'uan, collected more than thirty years ago, are regarded as indicating the same geological horizon which Dr. Weller correlates with the Mohawkian (Middle Ordovician) of North America. The fossiliferous Ordovician beds of the central Himalayas, to which he makes no reference, have been regarded as of the same age. There is no similarity to the Ordovician faunas of eastern Yun-nan and Tonkin or of the Northern Shan States, but some species appear comparable or closely allied to Spiti forms; and in south-western Yun-nan it is probable that the Ssï-ch'uan fauna is represented. A conclusion of special interest at which Dr. Weller arrives is that there is a mixture of North American and Baltic forms in China, as in the Himalayas, where, however, the American element seems to be stronger.

The Carboniferous fauna described by Dr. Girty from Shantung, Shan-si, and Ssï-ch'uan is very scanty and of peculiar facies, but seems remotely allied to Russian and Indian faunas, and is considered to be of Upper Carboniferous (Pennsylvanian) age, with the exception of a few very doubtful fossils. The rich Middle and Upper Carboniferous faunas described by Kayser, Loczy, Mansuy, and Deprat from other parts of China appear to be unrepresented.

F. R. C. REED.

MARINE BIOLOGY.

THE life-histories of the Pacific Coast salmon and the halibut caught off the west coast of North America form the subject of two papers just published by Dr. J. P. McMurrich in vol. vii. of the Transactions of the Royal Society of Canada. In this work the author puts the method of scale examination to a somewhat severe test. It is fairly certain that this line of investigation must be regarded only as supplementary to detailed research by means of fishery experiments and statistical studies; such is the experience of most workers in Europe. Yet Dr. McMurrich does not hesitate to describe the conclusions that may be deduced from the study of the scales of twenty-two, or ten, or even three fishes, as "remarkably definite." The species of Oncorhynchus (the Pacific salmon) spawn only once in their life-times. The Pacific halibut becomes mature in its eighth year, and then enters upon a period of reproductive maturity. The ova ripen gradually, and "spawning is not a matter of a few days or even weeks, but is prolonged over, it may be, several years." This is too exceptional and improbable a result to deduce from a microscopic examination of the scales of three fishes, especially when the author admits that practically nothing is known as to the life-history of the halibut in North American waters. It is also incorrect to say that planktonic ova of this fish have not been found in European waters. Less, perhaps, is known about the halibut than most other Pleuronectids, but our ignorance is not such an utter blank as is suggested in the paper noticed.

Part i. of the Journal of the Marine Biological Association, published in November, 1913, contains papers dealing with varied aspects of marine biology. Mr. J. H. Orton, in a most useful paper, describes the functioning of the ciliary mechanisms on the gills of Amphioxus, Ascidians, and Solenomya. English writers, apparently accepting as correct the earlier work of Fol, have described food collection as occurring in the endostyle of Ascidians, the solid particles being then conducted along the peripharyngeal grooves, and so into the dorsal groove. Mr. Orton points out that no food-matter at all is taken up by the endostyle. The latter secretes mucus, which is then driven dorsally over the pharynx to the dorsal groove. Essentially the same mode of functioning of the ciliary tracts occurs both in Amphioxus and Ascidians. The pharynx in these animals, and the gills in Lamellibranch molluscs, are not respiratory mechanisms, but organs which function as water-pumps and food-collectors. In the same number of the journal there is an account of some very interesting experiments made by Mr. J. Gray with the object of investigating the chemical and physical changes which occur when the egg of the sea-urchin is naturally fertilised. The entrance of the sperm into the egg raises the electrical conductivity of the latter, the change attaining a maximum within ten minutes of the addition of the sperms to the ripe eggs. The egg-membrane in the unfertilised condition is remarkably impermeable to electrolytes, its surface being polarised. Probably the entrance of the sperm effects depolarisation and increases the permeability of the membrane to ions, but in some fifteen minutes polarisation again occurs, and the egg returns to its electrical state prior to fertilisation. Five other papers in the journal are written by zoologists of University College, Aberystwyth, and deal with sea-anemones, with the habits of the Galatheidea, and with the littoral fauna of Cardigan Bay. Dr. Th. Mortensen writes also on the development of some British Echinoderms. This number of the journal is altogether a very interesting one.

J. J.

CRYSTALLINE STRUCTURES AS REVEALED BY X-RAYS.[1]

THE analysis of crystal structure by means of X-rays depends on the fact that a pencil of X-rays of uniform quality is reflected by a crystal face when, and only when, it meets the face at exactly the proper angle. As we shall see presently, the effect depends on the regularity of the crystal structure according to which the atoms of the crystal are arranged in planes, which are parallel to the face and regularly spaced. There is a certain relation between

[1] From a lecture delivered before the Manchester Literary and Philosophical Society on March 18, by Prof. W. H. Bragg, F.R.S.

the wave-length of the X-radiation, the spacing of the planes, and the proper angle of incidence. If we always use the same rays, and measure the angles at which they are reflected by the different faces of a crystal, natural or prepared, we discover the relative spacings of the many systems of planes which can be drawn regularly through the atoms of the crystal; and hence the actual arrangement of the atoms can be deduced. It is in this way that the structure is analysed.

Let us first consider some details of the reflection effect. The theory is not entirely strange to us, for Lord Rayleigh carefully investigated a strictly analogous phenomenon twenty-five years ago; this was the brilliant coloration of crystals of chlorate of potash. When white light falls on these crystals there is a strong selective reflection of rays the wave-lengths of which are confined within very narrow limits. R. W. Wood has prepared crystals which reflect waves the limits of which are no wider apart than the two D lines of sodium. Rayleigh showed that the effect was due to the existence of regularly spaced twinning planes parallel to the reflecting surface. He pointed out the analogy to other physical problems in sound, and in a Friday evening discourse at the Royal Institution he illustrated the effect by reflecting a high-pitched note by a series of parallel muslin sheets stretched tight and evenly spaced.

Rayleigh showed that in these and parallel cases the reflection must be total provided the number of planes was sufficiently great, no matter how feeble the reflection from each plane. In the present case the wave-lengths of X-rays are many thousands of times smaller than the waves of light which Rayleigh used; and the crystal planes being at atomic distances from each other are also many thousands of time closer than the twinning planes of chlorate of potash.

It is found that pencils of homogeneous X-rays suitable for use in the experiment, are contained in the general mass of radiation issuing from an X-ray bulb. The antikathode of the bulb emits "lines" or rays of definite wave-length which are characteristic of the material of which it is made.

The platinum antikathode gives a spectrum containing five sharply defined and intense lines which stand out well from the general radiation. The osmium spectrum appears to have five similar triplets instead of the five lines of the platinum, the head of each triplet coinciding with a platinum line. Several substances ranging in atomic weight from silver down to calcium emit similar spectra consisting each of two strong lines, increasing regularly in wave-length as the atomic weight decreases. A large number of these have been photographed by Moseley. Bulbs having rhodium or palladium antikathodes have been exceedingly useful in the crystal analysis, as they last well, their line spectra are very intense, and the wave-lengths are of convenient magnitude. The principal rhodium line is really double; and it will serve to illustrate the surprising exactness of the reflection effect when it is stated that the two constituents are just separated by reflection at the cleavage face of the diamond. The glancing angles are then 8° 35′ and 8° 39′.

Let us next consider the application of these principles to the determination of crystal structure. We take first, naturally, the large class of cubic crystals which are not only of high importance, but also of the most simple construction.

The atoms of a crystal can be arranged in the form of a repeated group or pattern. Each group is to be supposed to contain as few atoms as possible consistent with the requirement that the whole crystal can be built by packing these groups together, all the groups being similar and similarly oriented. If a point is chosen similarly in each group it serves to indicate the position of that group relative to other groups. An arrangement of points chosen in this way shows the basal structure of the crystal, and is known as a "space lattice."

There are three space lattices which give cubic character to crystals. In the first the representative points are placed at the corners of a cube; the whole lattice consisting of a repetition of this arrangement in all directions in space. In the second there are representative points at the corners of a cube, and the centre of the cube; in the third at the corners of a cube and at the middle points of the faces. The three are called the cubic, the centred cubic, and the face-centred cubic respectively.

These three types of lattice can be at once distinguished from each other by the X-ray method. Suppose we consider three important types of plane which may be drawn through the atoms of a cubic crystal, that is to say, planes perpendicular to (*a*) a cube edge, (*b*) a face diagonal, (*c*) a cube diagonal. If we draw a diagram or build a model we find readily that the relative spacings of the three sets are different in the different crystals, and this causes corresponding differences in the angles of reflection of some standard line.

Proceeding on these lines we come at once to a case of great importance. Rock-salt or sodium chloride and sylvine or potassium chloride have long been known to be of similar construction, though the nature of the construction has been uncertain until now. X-ray analysis shows, however, that the former crystal has the characteristics of the third class of lattice, and the latter of the first. Moreover, it appears that the elementary group or pattern contains the same number of atoms in each case. There is one obvious way of explaining these facts. Suppose that we place chlorine atoms at the corners of a cube and at the centres of the faces and sodium atoms at the middle points of the edges of the cube and at the cube centre, and take this to represent the structure of rock-salt. Potassium chloride may be derived from sodium chloride by replacing the chlorine atoms of the structure by potassium. Now it appears from a number of mutually supporting indications that the contribution of an atom to the reflection effect depends on its atomic weight only. The atoms of potassium and chlorine are of very nearly the same weight, and can be looked on as equivalent. If this is done the structure of potassium chloride is in effect the simple cubic. But there is a great difference between the weight of sodium and chlorine, and the face-centred arrangement of the chlorine atoms taken separately gives its character to the whole rock-salt structure. All this agrees with experiment. But there is more. The presence of the sodium atoms amongst the chlorine, arranged as a matter of fact on a face-centred lattice of their own, modify the purely face-centred character of the spectra, and experiment shows that the modification is exactly such as theory predicts.

It is impossible in a short account to describe in full the work that has or can be done. Moreover, description is difficult without the aid of a plentiful supply of diagrams or models. It will be sufficient to say that the examination of the positions of the spectra, and especially of the relative intensities of the different orders give information which is gradually being interpreted. The simpler crystals have already been analysed, and the structure of many of the more important cubic crystals is known. The more complex structure of the calcite series has been determined, and something has been discovered of the still more difficult structures of sulphur and of quartz. It must be remembered that in all these cases complete analysis requires not merely the determination of the lattice, but, what is far more difficult, the

arrangement of the atoms in the group which is represented by each point on the lattice.

We may consider certain points of more general interest. The structure of the diamond stands out with some prominence. It is interesting to find that the carbon atoms are arranged in the most beautifully symmetrical pattern, each being at the centre of a regular tetrahedron composed of its four nearest neighbours. Rings of six carbon atoms are a predominating feature. Planes perpendicular to a cube diagonal—the diamond is, of course, a cubic crystal—are arranged in a curious way, the spacings being alternately large and small in the proportion of three to one. This leads to the extinction of the second order reflection from these planes. The effect can be readily illustrated optically by ruling a diffraction grating in the corresponding fashion. Zincblende has exactly the same structure as the diamond, but the alternate planes of the kind just mentioned contain alternately zinc atoms alone and sulphur atoms alone. This explains the well-known polarity of the crystal. Iron pyrites has a rather more complicated structure, which explains at once the curious disposition of the striations on its faces. Sulphur has eight interpenetrating lattices, quartz three of silicon and six of oxygen. In each of these two cases there is regular spacing of the lattices along the long axis, but not in other directions.

The atoms of a crystal are not, of course, at rest; the extent of their movements depends on thermal considerations. As the temperature rises the motion increases. According to theory, this must tend to destroy the intensity of the spectra, particularly those of higher order. Experiment confirms the theoretical deduction, and gives some promise of being able to decide between conflicting hypotheses as to the extent of the thermal influence. It is curious to observe the angles of reflection diminish as the crystal expands with heat and the spacings of the planes increase. The method might even be applied to the measurement of coefficients of expansion of crystals.

Lastly, the study of the X-ray spectra emitted by various substances when made the antikathodes of the X-ray bulb gives valuable information respecting atomic structure, and is most skilfully made use of in the investigations which are being conducted in the physical laboratory of the University of Manchester.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Prof. H. H. Jeffcott has been appointed by the Senate to the chair of engineering tenable at University College, vacated by the appointment of Prof. J. D. Cormack to a professorship at Glasgow. Prof. Jeffcott was educated at Trinity College, Dublin, and is now professor of engineering in the Royal College of Science, Dublin.

The D.Sc. degree in physics has been granted to Dr. E. E. Fournier d'Albe, Royal College of Science and Birmingham University, for a thesis on the efficiency of selenium as a detector of light.

Evidence is to be presented, on behalf of the University, to the Departmental Committee of the Board of Education in regard to external students, without being restricted to the recommendations of the Royal Commission.

MR. C. A. KING has been appointed professor of mechanical engineering in the Civil Engineering College, Sibpur, India.

A FREE scholarship of the value of 30*l*., tenable at the Northampton Polytechnic Institute (London) is being offered to students. In view of the openings which the calling and craft of optics now offer, this "Aitchison Memorial Scholarship," should prove most attractive to intelligent youths. The subjects of examination include English, mathematics, and elementary physics. Full particlars can be had of the hon. treasurer, Mr. H. F. Purser, 39 Charles Street, Hatton Garden, London, E.C.

A COPY has been received from New York City of a volume entitled "A Study of Education in Vermont prepared by the Carnegie Foundation for the Advancement of Teaching at the request of the Vermont Educational Commission." The legislature of Vermont on November 19, 1912, appointed a commission to report on the educational responsibilities of the State. On February 24, 1913, the commission invited the Carnegie Foundation to undertake an expert study of the school system of the State, including the higher institutions of learning. The resulting report provides much information and enumerates the conclusions and recommendations of the foundation. Among other recommendations the withdrawal of State subsidies from all higher institutions not owned and controlled by the State is suggested. Three colleges are now subsidised by the State of Vermont, and these have some 1026 students, 565 of which are provided by Vermont itself, while 400 Vermont students attend colleges in other States. There are in every thousand of population in Vermont three students of higher education. In connection with the University of Vermont, one of the institutions aided by the State, strong courses in the humanities and in the sciences are recommended, as well as the development by the University of the State Agricultural College.

THE general and departmental reports for the session 1912–13 of the Bradford Technical College reveal a satisfactory growth in the usefulness of the institution. There was an increase in the attendance over the previous academic year. The arrangement under which advanced students in dyeing from the Leeds University attend a course in the practical dyehouse at Bradford was in work during the session. A number of Bradford students also attended special courses of lectures at the Leeds University. This reciprocal arrangement, having proved satisfactory, is being continued. The head of the department of textile industries reports that although no large increase in the number of day students is to be expected, it is worthy of note that attendance in the department forms a ready entrance into the higher walks of the textile industries in the case of students of ability who lack special influence in the trade. He points out also that the raising of the standard of attainment in the industry is possibly the most important work of the college evening classes, and those who have followed this development recognise the help which the college has rendered to the textile trade of the city in this direction. The work of the materials testing laboratory of the department of engineering is growing at a rapid rate, and at the present time more than one thousand tests per annum are being made for the various Government and corporation departments, and for local firms. This has the effect of bringing the work of the department into close touch with the engineering trade of the district, and a number of interesting problems of a practical character are forthcoming, in the solution of the majority of which the students are permitted to take part.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 26.—Sir William Crookes, president, in the chair.—J. H. **Mummery**: The nature of the tubes in marsupial enamel and its bearing upon enamel development. In the present paper the author

has endeavoured to show that the tubes are dentinal tubes and not an enamel product, and that the penetration of the dentinal fibril results from the late and imperfect calcification of the cement substance between the prisms.—W. T. **Lockett**: Oxidation of thiosulphate by certain bacteria in pure culture. In the course of investigations on the oxidation of thiosulphate on bacterial sewage filters, it was found that the oxidation was due largely to the presence of living organisms. Experiments were undertaken with a view to the isolation of the organism or organisms capable of bringing about this oxidation.—A. E. **Everest**: The production of anthocyanins and anthocyanidins. The question of the production of Anthocyan pigments from the yellow pigments of the flavone and flavonol class is discussed. Evidence is brought forward to show that the Anthocyan pigments must be regarded as reduction products of flavone or flavonol derivatives, and that they are readily produced as glucosides from the glucosides of the yellow compounds without intermediate hydrolysis.—A. J. **Walton**: Variations in the growth of adult mammalian tissue in autogenous and homogeneous plasma. This paper considers the results of experiments performed to obtain information as to the presence in plasma of substances inhibitory to the growth of tissue. Several tissues were used and several plasmata were investigated.—E. C. **Grey**: (1) The decomposition of formates by *B. coli communis*; (2) the enzymes which are concerned in the decomposition of glucose and mannitol by *B. coli communis*.—Surg.-General Sir D. **Bruce**, Major A. E. **Hamerton**, Captain D. P. **Watson**, and Lady **Bruce**: (1) description of a strain of *Trypanosoma brucei* from Zululand. Part i.—Morphology. Part ii.—Susceptibility of animals. Part iii.—Development in *Glossina morsitans*. (2) The Trypanosoma causing disease in man in Nyasaland. Part iii.—Development in *Glossina morsitans*.

Linnean Society, March 19.—Prof. E. B. Poulton, president, in the chair.—Dr. E. F. **Armstrong**: The bearing of chemical facts on genetical constitution. The subjects dealt with were:—(1) The relation of enzymes to colour inheritance in plants; (2) the nature of oxydases; (3) the anthocyan pigments of plants and their mode of formation; (4) other plant pigments; (5) An hypothesis as to the relation between the several members of an epistatic series of pigments.

DUBLIN.

Royal Dublin Society, February 24.—Dr. J. H. Pollok in the chair.—Prof. G. H. **Carpenter** and T. R. **Hewitt**: The reproductive organs and first-stage larva of the warble-fly (Hypoderma). Descriptions with figures of the reproductive organs of both sexes of *Hypoderma bovis* are given, and comparative studies of the ovipositor and external male genitalia in *H. bovis* and *H. lineatum* have been made, very definite specific characters being apparent. The male genitalia of Hypoderma are symmetrical, and apparently more primitive than the corresponding structures in the blow-fly or house-fly, three pairs of gonapophyses being well developed. There are evidently ten segments in the abdomen of the male *H. lineatum*. The newly hatched larva of the warble-fly is exceedingly spiny, and provided with strong mouth-hooks and a sharp median piercer connected with the pharyngeal sclerites. In this stage the larva offers a marked contrast to the almost smooth second instar which is found in the wall of the ox's gullet.—J. E. **Collin**: Notes on the specimens of Borboridæ and some Ephydridæ in the Haliday collection in the National Museum, Dublin. The paper gives details of Haliday's type specimens, accompanied with systematic and synonymic notes. Many of the specimens are still in excellent condition after a lapse of eighty years.

EDINBURGH.

Royal Society, February 16.—Prof. J. Geikie, president, in the chair.—Dr. **M'Whan**: The axial inclination of curves of thermoelectric force: a case from the thermoelectrics of strained wire. The author found that when the thermoelectric force, for a given temperature difference, between strained and unstrained nickel was compared with the load, the relation was represented by a parabola the axis of symmetry of which was inclined to the coordinate axes, thus obtaining for the relation between electromotive force and longitudinal stress a relation similar to that which Mr. Hamilton Dixon had established for electromotive force and temperature.—A. R. **Fulton**: Rupture strains in beams and crane hooks. A modified theory as to the strains in bending as the elastic limits were approached was tested and verified by experiments on the rupture of beams and hooks.—Dr. H. A. **Haig**: A description of the systematic anatomy of a Fœtal Sea leopard (*Stenorhynchus leptonyx*), with remarks upon the microscopic anatomy of some of the organs: Scottish National Antarctic Expedition. The fœtus investigated had attained about one-third of its intrauterine development, and was 122 mm. in length. The flippers were well formed, as also the nostrils and eyelids. Points of special interest were described in connection with the cerebellum, the heart, the position of the cæcal diverticulum, and the pituitary gland. The placentation of the seals resembled that of the cat or dog, the placenta being of the zonary type. A general survey of the developmental aspects indicated that certain organs of brain, internal ear, and pituitary were, comparatively speaking, more advanced than the same organs of the three-months human fœtus. Further investigation, more especially of the earlier stages, would be of great interest in connection with the pituitary gland and the kidney, the latter organ being of the type in which separate renal pyramids are met.

March 2.—Sir E. A. Schäfer, vice-president, in the chair.—Sir Thomas **Oliver** and T. M. **Clague**: Electrolytic method of treatment for blood poisoning.—Sir William **Turner**: The aborigines of Tasmania. Part iii. The hair of the head compared with that of other Ulotrichi, and with Australians and Polynesians. The paper consisted of a detailed examination of ulotrichous hair—that is, woolly or frizzly hair—as it is found in various African races, in the aborigines of Tasmania, New Guinea, and the Melanesian Islands, and in the Negritos of the Malay Peninsula, etc. The comparison was based upon the author's observations and measurements of the specimens which formed the collection in the anatomical museum of the University of Edinburgh, a collection which had been made over a number of years for the purposes of anthropological study.

MANCHESTER.

Literary and Philosophical Society, March 10.—Mr. Francis Nicholson, president, in the chair.—Prof. Edmund **Knecht** and Miss Eva **Hibbert**: *l*-Pimaric acid from French rosin. The authors described a method of obtaining lævo-pimaric acid from French rosin in a chemically pure state and in considerable bulk. Further, the composition, molecular weight, and the more important physical constants of the acid have been determined. The acid appears to be a derivative of the terpene or the camphene series. If treated for some time to the temperature of the boiling point of aniline (183° C.) the acid is converted into an anhydride resembling ordinary rosin in appearance. On dissolving this in alcohol or glacial acetic acid hydrolysis ensues, and an optically inactive (racemic) acid is obtained, possessing the remarkable

property of showing in benzene or alcohol solution molecular weight of its optical isomer. The racemic compound can be resolved into its optically active components by means of *d*-tetrahydroquinaldine.—R. F. **Gwyther**: The specification of stress. Part iv., The elastic solution, the elastic stress relations, question of stability, struts, ties, and test-pieces. The author proposed a general dynamical solution of the elastic problem, but admitted that there are special cases. Certain hypotheses are made in the solution which from the dynamical point of view seem reasonable. Treating the statical case, the solution is found without the necessity of employing these hypotheses. If the statical result is a special case of the general dynamical result no question arises. But on introducing time-factors into the statical solution, the question arises whether the dynamical equations are generally satisfied, whether they are satisfied in some special way or whether they cannot in any circumstances be satisfied by the variation of the statical solution. The relations of stresses when all direct reference to strains is eliminated is considered, and it is shown how each element of stress can be represented in terms of the invariant of the three longitudinal stresses.

March 24.—Mr. Francis Nicholson, president, in the chair.—Faunal survey of Rostherne Mere, Cheshire. (1) Dr. W. M. **Tattersall** and T. A. **Coward**: Introduction and methods. The authors gave an account of the formation of the mere and its physical characteristics, pointing out that the mere was a dissolution basin formed as the result of subsidence of the earth's surface, consequent on the action of underground water in dissolving and carrying away rock-salt from the underlying strata. Accounts of the temperature of the lake and of the chemical composition of the water were given.—(2) R. S. **Adamson**: Preliminary account of the flora. A description of the marginal vegetation of the lake.—(3) T. A. **Coward**: Vertebrata. A list was given of the vertebrates which occurred in and round the mere. The author included only those vertebrates which were in one way or another influenced by the presence of the water, and were therefore factors in the ecology. Five mammals, seventy-six birds, and eleven fish were enumerated.—(4) A. W. **Boyd**: Preliminary list of lepidoptera. One hundred and forty-four species, found by the author during the last three years, were recorded. Three species were new to the Cheshire list. The tendency towards melanism, as is usual in the north of England, was noted in a number of species.

PARIS.

Academy of Sciences, March 23.—M. P. Appell in the chair.—A. **Haller** and Ed. **Bauer**: Syntheses by means of sodium amide. The preparation of allyl ketones derived from the alkylacetophenones and pinacoline. It has been shown in a previous paper that the interaction of sodium amide, iodide or bromide of allyl, and acetophenone does not give allylacetophenones but only condensation products. With mono- and di-alkylacetophenones, however, the reaction goes normally, and allyl derivatives are formed. Details of numerous examples of this reaction are given.—Paul **Sabatier** and A. **Mailhe**: The use of manganous oxide for the catalysis of acids. The preparation of fatty and aryl ketones. The oxides of calcium or of iron, although giving satisfactory results in many cases, do not give satisfactory yields of ketones from *iso*butyric and *iso*valeric acids. A study of various oxides from this point of view has shown that manganous oxide, MnO, acts well as a catalyst, is not expensive, preserves its catalytic properties nearly indefinitely, and can be utilised for the production of aldehydes as well as ketones. The vapours of the acids are carried over a 60 cm. column of the MnO maintained at a temperature of 400° to 450° C. Numerous examples of the excellent yields obtained are given.—A. **Lacroix**: The laterites of Guinea.—Charles **Moureu** and Adolphe **Lepape**: Crude nitrogen (nitrogen and rare gases) in natural gas mixtures (see p. 120).—R. de **Forcrand**: Potassium tetroxide. The pure K_2O_4 has been prepared by two methods, and its thermochemical constants determined. The results are compared with those previously obtained for rubidium and cæsium.—A. **Calmette** and A. **Mézie**: The treatment of epilepsy by snake poison. The snake poison used was extracted from *Crotalus adamanteus*, injected in gradually increasing doses. The number of fits per annum was reduced in all the cases detailed, and this improvement was maintained after the treatment was stopped.—Lucien **Godeaux**: Involutions having only a finite number of points belonging to an algebraical surface.—M. **Gunther**: The general theory of systems of partial differential equations.—E. **Baticle**: The partial differential equations of the limiting equilibrium of a sandy mass, comprised between two surfaces of rectilinear profile.—Louis **Benoist** and Hippolyte **Copaux**: Application of the laws of transparency of matter to the X-rays to the determination of some contested atomic weights. The case of beryllium. The transparency of beryllium to X-rays corresponds to the atomic weight 9·1.—Georges **Claude**: The absorption of gases by carbon at low temperatures (see page 120).—A. **Leduc**: The density and atomic weight of neon. Eighteen litres of neon containing some helium and nitrogen as impurities were purified by treatment with charcoal cooled with liquid air. The density found was 0·696, or nearly 3 per cent. higher than the value found by Ramsay and Travers (0·674). From this is deduced that the atomic weight of neon is exactly twenty times that of hydrogen, or 20·15 for O = 16.—Jean **Bielecki** and Victor **Henri**: Contribution to the study of tautomerism. The quantitative study of the absorption of ultra-violet light by the derivatives of acetoacetic acid.—L. **Moreau** and E. **Vinet**: A method of determining traces of arsenic of the order of a thousandth of a milligram. The method is based on the production of a silver mirror in a small glass U-tube containing silver nitrate.—Mil. Z. **Iovitchitch**: The absorption of carbon dioxide from the air by chromium hydroxide.—A. **Joannis**: The constitution of potassium carbonyl. By the controlled action of water vapour upon the compound KCO obtained by the interaction of potassium and carbon monoxide, glycollic acid was obtained, according to the reaction,

$$K.CO-CO.K+H_2O=CH_2.OK-CO.OK.$$

—Félix **Bidet**: The hydrates of the primary amines. Normal and *iso*amylamines and *iso*butylamine combine with water vapour from the air and form well-crystallised hydrates, fusible below 100° C., and possessing high vapour pressures.—Const. A. **Ktenas**: The petrographical relations existing between the island of Seriphos and the neighbouring formations.—J. L. **Vidal**: The adaptation of the vine to the different conditions of life created by pruning at different periods and its consequences on the evolution of the reserve carbohydrates.—M. **Marage**: The action on certain organisms of an artificial current of water. An account of some experiments with the divining rod, in which the flow of water was controlled. For water flowing in pipes the experiments failed, as the person holding the divining twig was unable to detect the flow of water with certainty.—H. **Coutière**: The "ocular tubercles" of podothalmic Crustacea.—P. **Benoît**: The formation of the gonophore in *Tubularia indivisa*.—Bernard **Collin**: The involution forms of ciliated Infusoria in the renal organ of a Cephalopod.—Theodor

Mironescu: The action of some pharmaceutical substances on the development of experimental cancer.—A. **Blanchet**: The activity of the lipodiastase of castor oil seeds at a low temperature. Although the diastatic activity is reduced by lowering the temperature it is not entirely suppressed at −5° C.—L. **Cavel**: The transportation of micro-organisms into the atmosphere by the pulverisation of polluted water. The sprays in actual use in connection with bacterial beds for the treatment of sewage give up organisms to the surrounding air, and may be a source of danger in time of epidemics.—Em. **Bourquelot** and M. **Bridel**: The biochemical synthesis of the β-monoglucoside of glycol with the aid of emulsin.—Paul **Durandin**: The possible existence of oil-bearing strata in French Indo-China.—F. **Jadin** and A. **Astruc**: Manganese in some springs of the Vosges *massif*.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part 4 for 1913, contains the following memoirs communicated to the society:—

May 24.—G. **Angenheister**: The velocity of propagation of magnetic disturbances and pulsations (report on the instantaneous records of terrestrial magnetism in Apia (Samoa), Batavia, Cheltenham, and Tsingtao in September, 1911).

June 21.—H. **Bohr**: The significance of power-series of an indefinitely large number of variables in the Dirichlet series, $\Sigma a^n/n^s$.—O. **Faust**: The internal friction of fluids under high pressure.

July 7.—A. **Peter**: Injuries to forest-trees by lightning-stroke over large areas.

July 19.—C. **Carathéodory**: Boundary-adaptation in conformal representation.—L. **Föppl** and P. **Daniell**: The kinematics of Born's rigid body.

August 23.—B. **Meese**: Some observations on the optical constants of potassium and sodium.

November 1.—L. **Bieberbach**: A theorem of Carathéodory.—O. **Mügge**: Shearing-deformations in phosgenite and galena.—R. von **Mises**: The mechanics of solid bodies in the plastic-deformable condition.—G. **Tammann**: The discrimination of racemism from pseudo-racemism.

BOOKS RECEIVED.

Descriptive Geometry. Part i. Lines and Planes. By J. C. Tracy. Part ii. Solids. By H. B. North and J. C. Tracy. Pp. ix+126. New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

The Horticultural Record. Compiled by R. Cory. Pp. xv+500+plates. (London: J. and A. Churchill.) 42*s*. net.

Die Welt der Kolloide. By Dr. H. Leifer. Pp. 121. (Leipzig: P. Reclam, jun.) 80 pfennigs.

Papers and Proceedings of the Royal Society of Tasmania for the Year 1913. Pp. 337+xxii plates. (Hobart: Tasmanian Museum.) 15*s*.

Table Auxiliaire d'Intérêts Composés. By A. Trignant. Pp. viii+21. (Paris: Gauthier-Villars et Cie.) 2 francs.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 74 and 75. (Jena: G. Fischer.) 2.50 marks.

Die mathematischen Wissenschaften. Unter leitung von. F. Klein. Zweite Lief., Die Beziehungen der Mathematik zur Kultur der Gegenwart. By A. Voss. Die Verbreitung mathematischen Wissens und mathematischer Auffassung. By H. E. Timerding. Pp. 161. (Leipzig und Berlin: B. G. Teubner.) 6 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 41. (Jena: G. Fischer.) 5 marks.

Geological Survey of Alabama. Monograph 8. Economic Botany of Alabama. Part 1. Geographical Report. By R. M. Harper. Pp. 228+plates. (Alabama.)

Antarctic Penguins. By Dr. G. M. Levick. Pp. x+140+plates. (London: W. Heinemann.) 6*s*. net.

University of California Publications in Geography. Vol. i., No. 4. The Rainfall of California. By A. G. McAdie. Pp. 127–240+plates. (Berkeley, Cal.)

Eugenics Record Office. Bulletin 10*a* and 10*b*. The Scope of the Committee's Work. By H. H. Laughlin. Pp. 64. The Legal, Legislative, and Administrative Aspects of Sterilization. By H. H. Laughlin. (Cold Spring Harbour, Long Island, New York.) 20 cents and 60 cents respectively.

The South African Institute for Medical Research. Memoir No. 1. An Enquiry into the Etiology, Manifestations, and Prevention of Pneumonia amongst the Natives on the Rand, Recruited from Tropical Areas. By G. D. Maynard. Pp. 101+xi charts. (Johannesburg: South African Institute for Medical Research.) 5*s*.

Proceedings of the Rhodesia Scientific Association. Vol. xii. Containing Papers Read During 1912–13. Pp. 161. (Bulawayo.)

Nature and the Idealist. By H. D. Shawcross. Pp. xii+186. (London: Sampson Low and Co., Ltd.) 5*s*. net.

Some Minute Animal Parasites or Unseen Foes in the Animal World. By Dr. H. B. Fantham and Dr. A. Porter. Pp. xi+319. (London: Methuen and Co., Ltd.) 5*s*. net.

A Third Year Course of Organic Chemistry. The Heterocyclic Compounds, Carbohydrates, and Terpenes. By Dr. T. P. Hilditch. Pp. xii+411. (London: Methuen and Co., Ltd.) 6*s*.

Sumer is icumen in. By Dr. J. B. Hurry. Second edition. Pp. 53. (London: Novello and Co., Ltd.)

Structural Geology. By C. K. Leith. Pp. viii+169. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

A Flora of Norfolk, with Papers on Climate, Soils, Physiography, and Plant Distribution, by Members of the Norfolk and Norwich Naturalists' Society. Edited by W. A. Nicholson. Pp. vii+214+2 maps. (London: West, Newman and Co.) 6*s*.

Life and Human Nature. By Sir B. Fuller. Pp. xii+399. (London: J. Murray.) 9*s*. net.

Le Hasard. By Prof. E. Borel. Pp. iv+312. (Paris: F. Alcan.) 3.50 francs.

The Origin of the World. By R. McMillan. Pp. xiii+136. (London: Watts and Co.)

Guide to the Geology of the Whitby District. By L. Walmsley. Pp. 37. (Whitby: Horne and Son.) 1*s*. net.

Grundzüge einer chemisch-physikalischen Theorie des Lebens. By Dr. H. Lundegårdh. Pp. v+63. (Jena: G. Fischer.) 2 marks.

Ueber die Bedingungen der Gebirgsbildung. By Dr. K. Andrée. Pp. viii+101. (Berlin: Gebrüder Borntraeger.) 3.20 marks.

Memoirs of the Geological Survey of India. Palæontologia Indica. New series. Vol. v. Memoir No. 1. Triassic Faunæ of Kashmir. By Dr. C. Diener. Pp. 133+xiii plates. (Calcutta: Geological Survey; London: K. Paul and Co., Ltd.) 4*s*. 4*d*.

The Synthetic Use of Metals in Organic Chemistry. By A. J. Hale. Pp. xi+169. (London: J. and A. Churchill.) 4*s*. 6*d*. net.

Modern Steel Analysis. By J. A. Pickard. Pp. viii+128. (London: J. and A. Churchill.) 3*s*. 6*d*. net.

School Lighting. By E. H. T. Nash. Pp. 28. (London: J. and A. Churchill.) 1s. net.

Die Mechanik des Geisteslebens By. Prof. M. Verworn. Pp. 92. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Tasmanian Bryophyta. Vol. i. Mosses. By L. Rodway. Pp. 163. (Hobart: Royal Society of Tasmania.) 5s.

Royal Society of Tasmania. The Foundation and Early Work of the Society, with Some Account of other Institutions of Early Hobart. By E. L. Piesse. Pp. 117–166. (Hobart: Royal Society of Tasmania.) 2s.

Allgemeine Ergebnisse und Probleme der Naturwissenschaft. Eine Einführung in die moderne Naturphilosophie. By Dr. B. Bavink. Pp. xiii+314. (Leipzig: S. Hirzel.) 6 marks.

Das neue Botanische Institut der Universität Innsbruck. By Prof. E. Heinricher. Pp. 18+iii plates. (Jena: G. Fischer.) 80 pfennigs.

Mysore Government Meteorological Department. Report on Rainfall Registration in Mysore for 1912. By N. V. Iyengar. Pp. xvii+49. (Bangalore: Government Press.)

Paul Ehrlich. Eine Darstellung seines wissenschaftlichen Wirkens. By H. Apolant, H. Aronson, H. Bechhold, J. Benario, and others. Pp. viii+668. (Jena: G. Fischer.) 16 marks.

DIARY OF SOCIETIES.

THURSDAY, APRIL 2.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Series Lines in Spark Spectra: Prof. A. Fowler.

ROYAL INSTITUTION, at 3.—The Progress of Modern Eugenics. II. Eugenics To-day: Its Counterfeits, Powers, and Problems: Dr. C. W. Saleeby.

CHILD STUDY SOCIETY, at 7.30.—The Nervous Child: Dr. L. Guthrie.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Signalling of a Rapid Transit Railway: H. G. Brown.

LINNEAN SOCIETY, at 8.—Plants, Natives of Australia found growing on the Banks of the Rivers Tweed and Gala; also Seeds from Australian Wool: Miss Ida M. Hayward.—Lantern Slides of Cape Plants, mostly in their Native Habitats. Second Series: W. C. Worsdell.—Mr. W. A. Lambourn's Breeding Experiments upon *Acræa encedon*, Linn., in the Lagos District of West Africa, 1910–1912: Prof. E. B. Poulton.—Structure of the Wood of Himalayen Junipers: W. Rushton.—A Contribution to the Flora of Fiji: W. B. Turrill.—A New Amphipodan Genus and Species (Family Dexaminidæ) from New Zealand: Prof. C. Chilton.

FRIDAY, APRIL 3.

ROYAL INSTITUTION, at 9.—Further Researches on Positive Rays: Sir J. J Thomson.

INSTITUTION OF CIVIL ENGINEERS at 8.—East Stirlingshire Waterworks, and a Note on Earthen Embankments: O. I. Bell.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of North Cornwall: H. Dewey.

SATURDAY, APRIL 4.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

MONDAY, APRIL 6.

SOCIETY OF ENGINEERS, at 7.30.—The Utilisation of Solar Energy: A. S. E. Ackermann.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—By-products from Peat: F. Mollwo Perkin.—Sulphuric Acid—the Swing of the Pendulum: H. E. Armstrong.—Table of Specific Gravities of Spirits for Use with Bedford's Tables: J. N. Rakshit and S. N. Sinha.—The Viscosity of Rubber Solution: R. Gaunt.

ARISTOTELIAN SOCIETY, at 8.—*Discussion:* The Value of Logic: Dr. A. Wolf and Dr. F. C. S. Schiller.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some Famous Maps in the British Museum: J. A. J. de Villiers.

VICTORIA INSTITUTE, at 4.30.—The First Chapter of Genesis: E. W. Maunder.

TUESDAY, APRIL 7.

RÖNTGEN SOCIETY, at 8.15.—The Energy of the Röntgen Rays: Dr. R. T. Beatty.

ILLUMINATING ENGINEERING SOCIETY, at 8.—The Lighting of Railway Carriages and other Public Vehicles: E. K. Scott.

ZOOLOGICAL SOCIETY, at 8.30.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea.—XIII. Two New Species belonging to the Genera Oochoristica and Linstowia, with Remarks upon those Genera: Dr. F. E. Beddard.—The Nature of the Lateral Muscle in Teleostei: E. W. Shann.—Report on the River-Crabs (Potamonidæ) collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: Dr. W. T. Calman.—Report on the Mammals collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: Oldfield Thomas.—Notes on a Collection of East African Mammals presented to the British Museum by G. P. Cosens: G. Dollman.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Transportation Problem in Canada, and Montreal Harbour: F. W. Cowie.

WEDNESDAY, APRIL 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

GEOLOGICAL SOCIETY, at 8.—The Evolution of the Essex River System, and its Relation to that of the Midlands: Prof. J. W. Gregory.—The Topaz-bearing Rocks of Gunong Bakau (Federated Malay States: J. B. Scrivenor.

THURSDAY, APRIL 9.

CONCRETE INSTITUTE, at 7.30.

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