THURSDAY, AUGUST 4, 1910.

CHRISTIAN TOPOGRAPHY.

The Christian Topography of Cosmas Indicopleustes. Edited, with Geographical Notes, by E. O. Winstedt. Pp. x+376+xiv plates. (Cambridge: University Press, 1909.) Price 12*s.* 6*d.* net.

THE "Christian Topography" of Kosmas Indikopleustes is a very peculiar work. As a monument of literary style it is precious, for it shows us what terrible rubbish, what wandering and discursive twaddle, people were already writing in the sixth century, when the mental degeneration of the Middle Ages (more properly called the "Dark Ages") had hardly yet set in. As a geographical landmark it is also precious, for the author, twaddlemonger as he was, went to various parts of the East beyond the ken of the ordinary man of the time, and his descriptions of the Somali coast, of Coromandel, and of Ceylon, which he apparently visited himself, in the sixth century, are in the highest degree interesting and valuable. Finally, as a work of unintentional humour, it is beyond price. Of course, the humour of it would not be apparent to all, and it is perhaps irreverent (to the sixth century, which is now somewhat venerable) to direct the reader's attention to this feature of this peculiar work. Yet, since the editor himself indulges in a hearty laugh over the poor old "Christian Topographer," perhaps the reviewer may be allowed to do so too. At any rate, he sins in the most authoritative company, and if the editor treats his subject (as Mr. Winstedt does) something after the style of Mark Twain and the Yankee at the Court of King Arthur, the reviewer must not be censured if he frivolously suspects the Syndics of the Cambridge University Press of having produced a humorous book.

For, really, Mr. Winstedt's introduction to Kosmas is pitched in rather too humorous a tone. Such a quotation as "they didn't know everything down in Judee" (p. 15) is a fault of taste, and one can imagine the bewilderment of a French or German scholar at such an unintelligible sentence as "when he can momentarily get free from the obsession of his King Charles' head—the 'great cosmographer Moses'"! (p. 9). Mr. Winstedt presumably intended this book to be of use to international science, but if so, why has he so ill-advisedly interlarded his otherwise most learned and interesting introduction with comic relief only comprehensible to Englishmen or Americans who know their Dickens and Mark Twain?

Kosmas is funny enough of himself without any editorial attempt to make him funnier by means of jarring modern jests, and Mr. Winstedt may be permitted to enjoy, as he does without spoiling things, the good man's explanation of why the Creation took six days when the Deity could *ex hypothesi* have done it at a single *coup* if He had liked; the reason is that the angels were such weak-minded creatures that if He had created everything all at once they would not have understood it at all, so He took six days about it for their sake, in order that they might fully comprehend how it was done. This, of course, in all seriousness and devoutness. But it shows how weak-minded people were themselves already becoming as early as the sixth century. To a civilised man of three centuries before, the idea would have seemed as comic as it does to us.

The stupidity of the Dark Ages is already in full blast in the mind of Kosmas the Indian-farer.

"What scholar (as the editor quotes from Marion Crawford's 'With the Immortals') has not laughed at the idea of Kosmas, the Alexandrian, that the sun retired behind a mountain to spend the night? And that the earth, the ocean, and the fabulous mountain were all included and enclosed in a luminous oblong box of the exact shape of the tabernacle of Moses?"

He undoubtedly had Moses "on the brain" (though we demur to the use of the expression "King Charles' head" in a scientific work); for him Moses was the "great cosmographer." Religious preconceptions and misunderstood texts were jumbled up in his mind with fragments of the old knowledge and the results of his own travel experiences to produce this extraordinary farrago which he called "Christian Topography," a title which, as the editor says, is excellent, "as it cannot possibly convey any particular meaning to anybody." Photius calls the book a commentary on the Octateuch. It

"might as well be called that as anything else, since Cosmas quotes and comments on a considerable portion of the Octateuch. That, however, was not the main object of his work. His intention was to refute the theory that the earth was round, and to prove that Moses' tabernacle in the wilderness was a model of the universe."

This was his theory, which he illustrated from his own travels, and it is the account of the travels that forms the serious interest of the book to us nowadays as giving a most interesting account of the East in the sixth century, and invaluable information as to the geographical ideas of the time. Kosmas observed the habits and customs of the peoples he visited, and noted the animals and plants of their countries, with care. He also drew pictures of the latter, in which undoubtedly he gave some freedom to his imagination. These pictures, copied and re-copied, have come down to us in the later MSS. of his book, no doubt, somewhat changed *en route*, but still characteristic. Several of them are reproduced by Mr. Winstedt. The picture of a man picking coco-nuts (plate xiv) is especially interesting. Pictures of his weird conception of the universe are, of course, given (plate vi), and the diagram by which he sought to throw contempt upon the horrid theory of Antipodes. The way in which the men of the Middle Ages resolutely set themselves to abjure and ban the theory of spherical worlds, which their civilised ancestors had already promulgated, is curious and characteristic. Kosmas quotes Scripture at length against the wicked pagans who believe in a round world, and his further quotation from Athanasius's "Festal Letters" in support of the current Christian view has chanced to be the means of preserving to us almost all that survives of the Greek text of that work.

Another thing of value that has been preserved in

the "Christian Topography" is the text of two important historical inscriptions which he copied at Adulis, the modern Zulla. One of these was set up by officers of Ptolemy Euergetes, and commemorates that great king's conquests in the East; the other was added by a local king of the Axumite dynasty, probably in the second century A.D., to chronicle his conquests in Abyssinia. Historians have to be grateful to the "Christian Topographer" for the preservation of these two documents, and also for the valuable information which he gives us here and there as to the history of his own time. Thus he copied the Adulite inscriptions at the request of Asbas, the Axumite governor, who had been ordered to send copies of them to his master, King Ellatzbaas, who was just then about to set out on his famous expedition to Arabia against Dhu Nuwâs, king of Himyar, which was so brilliantly successful. This was about the year 525 A.D. He gives us also invaluable information as to the great spread of Christianity in the East by the sixth century, especially in Persia and India.

The book, therefore, was fully worthy of an adequate English edition, and, having made our *caveat* as to certain blemishes in dealing with the comic side of the subject, we can say that the editor has done his work well, especially, no doubt, upon the textual side.

TROPHOBLAST AND THE EARLY DEVELOPMENT OF MAMMALS.

Die Säugetierontogenese in ihrer Bedeutung für die Phylogenie der Wirbeltiere. By Prof. A. A. W. Hubrecht. Pp. v+247. (Jena: Gustav Fischer, 1909.) Price 7 marks.

IT is now twenty years since Prof. Hubrecht published, in the pages of the *Quarterly Journal of Microscopical Science*, his classic researches on the trophoblast and allantoic placenta of the hedgehog, *Erinaceus europaeus*. This work, along with the investigations of Eduard van Beneden and M. Duval, may be said to have revolutionised our knowledge of the placental phenomena in the mammalia. By it new light was thrown on the egg-cleavage, the so-called gastrulation, and, especially, on the mode of origin and the nature of the "fœtal membranes," the chorion (trophoblast), amnion, and allantoic placenta. For the Dutch investigator this was the starting-point of a long period of painstaking researches into the placental conditions of diverse mammals, and of these the present work is an author's translation of the English version, published (November, 1908) in the journal containing his earlier results.

So long ago as 1894, under the title "Spolia nemoris," an appetising account was given of the wonderful array of material of mammalian development, which, in the Dutch East Indies, had either been collected personally or obtained and sent to Utrecht by others. We do not recall any similar journey in quest of embryological material which has been attended by such remarkable success in enlisting, and retaining, the altruistic help of so many different collectors. Other embryologists remember, to their sorrow, the failure of attempts to increase their collections by the aid of others and amateurs. This vast material, much of it of rare and interesting species of mammals, has served as the basis of Prof. Hubrecht's researches, and with great generosity he has placed it at the service of other investigators in the Zoological Institute of Utrecht. The limits of space assigned to this notice allow only a general reference to the work before us.

What is *trophoblast?* The word and the thing may be described as the main theme of the work, even though it treats also of the egg-cleavage, germinal layers, allantoic placenta, and the descent of mammals. According to Hubrecht, trophoblast is a specialised portion of the outer layer, the epiblast, of the embryo, and he identifies it more particularly as equivalent to that portion of this layer which in amphibians, for example, forms the outer or covering layer. This latter, admittedly, takes no share in the formation of embryonic structures, and it, and trophoblast also, is regarded by Hubrecht as larval and transitory in character. On the other hand, another mammalian embryologist, Mr. Richard Assheton, has recently again urged the view that trophoblast is in reality a derivative of the inner layer or hypoblast. Apart from other considerations, this identification is, in our opinion, negatived by the circumstance that nowhere in the animal kingdom is the hypoblast known to be formed, as is the trophoblast, as a product of the first cleavages of the egg. Prof. Hubrecht's own recognition of its embryonic epiblastic nature (that it is really a part of "the embryo") seems to be disproved by his own researches on Tupaja. Of the eight products of the egg-cleavage here, seven are destined to become trophoblast, while out of the eighth the whole of the embryo, including presumably its epiblast, is unfolded. If the two foregoing objections be valid, the explanation of the nature of trophoblast must be sought elsewhere, for as yet no one has had the temerity to suggest the remaining alternative, the third germinal layer or mesoblast, as its source of origin.

The truth is, as so often happens in embryology, far too little account has been taken of physiological considerations. The trophoblast arises early in development, and never takes part in the formation of embryonic organs, but instead thereof it eats and erodes its way into the uterine wall, and in doing this it destroys the epithelial lining and much besides. If this happens to be in a tubal (oviducal) gestation, the erosion is finally through the oviduct, with sudden and often fatal hæmorrhage into the abdominal cavity. A mass of cells, trophoblast, which can do this, and in the absence of a normal embryo may become the most deadly form of cancer, chorio-epithelioma, can have no nutritive import for the embryo, as its name falsely implies, nor by any stretch of the imagination can it be assigned to either epiblast or hypoblast, for there is nothing in embryology to indicate that embryonic epiblast or hypoblast possesses this property of eroding and destroying maternal tissues. It is not intended as a reproach to the author, or in depreciation of the immense value of his published researches to science, when this lack of information on the physiological and biochemical side is insisted upon. In fine, like so much in embryology,

these researches would appear to fall short of their object in that they ignore the foundations and principles, and even the existence, of a science of stereochemistry, founded so long ago as 1860 by Pasteur for chemists—and biologists. In his two lectures "On the Asymmetry of Naturally Occurring Organic Compounds," Pasteur wrote :—

"Who can foresee the organisation that living matter would assume if cellulose were lævo-rotatory instead of being dextro-rotatory, or if the lævo-rotatory albumens of the blood were to be replaced by dextro-rotatory bodies? These are mysteries which call for an immense amount of work in the future, and to-day bespeak consideration in the science."

Trophoblast, which, by means of its intracellular ferments, pulls down the living "lævo-rotatory albumens of the blood," cannot itself be made up of such bodies, but by all the canons of stereo-chemistry must consist of dextro-rotatory ones. B.

PLANT-LIFE IN THE BALKANS.

Die Vegetationsverhältnisse der Balkanländer (Mösische Länder). By Prof. Lujo Adamović. Pp. xvi+567; with 49 plates, 11 text-figures, and 6 maps. (Leipzig: W. Engelmann, 1909.) Price 32 marks.

THIS bulky volume on the vegetation of the Balkan district is the eleventh in the series of monographs of plant geography, edited, under the title "Die Vegetation der Erde," by Profs. A. Engler and O. Drude. The district includes Servia, Bulgaria, East Rumelia, North Thracia, and North Macedonia, and the volume therefore forms a companion one to Dr. Beck von Mannagetta's account of the vegetation of the Illyrian district, comprising the western part of the Balkan peninsula, which formed the fourth volume of the same series.

In an introductory chapter, Dr. Adamović gives a sketch of the history of the botanical exploration of the Balkan territory. This began in earnest with the work of Josef Pančić on the flora of Servia (1846–88), which has been supplemented by that of numerous other botanists, especially of Dr. Adamović himself, who has worked continuously from 1890 onwards. The bibliography includes a long list of papers.

The subject-matter of the book falls under four sections. The first is a sketch of the physical geography of the area, in which chapters are devoted to the orographic, hydrographic, geognostic, and climatic conditions respectively. Climatic conditions are regulated by the position of the area under consideration, in the interior of a broad peninsula bordered only by small seas, while in the south high mountain ranges—the Rhodope system in the south-east and the Dinaric system in the south-west—hinder the approach of warm winds, and in the north the cold northern winds find a free entrance. Three climatic zones are recognised—(1) the West Mœsic, which stretches westward from the two mountain systems just mentioned, and is characterised especially by the prevalence of northerly and easterly currents; a cold winter is followed by a cool and damp spring, a fairly warm summer, and usually a warm and fairly long autumn; (2) the East Mœsic zone, to the north of the Balkan range, characterised by easterly currents and a climate similar to that of southern Russia; and (3) a southern zone, including almost the whole of East Rumelia, Thrace, the southernmost part of "Alt Servia" and North Macedonia, which has a climate approaching that of the Mediterranean region.

The second section deals with the vegetation, and is divided into three parts, in the first of which, "Œcological Factors," the author discusses the influence on the plant-life of external influences. Such are the so-called tectonic factors—disposition of land, mountain, plain, and valley, difference of exposure and the like, composition of the soil—chalk, serpentine, volcanic sand, or salt. A good deal of matter of general biological interest is included in the chapter dealing with climatic factors and the effect of many animals and plants themselves on the vegetation. The remainder of the section is an account of the various plant-formations; these are arranged under two heads, representing the two great constituents, those characteristic respectively of the Mediterranean and Central European floras. Under the former are included the "Ornus-Mischlaubwald," the mixed deciduous forest which forms a characteristic high-wood on the hilly and submontane districts of the Balkan peninsula; the diversity and abundance of its constituents render it comparable with no other European formations. Here also is the horse-chestnut-formation and the pseudo-maquis, the latter analogous to the evergreen bush-formation or maquis of the Mediterranean area, but adapted to a necessarily shorter vegetative period; the most frequent and widely distributed element of the pseudo-maquis is *Juniperus oxycedrus*, while the arborescent *Juniperus excelsa*, the box, and *Phillyrea media* are characteristic elements. These and other formations comprise the arborescent and bush vegetation, besides which is a series of steppe, rock, salt-marsh, aquatic, meadow, cultivated land, and other formations. The third and largest portion is an account of the plant-formations of a Central European type, the submontane woods of oak, sweet chestnut, and black pine, the mountain woods of fir, pine, spruce (*Picea omorica*), birch, and beech, the bush-formations, the rock, steppe, meadow, marsh, and aquatic formations, and, finally, the subalpine and alpine.

In the third section the author suggests zonal arrangements, both horizontal and vertical, of the two great type-groups of the vegetation; and in the fourth and last section attempts to trace the developmental history of the flora by a consideration of the fragmentary evidence afforded by the plant remains from successive geological strata.

A notice of Dr. Adamović's exhaustive and painstaking survey of the vegetation of the Balkan area would be incomplete without an appreciation of the plates, most of which are reproduced from photographs taken by the author. A. B. R.

MATHEMATICAL TEXT-BOOKS.

(1) *Elements of the Differential and Integral Calculus.* By Prof. A. E. H. Love, F.R.S. Pp. xiv+208. (Cambridge: University Press, 1909.) Price 5*s*.

(2) *Plane Trigonometry. An Elementary Text-book for the Higher Classes of Secondary Schools and for Colleges.* By Prof. H. S. Carslaw. Pp. xviii+293 +xi. (London: Macmillan and Co., Ltd., 1909.) Price 4*s*. 6*d*.

(3) *Elementary Projective Geometry.* By A. G. Pickford. Pp. xii+256. (Cambridge: University Press, 1909.) Price 4*s*.

(4) *A First Course in Analytical Geometry, Plane and Solid, with Numerous Examples.* By C. N. Schmall. Pp. viii+318. (London: Blackie and Son, Ltd., 1909.) Price 6*s*. net.

(1) THIS book is founded on lectures delivered by Prof. Love at Oxford to students of applied sciences. The object, both of the book and of the lectures, is to encourage the study of the Calculus amongst a wider circle than has been commonly the case hitherto. To quote from Prof. Love's preface:—

"The principles of the Differential and Integral Calculus ought to be counted as a part of the heritage of every educated man or woman in the twentieth century, no less than the Copernican system or the Darwinian theory. In order to make a beginning no previous knowledge of mathematics is needed beyond the most elementary notions of geometry, a little algebra, including the law of indices, and the definitions of the trigonometric functions."

The more difficult theorems on limits which are needed have been proved with considerable detail, but the proofs are placed in appendices so as to avoid discouraging the beginner. The most novel of these is the very complete and satisfactory discussion of the length of an arc of a circle (App. v.); but it seems a pity that the same method was not carried on (in App. vi.) to obtain the limits of $\sin\alpha/\alpha$ and $\tan\alpha/\alpha$ (as α tends to zero) instead of following the more intuitive method which is given in most text-books.

With the aim and methods of Prof. Love's book we are in hearty sympathy; our sole criticism would refer to the difficult problem of treating the logarithmic function, about which opinions will probably always differ. In conclusion, we may refer to the welcome practice of reducing definite integrals to numbers, in suitable cases, instead of stopping at analytical formulæ; it is very instructive to beginners to compare the result of such a calculation with the value found from a graph, by estimating its area roughly.

(2) The earlier part of this book is based upon lectures delivered by Prof. Carslaw to first-year pass classes, first at Glasgow and afterwards at Sydney. Very good graphs of the trigonometrical functions, direct (pp. 60–2) and inverse (pp. 205–8), including the less familiar functions, such as $\sec x$ and $\sec^{-1}x$, will be found in the book; and a set of four-figure tables is given at the end of the book. While welcoming the spread of these tables, it seems a pity that more modern tables (in tenths and hundredths of degrees) were not used instead of Bottomley's forms.

The second part of the book, on analytical trigonometry, is less completely handled, proofs of the more difficult theorems (such as the power-series for $\sin x$ and $\cos x$, the product for $\sin x$) being outlined only, without any attempt at rigorous investigations.

A few notes of difficulties may be added, in view of later editions. In discussing the limit of $\sin\theta/\theta$ as θ tends to zero (§ 92) it is assumed that the length of a circular arc is less than the sum of the tangents drawn at its extremities. Although this assumption is natural enough in a purely intuitive discussion, yet, after having given an arithmetic definition of length in §§ 89, 90, it would be only reasonable to deduce the theorem in question from the definition.

When discussing the solution of trigonometrical equations, it seems strange that no use is made of the substitution $t=\cos\theta+i\sin\theta$; and the more so since all the examples solved in the book (§ 136) can be more easily treated by this substitution than by any other.

In § 148 the convergence of the series $\Sigma a_n\cos n\theta$, $\Sigma a_n\sin n\theta$ is treated graphically by the aid of a spiral polygon. This method is interesting on account of its applications in physical optics, leading up to the graphical treatment of diffraction-integrals by a smooth spiral curve (such as Cornu's spiral); but it is not quite obvious where the geometrical discussion introduces the condition $a_n>a_{n+1}$. It would be helpful to give an algebraical treatment as well, following the classical methods of Abel and Dirichlet, from which the essential character of the condition $a_n>a_{n+1}$ is at once evident.

Prof. Carslaw's book may be heartily recommended to anyone wishing for a good knowledge of elementary trigonometry, together with a first introduction to more advanced methods.

(3) It is not easy to estimate the effect which a geometrical text-book will produce on a beginner; and we have had no opportunity of testing this particular book in actual teaching. But on a first reading the arrangement adopted seems less satisfactory than in several existing books: in a course on *projective* geometry, the method of *projection* should take a prominent part, and not be left until the last chapter in the book. There is a tendency also to give a variety of proofs of theorems which are really all special cases of one general theorem (such as Pascal's or Brianchon's), and this helps to make the book longer, without making it any easier to read.

Two details may perhaps be criticised: the idea of *involution* is introduced very early, before defining projective ranges on the same line; but in actual teaching it is generally found easier to define involution as a special type of homography. Also the pole-locus of a line with respect to a system of four-point conics is called the *nine-point* conic, instead of the *eleven-point* conic; the latter term is now generally adopted, and the reason for the change is not obvious.

It seems to us that there is some need for a book on projective geometry which makes occasional use of analytical methods—in fact, a book written more on the lines of the second half of Salmon's "Conics"—and a really useful addition would be some plates of drawings, on a fairly large scale, showing the actual construction of conics by means of pencil and ruler, in various ways.

(4) There is but little to distinguish the present

text-book from those in common use already. We note the usual unfortunate preference for the equation $y=mx+c$ to represent a straight line, instead of the homogeneous form $lx+my+n=0$. As a natural consequence, we find the equations $y=mx+\sqrt{(a^2m^2+b^2)}$, $y=mx+a/m$, for the tangents to an ellipse and parabola respectively; and we are still left to wonder why no teacher has the courage to write an elementary text-book which uses the tangential equations $a^2l^2+b^2m^2=n^2$, $ln-am^2=0$.

The chief innovation consists in a short chapter (xii., pp. 241–57) on higher plane curves, such as the cissoid, conchoid, lemniscate, cycloid, and some of the simpler polar curves; but as no Calculus is used, nearly all their more interesting properties have to be omitted, and it seems doubtful if the mere tracing of the curves is of sufficient interest to justify their introduction here. We should have preferred to see this space devoted to an extension of the chapters on solid geometry, which occupy only 30 pages, and are too brief to be of much service to beginners.

T. J. I'A, B.

SCHLICH'S MANUAL OF FORESTRY.

Schlich's Manual of Forestry. Vol. ii.: Silviculture. By Sir Wm. Schlich, K.C.I.E., F.R.S. Fourth edition, revised. Pp. ix+424. (London: Bradbury, Agnew and Co., Ltd., 1910.)

THIS book is a decided advance on the first edition of Schlich's "Silviculture," and a considerable amount of new matter has been added.

Probably the original intention of Schlich's "Manual" was to provide a text-book on the general principles of forestry adapted to the needs of Indian and Colonial forest officers. While this object is still met, the author has evidently made an effort (and we think successfully) to adapt the work better to British needs than was the case in earlier editions.

To accomplish this successfully is not perhaps the easy task many might imagine. It is true the principles of forestry are the same over all, but details in practice must of necessity vary, and climatic differences also tend to modify the relative silvicultural value of various species of trees for any country, or even for districts of a country.

The book is divided into four parts: part i. deals with what the author designates "The Foundations of Silviculture." Here we have a full discussion of such matters as climate, soils, effects of forest vegetation on locality; development of forest trees; character and composition of woods; advantages and disadvantages of mixed woods; and rules for forming pure and mixed woods. The various silvicultural systems are also described in detail.

Part ii. is concerning the "Formation and Regeneration of Woods." Fencing, soil preparation, sowing, planting, and tree nursing management are fully treated. Under this head also the various modern methods of natural regeneration are described.

Part iii. deals with the tending of woods throughout the various stages, from early youth to maturity.

Of part iv. ninety pages are devoted to a brief discussion of the silvicultural characters of British forest trees. Under the convenient title of "British Forest Trees" the author includes several recently introduced species, some of which are certainly of doubtful utility for British conditions, as, *e.g.*, American *Black Walnut* and *Black Cherry*. He wisely refrains, however, from definitely recommending such species for general planting.

The book is well illustrated. Although some of the illustrations are necessarily diagrammatic in character, they are none the less valuable to students on that account.

Schlich's "Silviculture" continues to hold its own as one of the chief standard works on the subject, and should be in the hands of all students of forestry.

J. F. A.

GENERAL BIOLOGY.

General Biology: a Book of Outlines and Practical Studies for the General Student. By Prof. James G. Needham. Pp. xiv+542. (Ithaca, N.Y.: The Comstock Publishing Co., 1910.) Price 2 dollars.

WE have long felt that if biology is ever to take the place which it undoubtedly should in our educational system, there will have to be some radical reform in the manner in which it is taught, or perhaps it would be more correct to say in the selection of those portions of the subject which are to be taught. The type-system, excellent as it is in many respects, has had far too much influence on biological curricula, and the over-specialisation in zoology and botany has resulted in a general neglect of those general principles which are the life-blood of both. Fortunately, signs are not wanting of a widespread striving towards a more rational treatment of the subject, and in this respect the Americans appear to be taking the lead. The work before us, modestly described by its author as "A Book of Outlines and Practical Studies for the General Student," strikes us as being delightfully refreshing and original. Its scope is, perhaps, almost too comprehensive. There are only seven chapters, but they are very long ones. In the first, the interdependence of organisms is illustrated by the relations between flowers and insects; galls, and the relation between ants and aphids. The second deals with the simpler organisms, illustrated by typical algæ and protozoa. The third is devoted to organic evolution, with a brief account of the animal and vegetable series and the general principles of the subject. The fourth discusses inheritance; the fifth the life-cycle; the sixth the adjustment of organisms to environment; and the seventh the responsive life of organisms.

A leading feature of the book is a set of practical exercises at the end of each chapter. These are extraordinarily varied and interesting, and well calculated to impart a real vitality to the subject, though perhaps some of them, such as the observations on the internal metamorphosis of insects, are rather too specialised.

The illustrations are excellent and to a large extent novel, and the portraits of Schultze, Pasteur, Von Baer, Linnæus, Agassiz, Darwin, Leeuwenhoek,

Mendel, and Aristotle help to keep the interest from flagging.

The author states in his preface that the book exists for the sake of the practical studies contained in it, and certainly any student who works conscientiously through these can hardly fail to acquire a very sound knowledge of the problems of general biology, and if his work in this direction is supplemented by an equally thorough study of the more special aspects of either zoology or botany his elementary biological training will leave little to be desired. A. D.

OUR BOOK SHELF.

Catalogue of British Hymenoptera of the Family Chalcididae. By Claude Morley. Pp. vi+74. (London: Printed by Order of the Trustees of the British Museum (Natural History); Longmans and Co., B. Quaritch, Dulau and Co., Ltd., 1910.) Price 3*s.* 6*d.*

SOME years ago the Entomological Society of London commenced a "General Catalogue of the Insects of the British Isles," of which, however, only six parts were published, between the years 1870 and 1876, as follows:—Neuroptera, by R. McLachlan; the Ephemeridæ, by Rev. A. E. Eaton; Hymenoptera Aculeata, by F. Smith; Hymenoptera: Chrysididæ, Ichneumonidæ, Braconidæ, and Evaniidæ: by Rev. T. A. Marshall; Hymenoptera: Oxyura, by Rev. T. A. Marshall; and Hemiptera Heteroptera, and Homoptera, by J. W. Douglas and J. Scott. No more appeared; and, of course, those already issued are now somewhat out of date, especially those on parasitic Hymenoptera, largely through the exertions of C. Morley and F. Enock. Since then, however, the Tenthredinidæ, Siricidæ, and Cynipidæ have been monographed by P. Cameron in four volumes issued by the Ray Society; leaving only the Chalcididæ, as the last family of Hymenoptera of which we had no recent compendium of the British species.

The preparation of the present catalogue was undertaken by Mr. Claude Morley, so well known for his work on the British Ichneumonidæ, and edited by Mr. C. O. Waterhouse. Though published by the Trustees of the British Museum, it is practically uniform with the Entomological Society's catalogues already mentioned.

There is little doubt that the order Hymenoptera is the largest of all the seven great orders of insects, and the Chalcididæ, including a large number of small species, almost all parasitic (a very few, however, are believed to be plant-feeders), is by far the largest family. Mr. Morley enumerates 148 genera and 1424 species; and although many of them may probably prove to be synonymous, these will probably be far more than counterbalanced by fresh discoveries when the family is at all adequately known. A great number of species were described by Walker, both in magazines and in separate publications; and to work out his species satisfactorily would be a work of many years. But the best preparation for such an undertaking is a carefully compiled and approximately complete reference catalogue, as the work before us appears to be.

How to Keep Hens for Profit. By C. S. Valentine. Pp. ix+298. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 6*s.* 6*d* net.

THIS is a well illustrated volume of some three hundred pages. A portion of the material, as the preface points out, has already appeared in the *New York Farmer*. The bulk of the work, with the exception of a chapter devoted to the Indian runner duck, deals with the breeding and management of the "American hen." The reader will have gathered that the book has been produced on the "other side," but there is much that is of interest to our own countrymen. Government aid, problems of improvement, and many amusing stories of the three-hundred-egg hen, are all dealt with, and now the development grant is in sight several of the hints given might be well worthy of consideration.

The most instructive chapters for the would-be poultry-keeper are those that deal with "Handling the Chicks," "Expensive Accidents," "Diseases," and "Runner Ducks." The book is furnished with an excellent index, and in many ways may be a useful adjunct to the library of the man who keeps poultry for utility purposes only in contradistinction to the breeder of exhibition stock.

The Prince and his Ants (*Ciondolino*). By Vamba (Luigi Bertelli). Translated from the fourth Italian edition by S. F. Woodruff, and edited by Vernon L. Kellogg. Pp. x+275. (New York: H. Holt and Co., 1910.) Price 1.35 dollars net.

A FAIRY tale of three children, who wished to become insects to escape doing their lessons. The two boys wished to be an ant and a cricket, and the girl to be a butterfly. The present volume relates the adventures of the boy who became an ant, among different species of ants, and afterwards among bees. At the end of the book he meets his sister as a caterpillar, and another volume is promised giving her adventures as a butterfly. The book is well illustrated, and the account of insect life appears to be fairly accurate.

The Thames. Described by G. E. Mitton. Pp. 56. *Windsor Castle.* Described by Edward Thomas. Pp. 56. *Shakespeareland.* Described by Walter Jerrold. Pp. 63. All pictured by Ernest Haslehurst. (London: Blackie and Son, Ltd., 1910.) Price 2*s.* net each.

IN noticing the first three volumes to be published in this series, the opportunity was taken to praise the beauty of the illustrations and the interest of the text. The present additions are quite up to the standard set in the earlier books. Though evidently not intended to serve any serious educational purpose, the volumes will form very acceptable gift books, and will soon become popular in this capacity.

A Manual of Geometry. By W. D. Eggar. In two parts. Part i., pp. xiii+160; part ii., pp. x+178. (London: Macmillan and Co., Ltd., 1910.) Price 2*s.* each part.

MANY teachers will welcome the re-issue in two parts of Mr. Eggar's "Manual of Geometry." Part i. will prove of particular value just now, since it covers the work specified in the memorandum issued by the Board of Education on the teaching of geometry to beginners. It may be said that the first part deals with the subjects of Euclid, Book i., and the second with those of Euclid, Books ii. to vi.

The South Devon and Dorset Coast. By Sidney Heath. Pp. xvi+445. (London: T. Fisher Unwin, 1910.) Price 6*s.* net.

THE latest addition to Mr. Fisher Unwin's "County Coast Series" will form a delightful companion for the visitor to the country lying between Poole on the east and Plymouth on the west. Mr. Heath's miscellany of historical, topographical, and archæological details relating to Devonshire and Dorsetshire is as informative as it is interesting, and the illustrations, which number nearly sixty, make the volume very attractive. There is little doubt that the book will become a favourite with residents in the delightful part of England with which it deals.

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.]*

X-Ray Spectra.

IT was shown by Barkla and Sadler (*Phil. Mag.*, February, 1907, and October, 1908) that many elements, when subject to a suitable beam of X-rays, emit a homogeneous beam of secondary X-rays of penetrating power characteristic of the radiating element. One of the writers (Barkla, Proc. Camb. Phil. Soc., May, 1909) showed that various groups of these characteristic radiations exist, and that each element most probably emits a line spectrum of X-rays, each line moving to the more penetrating end of the spectrum, with an increase in the atomic weight of the radiating element. For no single element, however, was the homogeneity of more than one radiation proved, or the penetrating power accurately determined. As all the principal phenomena accompanying the transmission of X-rays through matter are determined by the spectra of the constituent elements, it became a matter of considerable theoretical interest to confirm the theory by demonstrating the homogeneity of various radiations from some particular element. The writers therefore chose several of those elements the characteristic radiations of which were expected to be well within the range of penetrating power comparatively easy to experiment upon.

First, by using a penetrating primary beam, a mixture of the various secondary radiations characteristic of a particular element was obtained. After absorbing the softer constituents, a homogeneous beam of the penetrating secondary X-radiation belonging to Group B was left, its homogeneity was proved, and the coefficient of absorption in aluminium determined.

In order to isolate one of the more absorbable constituents, a very "soft" primary beam was used—too "soft" to excite the radiation of Group B just referred to. After the effect of the scattered radiation was determined by separate experiment and eliminated, this secondary X-radiation was also found to be homogeneous, and its absorption was determined. This radiation belonged to Group A.

Thus two of the lines of the spectra of antimony, iodine, and barium were determined. The following values of λ/ρ are the results of the most accurate measurements so far made (λ is defined by the equation $I = I_0 e^{-\lambda x}$ in transmission through aluminium of density ρ):—

Sb : (Group B) 1·21 ; (Group A) 435
I : (Group B) 0·92 ; (Group A) 306
Ba : (Group B) 0·8 ; (Group A) 224

A more absorbable radiation belonging to Group A has also been found to be emitted by silver in addition to the penetrating radiation of Group B, thus accounting for what appeared to Mr. Sadler (*Phil. Mag.*, March) to be an exception to the law connecting the emission of secondary corpuscular and secondary X-radiations emitted by an element.

There is indirect evidence of other spectral lines besides those of Groups A and B. Whether or not the radiation, more absorbable than that of Group A—in hypothetical Group X—has the properties of ordinary X-rays is a question to be decided experimentally.

C. G. BARKLA.
J. NICOL.

King's College, London, July 29.

Pwdre Ser.

IN case no other reader of NATURE should do so, may I direct Prof. McKenny Hughes's attention to a paper by M. Melsheimer on "Meteorgallerte," published in the *Jahresber. d. westfäl. Provinzialver. f. Wissensch. u. Kunst* (Bd. xxxvi., 1907–8, Münster, 1908, pp. 53–5), an abstract of which appeared in the *Centralblatt f. Bakteriologie* (Abt. ii., Bd. xxvii., Nos. 10–12, p. 237), published on June 22 of this year? The author appears to have paid attention to these masses of jelly, which are to be found in winter on meadows and other open places, for a period of years, and has come to the conclusion that they are the swollen oviducts of frogs. Herons eat female frogs in winter, and the oviducts become mixed in the crop with fish remains, which may become luminous. The contents are thrown up undigested, and become gelatinous when moistened. It is also possible that the heron may, during flight, discharge the gelatinous mass in a luminous condition, and hence the idea that the jelly is of meteoric origin.

GEO. H. PETHYBRIDGE.

Royal College of Science, Dublin, July 4.

THE PRESSURE OF LIGHT.[1]

THE earliest attempts to detect the pressure of light were made in the eighteenth century. The corpuscular hypothesis was then almost universally accepted, and to the believers in that hypothesis the idea that light should exert a pressure upon a body against which it fell was perfectly natural. Regarding the atoms and molecules of a luminous surface as a battery of minute guns firing off a continuous stream of still more minute shot—the corpuscles—they inevitably supposed that any body bombarded by the shot would be pressed back. Many experiments were made to detect this bombardment by directing a powerful beam of light on to a delicately suspended disc, sometimes in air at ordinary pressures, sometimes in a vacuum, but with quite inconsistent and inconclusive results. They were met with the disturbances which still beset experiments on light forces—disturbances partly due to convection in the surrounding gas, and partly due to the radiometer action which Sir William Crookes discovered and investigated a hundred years later.

According to the corpuscular theory, the pressure sought should be equal to twice the kinetic energy of translation per unit volume in the beam used. If the earlier experimenters had known the principle of the conservation of energy and the mechanical equivalent of heat, they would no doubt have measured the energy of the beam, and would then have found that the pressure to be looked for was far too minute for detection by the apparatus which they employed.

With the abandonment of the corpuscular theory and its replacement by the wave theory, the idea of pressure of light disappeared, for the form which the wave theory took at first did not suggest a pressure, and it was not until 1874 that a definite and exact theory of light pressure was given by Clerk Maxwell. According to his theory of stresses in the medium, both electric and magnetic tubes of force press out laterally. If, then, light waves consist of electric and magnetic tubes of force transverse to the direction of propagation, these tubes should press on any surface against which they impinge, and the pressure should be equal to the energy in unit volume of the light. Maxwell calculated that the pressure which should be exerted by full sunlight amounted to about 1/23000 of a dyne per sq. cm.

Twenty-five years later Prof. Lebedew succeeded in detecting and measuring the pressure. He allowed the concentrated rays of an electric lamp to fall on a thin blackened platinum disc delicately suspended in a vacuum so high that there was probably no convection, and even the radiometer action was comparatively small. By the ingenious device of using discs of different thickness with radiometer action proportional to the thickness, he was able to calculate the force acting on an infinitely thin disc on which there would

[1] Based upon the Bakerian lecture on "The Pressure of Light against the Source; the Recoil from Light," by Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, delivered at the Royal Society on March 17.

be no radiometer action. He measured the energy of the beam by its heating effect, and the mean of his results showed a pressure of very nearly the amount required by Maxwell's theory.

At the same time, Profs. Nichols and Hull were working at the subject. They used air pressures of one or two centimetres of mercury, that peculiar region of pressure where convection nearly ceases and where radiometer action has scarcely begun. They allowed the beam to fall on a silvered disc, thus obtaining a double pressure—that of the incident plus that of the reflected beam. To eliminate the action of the surrounding gas they made use of the fact that the light pressure has its full force the instant the beam falls on the surface, while the convection and radiometer actions only slowly develop as the disc gets heated. Nichols and Hull, therefore, only allowed the beam to fall on the disc for a short time—six seconds, a quarter period of the suspended system—and thus they eliminated the gas disturbances. They measured the energy of their beam by determining its heating effect, and the observed pressure was found to agree with Maxwell's theory to within 1 per cent.

When a beam of light, then, falls normally on an absorbing surface, it presses against it with a force per sq. cm. equal to the energy density. It is giving momentum to the surface at this rate. The beam is therefore a carrier of momentum. The waves of light carry momentum, momentum forward in the direction of propagation, just as surely as if they were material corpuscles; and on either theory the momentum given per second is equal to twice the *kinetic* energy per unit volume, since in the waves we may assume that the total energy is half kinetic and half potential.

If we trace back this momentum it must have been put into the train of waves at its source, at the luminous surface from which they issued. The waves are there acquiring forward momentum. The source is losing forward momentum, or is gaining backward momentum. That is, the source is being pressed back with a force per sq. cm. equal to the energy density in the issuing waves. Thus, if the total energy emitted by one sq. cm. in one second is R, and U is the velocity of propagation, we have the pressure given by

$$p=\frac{R}{U}.$$

It is here assumed that all the energy is emitted normally to the surface. If, however, the surface is emitting in all directions according to the cosine law, it is easily shown that the effect of the spreading round the hemisphere is to make

$$p=\tfrac{2}{3}\frac{R}{U}.$$

The pressure against the receiver is a proved experimental fact independent now of any particular hypothesis which we may adopt as to the nature of light; and it does not appear possible to avoid the conclusion that the momentum revealed in that pressure against the receiver was derived from the source.

The experiment which we now describe has been made to detect the starting of the momentum from the source. It should be manifested as a back pressure, a recoil of the emitting body from the light, or radiation, which it sends forth.

The most direct method would, no doubt, consist in suspending a disc black on one side, silvered on the other. Inside the disc should be a coil of wire, and this coil should be heated by a current introduced through the suspension. The heat would be given out as radiation by the black surface, and hardly at all by the bright surface, with the result that the black surface should be pushed back. But the experimental difficulties in the way of such a direct method appear insuperable. The disc was, therefore, heated by allowing radiation to fall upon it and to be absorbed. This heat issued again as radiation, and it is the back pressure of this issuing radiation that had to be detected.

The nature of the action to be looked for may be seen by considering an ideal case in which we allow a beam with energy P per cubic centimetre to fall normally in a perfect vacuum in turn on each of four discs, the front and back surfaces of these discs being respectively as in Fig. 1, where B represents a fully absorbing or "black" surface, and S a fully reflecting or non-radiating surface.

When the radiation falls on an absorbing face, as in the case of either of the discs (1) and (2), the temperature of the disc rises until a steady state is reached in which emission equals absorption. We may suppose that the discs are so thin that the two faces are sensibly at the same temperature. It we did not take into account the pressure due to issuing radiation, or if we only considered the initial effects before heating took place, the pressures on the first two discs would be P in each case, due to the incident beam alone, and on the last two would be 2P, due to the sum of the incident and reflected beams. We should have, therefore,

(1)	(2)	(3)	(4)
P	P	2P	2P

But when a steady state is reached, the discs (1) and (2) must be giving out as much radiant energy as they receive. The first disc gives out equal amounts

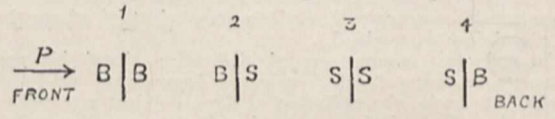


FIG. 1.

on the two sides, producing equal and opposite pressures. All the radiation from the second disc is given out at the front side, and is equal in energy to that of the incident beam. Assuming this emitted radiation is distributed according to the cosine law, the pressure resulting from it is easily shown to be $\frac{2}{3}$P, so that the total pressure on this disc is $\frac{5}{3}$P.

Since there is no absorption by discs (3) and (4), we still have the pressures 2P; hence we have now

(1)	(2)	(3)	(4)
P	$\frac{5}{3}$P	2P	2P

In a real case these results are modified in two ways:—

(1) By the possession of some small reflecting power by surface B, and of some small absorbing and radiating power by surface S.

(2) By an inequality of temperature between front and back surfaces conditioned by the energy which is carried through from front to back to be radiated thence. The vacuum is not perfect, and there is radiometer action due to the residual gas, which, owing to the inequality of temperature, is not the same on the two sides. This is probably the only way in which gas action is sensible, for the effects due to ordinary convection and conduction in the residual gas are negligible.

In the final form of the experiment each disc consisted of a pair of circular cover glasses, 1·2 cm. in diameter and about 0·1 mm. thick, between which was squeezed a layer of asphaltum also about 0·1 mm. thick, the temperature being first raised sufficiently to render the asphaltum molten. Such a compound disc appears to be perfectly opaque, and its surface is extremely black and little diffusing.

The reflecting surface was made by depositing a silver film on the outside of the compound disc by means of the discharge from a silver kathode in an exhausted receiver.

Four holes the size of the discs were cut in a plate of mica ABCD, the centres of the holes being at the corners of a 2-cm. square (Fig. 2). The discs were fixed in these holes by a minute amount of celluloid varnish. Below the mica plate were the two observing mirrors M_1, M_2. This system was suspended by a quartz fibre G, 9 cm. long, in the centre of a glass flask of 16 cm. diameter. The upper end of the quartz fibre was fixed to a brass collar H, held by friction in the neck of the flask.

The exhaustion of the flask was carried out to a very high degree, but an account of the method adopted and the precautions taken is here unnecessary. In the final stage of the process the residual gas was absorbed by a charcoal bulb kept surrounded by liquid air, which was boiled off continuously at a reduced pressure of about 2 cm. of mercury, for several hours before, and during the whole of the measurements.

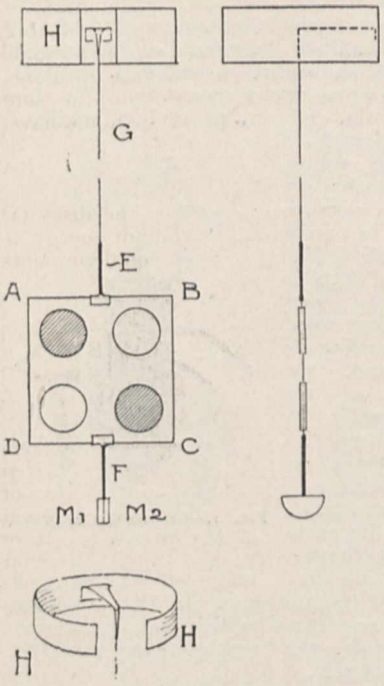


FIG. 2.

The source of light was an Ediswan 50-volt "focus lamp," which was fed from accumulators. By a suitable arrangement of achromatic lenses a uniformly illuminated image of a circular diaphragm was focussed on the disc to be worked with. The flask was mounted on a turn-table, so that by rotation through 180° experiments could be made on the reverse sides of the discs.

For reading the deflections the image of an electric lamp on a millimetre scale at a distance of 113 cm. was used, the deflection being read to 0·2 mm.

As the mean of a number of determinations we have the final values (in scale divisions) for the pressures on the four discs :—

BB	BS	SS	SB
16·1	22·3	28·7	28·0 (Observed)

A determination of the energy of the beam was made by allowing it to fall on a blackened disc of silver and observing the initial rate of rise of temperature by means of a constantan-silver thermoelectric junction soldered to the disc. The energy was found to be 33×10^{-6} ergs per cm. length of the beam used. This would be the force in dynes on a fully absorbing surface. Had the BB disc been fully absorbing the beam should have deflected it 13·6 scale divisions. Assuming that the asphaltum disc reflects 5 per cent. and the silver 95 per cent. of the incident beam—an estimate which cannot be seriously in error—it can easily be shown that the deflections of the four discs should have been :—

BB	BS	SS	SB
14·3	22·0	26·5	26·1 (Calculated)

The general agreement of these values with the observed values given above appears to afford satisfactory evidence for the existence of the recoil effect. In the case of the BB disc, however, there is a marked difference between the observed and calculated values, and this discrepancy is probably to be ascribed to residual radiometer action. There was reason to suspect that this action was not sufficiently reduced to make it quite negligible, and it was obvious that this disc should be more affected than the others by radiometer action, as the difference in temperature between the two sides of the disc is greatest in that case.

The forces due to light are so small, and the disturbances due to convection are relatively so great, that we cannot expect to find any effects due to light pressure here on the surface of the earth surrounded by a dense atmosphere. But out in interplanetary space, where the vacuum must be far higher than anything to which we can attain, the light forces may have uninterrupted play, and in the course of ages they may produce great effects; but even then only small bodies will be seriously affected. Take, for instance, a sphere; the pressure of sunlight upon it varies as the square of the radius, and the mass as the cube of the radius. Thus the acceleration produced is inversely as the radius for spheres of the same density. The whole pressure of sunlight upon the earth is only a forty-billionth part of the sun's gravitative pull. If we reduce the radius the pressure becomes more important in proportion, and on a sphere of one forty-billionth of the radius of the earth—or 16×10^{-6} cms. radius—and of the earth's density, if diffraction did not come into play, the pressure of sunlight would balance gravitation. Still smaller spheres would be pushed away.

But turning to the case of bodies somewhat larger than those in which gravitation is neutralised by light-pressure, bodies for which gravitation is still much greater than the light pressure, we will now consider an effect on them due to the pressure of radiation against the source. Let us suppose that a small spherical absorbing body is circling round the sun. It is receiving radiation from the sun on its bright half, transmuting it to heat, and then giving out this energy as radiation again all round. If the sphere is sufficiently small—say of 1 cm. diameter or less—it will be practically of the same temperature throughout, a small difference of temperature from front to back sufficing to carry through the energy which it radiates from the dark half. It virtually receives from the sun on its diametral plane, and it radiates out from its whole surface, which is four times as great. So that its rate of radiation per sq. cm. is one-fourth the solar radiation per sq. cm. passing the sphere. But we suppose that the sphere is moving round the sun. As it moves forward it crowds up the waves in front and opens out the waves behind it. It follows, then, that in consequence of the motion, the pressure is slightly greater against the radiation emitted in front, and slightly less against the radiation emitted behind. The negative acceleration, or retardation, works out to be

$$-\frac{S}{4a\rho}\frac{v}{U^2},$$

where S is the solar stream of radiation, a the radius of the sphere, ρ its density, v its velocity, and U the velocity of light. As the sphere moves against this resisting force its energy is gradually abstracted, and it tends to fall into the sun.

If a sphere 1 cm. in diameter, and of the density of the earth, is moving round the sun at a distance equal

to that of the earth, it will fall in about one mile in the first year. If it continues to describe a nearly circular spiral, it will fall in less and less each revolution, but the revolutions take less and less time, and in equal times it will fall in more and more. Such a sphere will reach the sun in something of the order of 45,000,000 years. But the rate of falling in is inversely as the radius, so that a sphere 1/1000 cm. in diameter will fall in 1000 miles in the first year, and will reach the sun in 45,000 years.

There is no doubt that there are such bodies in our system. We have clear evidence of their existence when they perish as shooting stars in our atmosphere. Also there seems no way to avoid the conclusion that they are all spiralling in to the sun and will ultimately reach him unless their career is cut short by some intervening planet. How, then, are we to account for their existence in our system to-day? Whatever limit we may assign to the age of the earth as a habitable globe, we must assign to the sun some vast number of millions of years, vast enough to have allowed him long ago to draw to himself all the specks of dust in his system. How is the supply renewed? Is interstellar space inhabited by scattered meteorites? Are they brought in by comets which have become disintegrated? And so light pressure raises once more an old and still unsolved problem.

A NEW TRYPANOSOME PARASITIC IN HUMAN BEINGS.[1]

THE terrible mortality caused by sleeping sickness in Africa, and the knowledge that this deadly disease is caused by a species of trypanosome, has directed the attention of the general public, as well as of scientific and medical men all over the world, to these blood-parasites. The frequent occurrence of trypanosomes in the blood of vertebrate animals of all classes has long been known to zoologists, but this fact was regarded as little more than a scientific curiosity until Bruce, scarcely fifteen years ago, showed that a species of trypanosome, since named after him (*Trypanosoma brucii*), was the cause of the dreaded tsetse-fly disease of domestic animals in Africa, and followed this up by his discoveries, in the present century, with regard to the nature and transmission of sleeping sickness.

No little sensation was created, therefore, when it was announced by Chagas about a year ago[2] that he had discovered a new species of trypanosome, named by him *Trypanosoma cruzi*, in human blood in Brazil. A full account of this parasite, its development, and mode of transmission, has now been published by Chagas, with numerous illustrations, and it proves to be a form no less interesting from the purely zoological than from the medical standpoint.

The manner in which this parasite was discovered is remarkable. Chagas found that in the province of Minas Geraes the houses, especially the thatched huts of the poorer classes, were infested by bugs (Fig. 1) of the species *Conorhinus megistus*, voracious blood-suckers of large size and nocturnal habits, responsible for much loss of sleep, as well as of blood, to the unfortunate inhabitants. Some of these bugs were collected and brought to Rio de Janeiro, where they were dissected and examined in the laboratory of the Instituto Oswaldo Cruz, and were found to contain in their digestive tracts numerous flagellate organisms resembling in form and structure the genus Crithidia. When such bugs were allowed to feed on experimenta animals, namely, marmosets (*Callithrix penicillata*) and guinea-pigs, they infected them with trypanosomes, to the effects of which the marmosets succumbed in about two months, the guinea-pigs in five to ten days. After this surprising result, Chagas returned to Minas Geraes and examined the blood of human beings in the zone infested by the bugs, and found several cases of human beings infected with similar trypanosomes. Thus the course of the discovery of this parasite has been the exact opposite to that of the progress of our knowledge of sleeping sickness; there the disease was thoroughly known long before it was found to be caused by a trypanosome, then the mode of transmission was discovered, and the complete life-cycle of the parasite has not yet been worked out; here the transmitting insect was first known, then the parasite itself was discovered, and, last of all, it was found to occur in human blood, with the result that the life-cycle of the trypanosome has been investigated in considerable detail, but very little is known of its effects in their clinical aspect.

The few cases of infected human beings observed by Chagas have not been followed out by him to their end as yet. He finds the effects of the parasite to be most marked, however, in children, amongst whom it appears to cause severe mortality. The chief symptoms are anæmia, œdema, general or localised, enlargement of the lymphatic glands and of the spleen, and functional disturbances, especially of the nervous system, leading in some cases to imbecility. A tendency to arrest of development, resulting in pronounced infantilism, was also noticed. According to information collected, the fatal termination of the disease was frequently attended by convulsions, regarded locally as the cause of death, and sometimes by dropsy in the last stages.

FIG. 1.—*Conorhinus megistus*, Burm., ♀.

The life-cycle of the parasite, as described by Chagas, shows some peculiarities not yet known in any other species of trypanosome. In the vertebrate host it exhibits three phases, which may be termed conveniently the adult, the multiplicative, and the growth phase respectively.

In the adult phase, the organism is free in the blood-plasma, and has the typical trypanosome-structure (Fig. 2, *a*). It shows, however, a dimorphism which Chagas regards as sexual. One form, regarded as male, is more slender, with a larger kinetonucleus and a more elongated trophonucleus; the other, regarded as female, is broader, with smaller kinetonucleus and rounded trophonucleus.

These adult trypanosomes in the peripheral blood were never observed to multiply by fission, a fact which the author seems to consider remarkable, doubtless from the standpoint of studies upon pathogenic trypanosomes, though it may be pointed out that the same is true of the common trypanosomes of vertebrate animals, especially those of birds and fishes. Chagas has discovered that the multiplication takes place by a process of multiple fission or "schizogony" in the lung. Hence he founds provisionally a new genus, Schizotrypanum, for this species. It remains to be seen how far such schizogony is peculiar to this parasite. The only salient difference between the multiple fission of *Schizotrypanum cruzi* and that of the common *Trypanosoma*

[1] "Nova tripanosomiaze humana." By C. Chagas. Memorias do Instituto Oswaldo Cruz I., 1909. Pp. 159-218; plates ix-xiii and 10 text-figures. (Portuguese and German text.)

[2] See the Bulletin of the Pasteur Institute for May 30, 1909, p. 453.

lewisi of rats, is that in the latter the flagellum is retained, as a rule, and in the former is always lost, during the process. In *S. cruzi* there appears to be an alternation between periods of multiplication with schizogony in the lungs, with adult free trypanosomes occurring sparingly in the blood, and periods in which the peripheral blood contains numerous trypanosomes. In the case of experimental animals, it was found, as a rule, that at the time of death trypanosomes were very scanty in the blood, while schizogony was proceeding actively in the lung.

The trypanosome, when about to undergo multiplication, first throws off the flagellum and undulating membrane; it may or may not lose its kinetonucleus at the same time. It then curls up (Fig. 2, *b*), and contracts into a rounded mass, the schizont (Fig. 2, *c*), after which the trophonucleus and the kinetonucleus, also, if present, divide each three times to form eight small nuclei of one or both kinds (Fig. 2, *d*). The protoplasmic body then divides up within its own skin (periplast) into as many parts, termed by Chagas merozoites (Fig. 2, *e*). Each merozoite contains either a single trophonucleus, or a kinetonucleus in addition. The generation with a persistent kinetonucleus is regarded by Chagas as male, that without

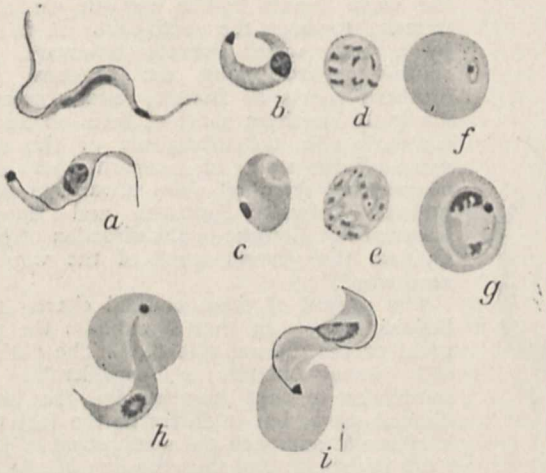


FIG. 2.—*a–i*, Phases of *Schizotrypanum cruzi* in vertebrate blood. *a*, the two forms of the adult trypanosome, "male" (upper) and "female" (lower), from human blood; *b*, preparations for schizogony; *c*, schizont; *d*, division of the nucleus of the schizont; *e*, division of the schizont into eight merozoites; *f*, merozoite in a blood-corpuscle; *g*, intra-corpuscular phase in late stage of growth; *h*, similar phase escaping from the corpuscle, the flagellum not yet formed; *i*, similar phase, the flagellum in process of formation.

any such body as female. Although the author insists on interpreting these and other differences as sexual, it should be noted that no sexual behaviour has been observed in any part of the life-cycle of the parasite.

The tiny merozoites are stated to escape singly from their envelope and to penetrate into red blood-corpuscles (Fig. 2, *f*), in which they grow into the adult form (Fig. 2, *g*, *h*). In those merozoites which are without a kinetonucleus, this body arises by division of the single nucleus present. The flagellum and undulating membrance appear to be formed when the organism is full-grown, sometimes not until it has escaped from the blood-corpuscle (Fig. 2, *h*, *i*). It is remarkable, however, that Chagas does not figure any intracorpuscular phases intermediate in size between the very smallest and those which are practically full-grown; and it must be said that many of his figures of the later growth-phases are not at all convincing as to the parasite being really within the corpuscle. With completion of growth and liberation from the corpuscle, the adult phase of the free trypanosome is reached.

On the ground that *Schizotrypanum cruzi* differs from all known trypanosomes in undergoing multiplication by schizogony, and in the possession of an intracorpuscular phase, Chagas regards it as a form connecting the trypanosomes and the Hæmosporidia (malarial parasites and allied forms), and supporting the union of these two groups in systematic classification. This view raises questions which cannot be discussed in a brief space.

By experiments on the transmission, Chagas found convincing evidence that the parasite goes through a developmental cycle, with a minimum duration of eight days, in the bug. Until this cycle is complete the bug is not infective. It is a point of great interest that, while bugs collected in human dwellings and bugs fed in the laboratory on infected marmosets transmitted the infection, he was never able to render bugs infective by feeding them on infected guinea-pigs. Chagas is of opinion that a certain condition of the parasite is necessary to produce infectivity in the bug, and that the requisite conditions are furnished by the blood of human beings or marmosets, but not by that of guinea-pigs. Experiments to prove transmission of the parasite through the egg of the bug gave entirely negative results in all cases.

Phases in the development of *Schizotrypanum cruzi* in the invertebrate host are described by Chagas from bugs bred in the laboratory and fed on infected animals. The parasites begin to undergo a change in the stomach of the bug about six hours after feeding (Fig. 3, *a*, *b*, *c*); they lose their flagellum and contract into rounded forms which multiply actively by fission (Fig. 3, *d*). After a period of multiplication, the rounded forms become pear-shaped, and develop a flagellum at the pointed end (Fig. 3, *e*, *f*); thus are produced flagellates of the Crithidia type (Fig. 3, *g*, *h*), which pass on from the stomach into the intestine, and there multiply rapidly by fission. As a result, the intestine becomes peopled by a swarm of crithidial forms, the characteristic condition of the infected bug. In a few instances Chagas found trypanosome-like flagellates in the body-cavity and the salivary glands (Fig. 3, *i*), and he regards these trypaniform individuals as the last phase in the development of the parasite in the bug, that is to say, as the form in which the parasite is inoculated into the vertebrates by the invertebrate host.

It should be noted here that the three principal forms which the parasite assumes in the bug, namely the rounded, crithidial, and trypaniform types, are found by Chagas to occur also in artificial cultures on blood-agar, and to succeed each other in the same order. This parallelism indicates that these forms represent the natural developmental cycle of the parasite in the invertebrate host; that the rounded and especially the crithidial forms represent the multiplicative phase whereby the parasite establishes itself in the bug, while the trypaniform individuals represent the propagative phase destined to infect new hosts. Chagas, however, interprets the facts observed in a different manner. He regards the crithidial forms as the end-product of an atavistic degeneration of the parasite, a mere culture-phase which does not develop further, and is of no importance for the transmission to the vertebrate host and the continued propagation of the parasite. On the other hand, he attaches great importance to two forms observed by him in the bug but not found in the artificial cultures, namely, encapsuled forms (Fig. 3, *j*), which he believes to represent zygotes, although no conjugation has been observed, and certain forms which he interprets as

schizogony in the intestine of the bug. According to Chagas, the true infective cycle of the parasite in the bug is comprised in four stages :—(1) the encapsuled "zygotes"; (2) the schizogony-forms; (3) the trypaniform individuals in the body-cavity; and (4) the similar forms in the salivary glands. I feel it incumbent upon me to state that in my opinion the encapsuled forms are merely resting stages of rounded or crithidial forms, the interpretation of which as zygotes is a pure assumption, and that the so-called schizogony-forms have nothing at all to do with the life-cycle of Schizotrypanum, but appear to be merely parasitic organisms of the nature of yeasts from the intestine of the insect. In justice to the author, however, it should be mentioned that he does not regard his observations on the life-cycle in the invertebrate as in any way final, and considers that many points remain to be further investigated.

The memoir of Chagas contains a great number of very interesting observations to which space does not permit of further reference. We may direct attention especially to his experiments on the variations in the virulence of the parasite as the result of passage through different vertebrate hosts. The whole work is an exceedingly important contribution to our knowledge of the trypanosomes, and we desire to congratulate both the author and the Instituto Oswaldo Cruz on a great achievement. E. A. MINCHIN.

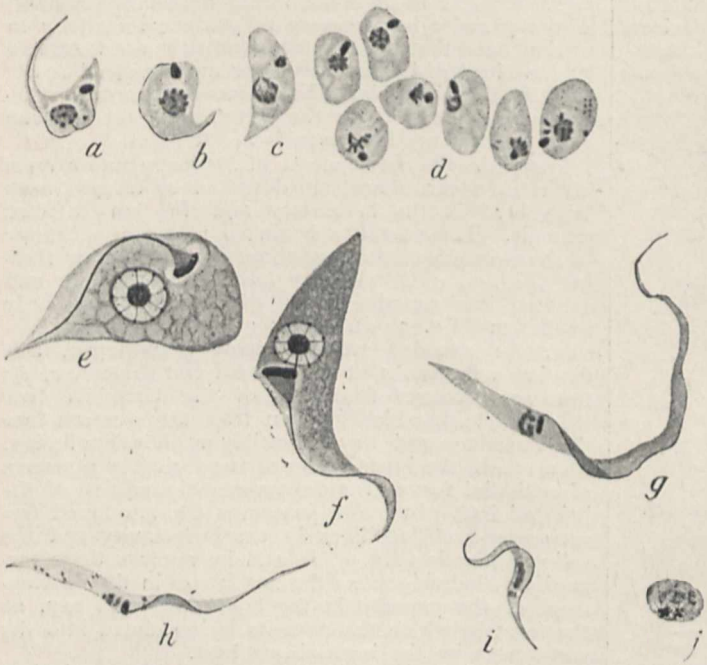


FIG. 3.—*a–j*, Phases of *Schizotrypanum cruzi* in the bug, *Conorhinus megistus*. *a*, *b* and *c*, forms transitional from the ordinary trypanosomes to the rounded forms; *d*, clump of rounded forms; *e* and *f*, change of rounded into crithidial forms; *g* and *h*, crithidial forms; *i*, trypaniform type from the salivary glands; *j*, encapsuled form from intestine.

TIDAL RESEARCHES.[1]

THE collection of data as to high and low water at various ports and the investigation of tidal currents present arduous tasks, and amongst those who have devoted themselves to these subjects Dr. J. P. van der Stok occupies a distinguished position. It is due to him that our knowledge of the tides of the Dutch East Indies rivals that furnished by our own admirable survey of India. He is an ardent adherent of the harmonic notation, and in the paper of which we now give an account he tabulates the principal tidal constants for no fewer than 138 ports in the Dutch Indies. To the best of my belief this immense mass of data has been collected and reduced through his own personal initiative.

This pamphlet gives an account of the theory on which harmonic analysis is based, but it is to be regretted, at least by all but his own fellow-countrymen, that it should have been written in his own language. Of course, the language is immaterial as regards the tables of constants, but it may prove an obstacle to those who desire to understand the other interesting points treated by the author.

Dr. van der Stok summarises his results in the form of co-tidal charts for the tract of ocean extending from the Malay Peninsula to New Guinea. The first of these exhibits the march of the principal lunar semidiurnal tide M_2. It appears that there is a point towards the south-eastern end of Sumatra at which the wave divides, one portion travelling north-west and the other eastward along the south coast of Java. Along the north-eastern coast of Sumatra, past Singapore, the wave travels in the opposite direction, namely, towards the south-east. It is met by a wave which travels westward and south-westward along the southern and northern coasts of Borneo, and westward along the northern coast of Java. Thus, in contrast with the divergence of the tide-wave off the south of Sumatra, there is a convergence from all sides towards a point midway between Sumatra and Borneo. Eastward of Borneo, in the direction of New Guinea, the general trend of the wave is northward.

The second of these co-tidal charts is, I believe, unique in that it exhibits the progress of the diurnal tide K_1.[1] The path of this wave exhibits a considerable resemblance to that pursued by the semi-diurnal wave, but it differs in the fact that it seems to approach the south coast of Java from the south, and thus the line of advance is from the south throughout the whole tract extending from the southern extremity of Sumatra to New Guinea.

I do not think that any previous investigator has attempted to draw a diurnal co-tidal chart. In the north Atlantic the diurnal tide is insignificant in amount and imperfectly known, but I think it might be possible to construct a similar chart for the coasts of India; I am not aware, however, that any such attempt has ever been made.

At the present time there are only three tide-predicting instruments in existence, namely, those in England, France, and the United States; but I have reason to know that a fourth is being constructed for another Government. Without the aid of such an instrument, tidal prediction is notoriously very laborious, and any process which may render predictions easier is very welcome. I have myself shown how numerical predictions may be made, but the preliminary computations are very laborious and tedious, although when the requisite tables are once formed it is easy and short to make a prediction.[2] But this method does little to facilitate the computation of a tide curve for a given place and given day direct from the harmonic constants. Now Dr. van der Stok pro-

[1] "Elementaire Theorie der Getijden—Getij-Constanten in den Indische Archipel." (K. Nederlandsch Meteorologisch Instituut, No. 102, 1910.)

[1] There is a short discussion of the diurnal tides in Harris's "Manual of Tides," part iv. A, p. 660.

[2] Phil. Trans., clxxxii. A, p. 169, or vol. i. of my "Scientific Papers."

vides just what is wanted to meet this requirement with all needful accuracy. He has computed a set of auxiliary tables from which the required results may be extracted with a fair degree of rapidity. It is in the explanation of the use of these tables that I fear the Dutch language may prove a difficulty to some would-be users of the method.[1]

I shall not try to explain the process in detail, but will only sketch the ideas on which it is founded. It is assumed that sufficient accuracy will be obtained if the phase of each of the constituent tides is specified to the nearest exact hour of mean solar time. It is easy to compute the fall and rise of any constituent tide for successive hours. For example, suppose that we consider the tide M_2, that its amplitude is, say, 174 (expressed in cm. or any other unit), and that we designate the hour of its high water as 0 h.; then its march would run thus :—

h.			h		
0	...	174	3	...	9
1	...	152	4	...	−76
2	...	92	&c.		&c.

Now if at any given place, and on any given day, we find the incidence of the high water of M_2 to the nearest clock hour, it is easy to write down the successive heights from the table in a schedule numbered from 0 h. to 23 h. If, for example, high water of M_2 is found to occur at 13 h. of clock time on the day in question, we should write 174 opposite 13 h., 152 opposite 14 h., and so on. The same process may be carried out for each of the principal component tides, and the sum may be obtained for each hour of the twenty-four, thus furnishing the resultant height of water. Auxiliary tables are furnished by Dr. van der Stok from which it is easy to determine the incidence of each partial high water in clock time, and tables of fall and rise are given for any required amplitude.

I should guess that it would take from twenty minutes to half an hour to compute and draw a fairly accurate tide-curve for any given day. If this estimate is correct, it would take a computer a month to draw a tide-curve for a whole year. Probably the work would be quicker when the tide is to be found for a succession of days, and in any case the task would not seem to be prohibitive to compute a year's tide-table with accuracy sufficient for practical purposes.

The paper also gives an example of the synthesis from harmonic constants of the tidal currents at a place called Sembilangan. This last statement may well prove almost unintelligible even to a man versed in tidal work. For a full explanation I must refer the reader to Dr. van der Stok's "Études des Phénomènes de Marée sur les Côtes Néerlandaises."[2] Four of this series of papers have been already published by the Nederlandsch Meteorologisch Instituut. I have not seen the first, but the second and third are dated 1905, while the last is of later date than the paper which we are now reviewing. I gather that the first of the series gives a method of obtaining tidal constants from observations taken every six hours, and the subject is resumed in the last paper, which contains an immense mass of information about the constants along the whole length of the Dutch coast. But I must revert to the subject of tidal currents discussed in the second and third of the series, and explain in outline what is meant by the harmonic analysis of tidal currents.

[1] Something of the kind has been done by Harris in his "Manual of Tides," part iii., p. 183. His procedure seems to be more elaborate, and probably more accurate, but also less rapid than that devised by Dr. van der Stok.

[1] These papers ought to have been noticed in the article "Bewegung der Hydrosphäre" of the German Encyclopædia of Mathematics. My article was really written before the publication of Dr. van der Stok's first three papers, but in the subsequent and final revision for the press I carelessly took these papers merely to relate to local hydrography. References are given in them to other papers by MM. Phaff, Petit, van Heerdt, &c., on the hydrography of the Dutch coast.

The author caused a large number of observations to be made from light-ships off the Dutch coast, and then undertook to make an elaborate study of the tidal currents which had been noted. He found it possible to define the velocities and phases of the components of current by means of a notation analogous to that used in defining the rise and fall of the tide. Thus the velocities for the several kinds of tide were specified in centimetres per second, and the phases by angles analogous to the κ's in use in the more ordinary harmonic analysis. A similar investigation had been carried out at Sembilangan, in the Dutch Indies, and it is the result for that place which is given in the paper under review.

It is clear that the harmonic constants which define the horizontal motion of the water cannot claim a high degree of accuracy, but it affords a conspicuous advance that the attempt should have been made and crowned with a certain amount of success.

The vortices off the Dutch coast are very complicated, and the author refers to Airy's theory ("Tides and Waves," §§ 358–63) as affording in some measure an explanation of the facts, although he does not find the explanation by any means complete.

In No. ii. of the papers to which I now refer, Dr. van der Stok integrates, for the light-ship station of Schouwenbank, the expressions for the components of velocity, and thus finds the trajectories of a particle of water under the influences of the tides M_2, S_2, and M_4; he also determines the general drift of the water. The figures illustrative of his conclusions are very interesting, and I commend these papers to the notice of all who are interested in tidal theory.[1]

G. H. DARWIN.

THE LEANING TOWER OF PISA.

THE first stone of the campanile of Pisa was laid in August, 1174, by Bonanno of Pisa and William of Innsbruck, but accounts given us by various authors are very conflicting and uncertain in regard to the construction of this splendid work of art, which, after being interrupted several times, was completed nearly two centuries later.

The tower, which is entirely of white marble, is of cylindrical shape, hollow in the centre, with a spiral staircase constructed in the thickness of the outer wall which leads up to the belfry floor. The first tier is surrounded by fifteen large columns, with vaulted arches half-encased in the wall, and the six upper tiers are each decorated by an equal number of peristyles with arches, supported by altogether 192 isolated columns. The eighth and last tier, of smaller diameter, on which are placed the bells, was constructed, according to tradition, by one Tommaso, architect and sculptor, a pupil of Andrea Pisano.

As is commonly known, the tower, the height of which is about 56 metres, has a noticeable leaning on its axis, and the cause of this leaning gave rise to bitter controversy among the Pisan writers in past centuries, some of whom attributed the strange piece of architecture to the high ingenuity of the builders, while others more reasonably maintained that the explanation was to be sought in the instability of the Pisa subsoil.

The recent investigations of a competent Government Commission, composed of Profs. Mario Canavari, Paolo Pizzetti, and Agenore Socini, and Drs. Giovanni Cuppari and Francesco Bernieri, have not only confirmed that the leaning of the tower is certainly due to a subsidence of the ground, but that this

[1] Similar results will be found in Helland-Hansen and Nansen's "Norwegian Sea, Report on Norwegian Fishery," vol. ii., 1909, No. 2, p. 107; and Miss Kirstine Smith's "Gezeitenstroemern," Havenundersögelser, vol. ii., No. 13, 1910.

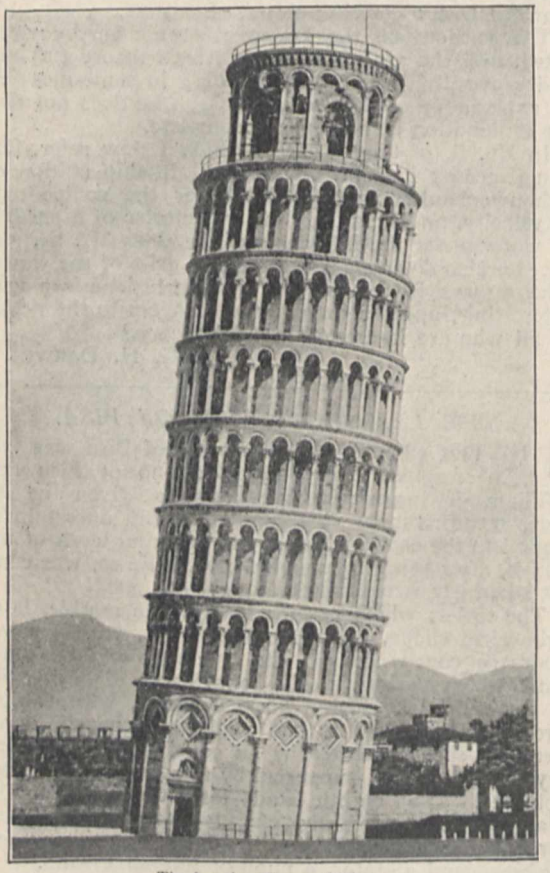
subsidence has gone on increasing in the last eighty years, and this serious conclusion has attracted the attention of competent authorities.

The investigations of the Commission have clearly brought out the following facts:—

(1) The tower does not rest on a mass of masonry extending over the whole area of the circular base, as was hitherto supposed, but is supported only by a more limited annulus of masonry corresponding to the cylindrical form of the superstructure.

(2) The foundations, hitherto supposed to be about 8 metres deep, are, on the contrary, much more superficial, and hardly sink to 3·60 metres below the level of the ground.

(3) A spring of water rises at the junction of the foundations with the surrounding permeable earth, causing serious damage to the foundations themselves. A tank excavated near the tower in 1839 for the purpose of maintaining the surrounding basin dry and preserving the base in good condition was made very deep, and much below the level of the actual edge, thus collecting other waters, which were pumped out regardless of the safety of the tower.



The Leaning Tower of Pisa.

(4) The slope of the tower, according to the measurements made in 1829 by Messrs. Cresy and Taylor, which may be regarded as correct, was, from the first to the seventh tier, 86·5 mm. per metre of height. The slope, as now determined by optical appliances by Prof. Pizzetti, and directly by the plumb-line by the engineers, Drs. Cuppari and Bernieri, is—again from the first to the seventh tier—92 mm. per metre. The slope has therefore increased 5½ mm. per metre, and there is thus an external displacement of 2·868 metres, and a total deviation of the axis, from the first to the seventh tier, of 3·265 metres, exceeding that found by the English observers in 1829 by nearly 20 centimetres.

The Commission has not been able to decide whether the increase in the leaning took place gradually or at intervals as the result of different causes. One such cause might be the excavation of the tank and the ill-advised pumping operations already mentioned; another might be sought in the effects of the earthquake of 1846, which was fairly violent at Pisa, and, as asserted by Leopoldo Pilla in his account of the times, caused the tower to oscillate in an alarming way. "Those people who had the opportunity of observing it during the shock," writes the great geologist, "assure me that its swaying was a terrible sight."

In spite of these serious conclusions, the Commission is nevertheless unanimously of opinion that the famous tower of Pisa still possesses good stability, and that the present condition of the same is not such as to give rise to excessive apprehension for the future.

A. BATTELLI.

RECENT BOOKS ON BOTANY.[1]

(1) MR. SCOTT ELLIOT has attempted an ambitious task, *i.e.* to give a popular and at the same time comprehensive account of modern botanical research. On the whole, he has been thoroughly successful, and has produced a readable book, which may well impress the layman or amateur botanist with the extent and scope of the botany of to-day. But (though this is perhaps inseparable from a work of this kind) one is almost bewildered by the rapidity with which the scene changes from the polar regions to the tropics, or the subject under discussion from, *e.g.*, the effect of electricity on plants to the origin of the British flora. In the preface the author states that he is particularly interested in "open-air botany, the story of the conquest of the world by green vegetation," and it is when discussing topics of this kind that he appears at his best. Such descriptions as that of the soil, with its manifold complexities of life and structure, or of a "Chroolepus Forest" are distinctly good, even if a trifle exaggerated. The chapters on bacteria, Arctic and Alpine floras, and the re-conquest of the water are amongst the best in the book. In a few cases, however, Mr. Elliot has attempted the impossible. Thus, in a chapter on the fern alliance, he condenses into three octavo pages an account of the alternation of generations, Bower's theory of the origin of the fern sporophyte, the reduction of the gametophyte in flowering plants, and a description of the pteridosperms. The result can scarcely be other than to cause confusion in the mind of the non-botanist. In describing the growth of the living crust of mosses on the top of a sphagnum bog (p. 74), the author suggests that "these moss plants may, for aught we know to the contrary, be the identical individuals which perhaps began to grow there at the close of the Glacial period." This raises the interesting metaphysical problem of how far the conception of individuality is applicable to plants. Unfortunately, Mr. Elliot does not discuss the question, though he briefly refers to it again on p. 152. It is to be expected that some inaccuracies should creep into a book of this nature. A desire for brevity is probably responsible for the statement on p. 109 that the

1 (1) "Botany of To-day: a Popular Account of Recent Notable Discoveries." By G. F. Scott Elliot. Pp. 352. (London: Seeley and Co., Ltd., 1910.) Price 5s. net.

(2) "The Book of Nature Study." Vol. v. Edited by Prof. J. B. Farmer. Pp. viii+224. (London: Caxton Publishing Co., n.d.)

(3) "A Text-book of Botany for Students, with Directions for Practical Work." By Amy F. M. Johnson. Pp. viii+535. (London: Allman and Sons, Ltd., n.d.) Price 7s. 6d.

pollen grains of a flower are male sperm cells; while the somewhat astounding information (p. 132) that the leaves of *Victoria Regia* may be 60 feet across is, of course, a mere slip, and not a traveller's tale. There are a number of beautiful photographs (chiefly of plants of economic importance), some of which, however, seem to have little reference to the matters discussed in the text. Similarly, "The First Land Plants," which is the title of chapter iii., scarcely describes its contents, which deal chiefly with soil and the nitrate supply of the vegetable world. One of the photographs is here reproduced.

(2) As other volumes of "The Book of Nature Study" have been reviewed in NATURE, it is unnecessary to indicate the general scope of this work. The first contribution to this volume is one by Miss C. L. Laurie, which (considering that it contains a chapter on aquatic vegetation, and another on that of meadows and pastures) bears the somewhat curious general title of "Xerophytic Vegetation." This part of the work contains a good deal of interesting information, and some useful suggestions for practical work; but, on the whole, it is rather disappointing. In many places there is a lack of clearness, both of expression and arrangement. On p. 15, for instance, it is stated that the amount of salt in the sea aster varies from 43–49 per cent. It is only incidentally mentioned in a later paragraph that this refers to ash analysis, and not to the fresh or dry weight of the plant. The editor might well have exercised a stricter supervision over these chapters.

But the remainder of the volume is on a higher level. Chapters v.–xii. are devoted to "The School Garden," the author being Mr. J. E. Hennesey. The subject is treated almost entirely from a practical point of view, gardening operations of various kinds —tillage, manuring, the propagation and treatment of plants, &c.—being clearly described. These chapters should prove invaluable to amateur gardeners, and perhaps more particularly to teachers who have the oversight of a school garden. Mr. Hennesey rightly emphasises the importance of a garden being attached to at least every rural school. It is interesting to note that such gardens are increasing in number in England, though we are still far behind Austria-Hungary, in which more than 18,000 school gardens have been established since 1870.

Distinctly the best part of the present volume has been reserved to the last chapter, which contains a really excellent account of "The Work of the Soil," by Mr. A. D. Hall. The author first deals with the origin of soils, and then with their properties. Under the latter heading clear directions are given for conducting simple soil analysis, also for experiments to show the behaviour of different soils towards water, the work performed by soil organisms, &c. Pp. 209–11 contain a graphic and convincing description of the competition of plants in nature.

Both "The Book of Nature Study" and Mr. Scott Elliot's "Botany of To-day" are worthy of a place on the bookshelves of every school library.

(3) Miss Johnson has produced a carefully and, on the whole, a clearly written text-book, but, like many other books of the kind, it is somewhat deficient in brightness and suggestiveness. In the opinion of the present writer, it is a mistake to adopt the water-tight compartment system in the teaching of elementary students. The author, however, adheres to the time-worn method of devoting entirely separate sections of her book to morphology, histology, and physiology. Thus the external characters, the structure, and the functions of a root are treated in quite different parts of the book. Further, bearing in mind the students for whom the work is intended (*vide* preface), it is somewhat overcrowded with unnecessary detail. The book is fairly free from serious errors, but perhaps it may be worth while to direct attention to the fact that the intercellular passages so frequent in the vascular bundles of monocotyledons are not *air* cavities. Again, the *chief* function of the air spaces in the stems of water plants is scarcely to "give lightness to the plant" (p. 219), though, curiously enough, this statement is also made by Miss Laurie in "The Book of Nature Study" (p. 23), reviewed above. The excellent illustrations, which are nearly all new, form the best feature of the book. These are chiefly by Miss Boys-Smith and Miss Berridge.

Photo.] [*Skeen and Co., Ceylon.*

Plucking Cocoa Pods. From "Botany of To-day."

NOTES.

SEVERAL weeks ago the announcement was made that an Italian Government Commission, appointed to inquire into the condition of the Leaning Tower of Pisa, had reported that the structure was in danger of collapse (July 14, p. 48). We are glad to be able to print in the present issue the translation of an article by Prof. A. Battelli, professor of physics in the University of Pisa, in which the facts with reference to the tower are clearly stated. The article should serve to moderate anxiety for the safety of this famous structure.

IT is stated by the Paris correspondent of the *Times* that the Government of the Republic of Ecuador has proposed to present to France the observatory at Quito, together with its apparatus and dependencies, and that the Academy of Sciences has decided provisionally to accept the gift.

WE regret to see the announcement of the death of the Rev. Robert Harley, F.R.S., on July 26, at eighty-two years of age.

THE Paris correspondent of the *Times* states, on the authority of the *Dépêche Coloniale*, that M. Louis Gentil, professor of geology at the Sorbonne, who accompanied the expedition which recently explored the Atlas region under the auspices of the Comité du Maroc, has been entrusted by the French Minister of Public Instruction with a mission to the Muluya Valley, where he will complete his scientific researches in the Algero-Moroccan frontier district.

THE famous extinct geyser of Waimangu, New Zealand, near which a volcanic eruption was reported last week as having commenced, was for a few years the most powerful geyser on record. The activity of this geyser in 1903 and 1904 created such anxiety in the North Island of New Zealand that an Auckland paper, attributing its activity to the great increase in the size of the adjacent Lake Rotomahana, proposed that the lake should be drained in order to allow the freer outlet from the hot springs of the locality. No action was taken, and the danger was removed by the bursting of the lake dam. The water of Lake Rotomahana was discharged to Lake Rotorua, and Waimangu ceased its eruptions. It will be interesting to learn from the New Zealand geologists whether the renewal of the volcanic activity along the Tarawera rift is connected with the cessation of Waimangu.

THE executive committee formed for the purpose of organising and holding a great International Horticultural Exhibition in London in the spring of 1912 is now doing everything possible to push forward the necessary arrangements. The honorary secretary of the committee is Mr. Edward White, 7 Victoria Street, Westminster, S.W. The exhibition will be held in May, and it will be open to the public on eight weekdays. Although in no way responsible for the exhibition, the Royal Horticultural Society is extending its general approval to the scheme. This society has not only agreed to forgo the holding of the usual Temple Flower Show for that year, but it has also contributed a sum of 1000*l.* towards the International Exhibition, and in addition is prepared to assist generously in the formation of a guarantee fund.

IT is seldom that for the period of a whole month there is such a failure of summer weather as was experienced this year throughout July. There were in all only five days at Greenwich with a temperature of 70° or above, and this is the smallest number of warm days in any July since trustworthy records were commenced in 1841, about seventy years ago. The July with the next fewest number of warm days was in 1879, when there were eight days with the temperature above 70°, whilst there have only been four Julys during the last thirty years with fewer than twenty such warm days, and as recently as 1905 the temperature of 70° was exceeded in July on twenty-nine days. In the last nineteen years there have only been two Julys besides last month in which the shade temperature failed to touch 80°. The mean temperature for the month was 60°, which is 4° below the average of the past sixty years, and it is 1·5° below the mean for the corresponding month in 1909, when the early part of the summer was unseasonable like the present, although July last year had eighteen days with a temperature above 70°. The aggregate rainfall in the neighbourhood of London for July this year was 3·5 inches, which is 1·1 inches more than the normal, and rain fell on seventeen days. The aggregate for June and July this year is 5·6 inches, which is 1·2 inches less than for the corresponding two months last year. The duration of bright sunshine in July this year was 115 hours, which is only one-half the average, and is sixty hours less than in July last year.

THE visit of the German Association of Gas and Water Engineers to Great Britain, which was postponed on account of the death of King Edward, has now been arranged to take place during the week commencing October 2 next. The visitors are to be the guests of the Institution of Gas Engineers, the Gas Light and Coke Company, the South Metropolitan Gas Company, the Croydon Gas Company, and the Corporations of Edinburgh and Glasgow respectively, of which latter city the engineer of the gas department, Mr. Alex. Wilson, is now the president of the Institution of Gas Engineers.

AT the last meeting of the British Science Guild, held in the rooms of the Royal Geographical Society, communications were received from the Canadian and New South Wales sections of the Guild. In the case of the Canadian section, Lord Grey is resigning the presidentship on account of his departure, and it is hoped that Lord Strathcona will act as president in his place. No fewer than 120 members have joined the New South Wales section of the Guild, and important literature has been forwarded in connection with technical education and the report on open-air spaces for school children in Sydney. The agricultural memorial to the Prime Minister having received numerous signatures from representative agricultural societies and others was ordered to be submitted to the Prime Minister. The report of the committee on the synchronisation of clocks was finally approved, and it was decided to approach the Local Government Board by deputation and to ask the President to promote legislation on the subject.

ACCORDING to Miss F. Buchanan, writing in the July number of *Science Progress* on the significance of the pulse-rate in vertebrates, the relative size of the heart in different groups of animals depends on the amount of work it is called upon to perform. Thus in fishes, where it has only to pump the blood so far as the gills, the heart is always small, averaging 0·09 per cent. of the body-weight; but in the inert flat-fishes it is still smaller, being only about 0·04 per cent. of the body-weight. On the other hand, in birds, more especially migratory and vocal species, the heart has very heavy work to perform, and is consequently of great relative size, ranging from 1 to 2, or in a few cases 2·6, per cent. of the body-weight. In consequence of these differences in the amount of work the heart has to execute, its size bears no fixed relation to that of the animal to which it belongs. "The heart

of a pigeon, *e.g.*, weighs twenty-five times that of a plaice of the same weight, and is about equal to that of a salmon fifteen times as heavy as the pigeon. A thrush, and a guinea-pig of six or seven times its weight, have hearts of about equal size."

IN the *Psychological Bulletin* for June Dr. J. C. Hubbard describes a curious visual phenomenon resulting from stimulation of the macular region of the retina. It was first, and can be best, observed when the pupil is dilated by atropin, but it is also said to occur under ordinary conditions when any feeble source of light is viewed against a dark background. If, for example, "a patch of soft red colour, such as a ruby lamp wrapped with tissue paper, be viewed in a dark room, diffuse brushes of bluish tint are seen, apparently spreading laterally from it. With the right eye alone the brushes seem to extend to the right of the source, and with the left eye to the left." These brushes terminate at a point which is found to correspond to the position of the blind spot, for the source of light when not too large disappears if the eye be turned to the point of termination of the brushes. The brushes disappear in two or three seconds if the eye remains carefully fixed, but reappear upon slightly moving the eye. They also occur when the source of light is daylight, are brightest in orange-yellow and yellow spectral light, and are almost imperceptible in blue and violet light. Dr. Hubbard points out that the distribution of these brushes of blue light is strikingly similar to that of the bundles of optic nerve-fibres radiating from the macula to the blind spot. He suggests that certain stimuli, "passing from the macular region along these fibres to the optic nerve, are capable of inducing secondary effects in portions of the retina along which they pass."

THE preliminary announcement made in the *Times* of July 27, by Dr. Max O. Richter, of the discovery by Dr. K. Koritzky and himself of the site of the famous Cyprian temple of Aphrodite-Astarte will, if the facts are verified, rank justly as one of the most important archæological events in recent years, and a well-deserved triumph for German science. We can only express the regret that, in spite of much exploration in Cyprus by British scholars, they have failed to secure the honour of this discovery. The clue to the supposed site of the temple at Rantidi, or Randi, was gained through the examination of some inscribed stones which were smuggled out of the country, the first having been accidentally found by a shepherd. Whether this be the shrine of the Paphian Venus or not, the remains are certainly numerous and interesting. The German archæologists have taken measures to secure the rights of excavation, and Dr. Richter believes that the antiquities to be unearthed will prove to be so numerous that it will be necessary to erect a special museum for their reception, probably at Limassol. The examination of the shrine will probably solve the much debated question of the relation of the worship of the goddess to Oriental cults. In spite of the fact that the law protecting antiquities in Cyprus is severe, we regret to learn from Dr. Richter that many of the precious inscriptions have been removed from the ruins by the Government engineers and broken up for ballast for the new road from Nicosia to Limassol.

THE presidential address on "Nature and Nurture" delivered by Prof. Karl Pearson at the annual meeting of the Social and Political Education League in April last has been published by Messrs. Dulau and Co. in the Eugenics Laboratory Lecture Series. Prof. Pearson lays stress on the necessity for exact methods in the study of sociological problems, and indicates the difficulty of analysing the resultant effects of nature and nurture so as to exhibit the relative importance of each factor. A few pedigrees are given illustrating the appalling extent to which abnormalities may be propagated by a fertile degenerate stock, and conversely the persistence of intellectual eminence in superior stocks; and the strength of nature is contrasted with that of nurture by two tables, the first showing correlations between parent and offspring or between members of the same family, and the second correlations between various factors taken as indices of environment and physical characters of children. Prof. Pearson concludes that "there is no real comparison between nature and nurture; it is essentially the man who makes his environment, and not the environment which makes the man." Not everyone will agree that the data are adequate to prove the conclusion, and from many of Prof. Pearson's *obiter dicta* the reader is likely to dissent; but the address gives a lucid and stimulating exposition, in popular language, of the lecturer's views.

NO. 1746 of the Proceedings of the U.S. Nat. Mus. is devoted to an account, by Mr. G. C. Embody, of a new species of amphipod crustacean, found in abundance in a large, spring-fed pond or lake some three acres in extent near Ashland, Virginia. When first collected, in 1908, they were referred to *Eucrangonyx gracilis*, but they are now found to be distinct, and described as *Eu. serratus*. Although these amphipods formed a portion of the food of at least three species of fishes, the thick fringe of vegetation round the pond, coupled with their rather rapid propagation, prevents any very great destruction of the crustaceans.

IN the July number of the *American Naturalist*, Mr. H. B. Wood discusses recent views as to the original source and spread of bubonic plague. Russian naturalists have urged that the bobac marmot (or perhaps some kindred central Asiatic species) is the sole originator of plague, and that it is permanently infected with the disease, thereby periodically re-infecting rats, and thus the human race, by means of fleas. The extermination of the bobac has, therefore, been demanded; but, as the author points out, there are probably other sources of original infection, and, in any case, certain American rodents have now become permanent centres of the disease. It is known, for instance, that a species of suslik, or ground-squirrel (*Spermophilus*, or *Citellus, beecheyi*), is plague-infected in California, and the same is the case with one of the wood-rats of the genus Neotoma, only in a less degree. Susliks may become infected *inter se* by the burrowing owl (Speotito) acting as flea-carrier, the fleas being probably carried from susliks to man by either cattle or rats, although direct transference from the former may take place. Two kinds of Californian rat-fleas will bite man, as will some suslik-fleas; and it has also been ascertained that rat-fleas will carry infection from rats to susliks, while suslik-fleas will carry it from one species of suslik to another, and likewise to rats and guinea-pigs.

AN account was given in the *Times* of July 26 of the deep-sea observations in the North Atlantic made by the *Michael Sars* expedition, which left Plymouth on April 7. It will be remembered that Sir John Murray liberally financed the expedition and took part in the cruise. The work was under the control of Dr. John Hjort, who had the assistance of Prof. Gran, Mr. Helland-Hansen, and Captain Iversen. Physical and biological investigations were made at most of the seventy-four observing stations. Upwards of 600 temperature observations at different

depths were recorded. The temperature observations agree very well with those of the *Challenger*, but the determinations of the salinity and density of the water have furnished new results. The measurements of the rate of the current in the Straits of Gibraltar showed that the limit between the upper (east going) and the lower (west going) currents is situated at a depth of between 50 and 100 fathoms, varying in depth with the tide. The greatest velocities measured were about five knots. In the warm waters of the Sargasso Sea, where the tow-nets of the German Plankton Expedition obtained few plants, the centrifuging of the water gave samples showing that the plants there consist of the smallest forms, which escape through the meshes of the finest silk nets; they were found in thousands to a depth of about 50 fathoms. Prof. Gran has recorded a great number of new species, and was able to make quantitative microscopic investigations, and thereby determine the vertical distribution of the different species. The temperature section across the Gulf Stream to the south of the Great Banks showed unexpected results. Both the temperature and the plankton indicate a counter-current at the southern border of the Gulf Stream. In consequence of this the *Michael Sars* followed the course of the Gulf Stream across the Atlantic, taking observations on the way, and the results will be published later.

In No. 1749 of the Proceedings of the U.S. National Museum, Mr. A. H. Clark describes a new species of feather-star (Antedon) from the Adriatic, and discusses the relationships of the other European members of the genus. It appears that considerable differences in the size of the eggs and of their rate of development have been noted by several observers in European Antedons from different localities, although all the specimens were referred to the ordinary *A. rosacea*, the range of which was thus considered to extend from Norway to the Mediterranean. It was, however, suspected by all that the specific determination was unsatisfactory. Mr. Clark is now able to announce the existence of four European species—two from the Atlantic, for which the names of *petasus* and *bifida* (=*rosacea*) are respectively available, and two from the Mediterranean, one of which should bear the name *mediterranea*. The two Mediterranean forms have long, slender arms, and numerously segmented long cirri, while in those from the Atlantic the arms and cirri are shorter and stouter, with fewer segments to the latter; further, it is believed that neither of the Atlantic species has infrabasal plates. These are, however, present in the Mediterranean forms; but the newly named *A. adriatica* has four or five, against three in *mediterranea*. The Mediterranean forms are more primitive than those from the Atlantic, which accords with the author's view that Antedon is primarily an Indian Ocean genus, where it is now represented by the more generalised Mastigometra.

To No. 40 of the Zoological Society Bulletin, New York, July, Mr. W. T. Hornaday contributes an illustrated article on the collections of heads and horns of big game in the temporary "Administration Building" in that city. It appears that attention was recently directed to the poverty of American museums in specimens of this nature from Africa, and that this has resulted in a very gratifying effort on the part of sportsmen and collectors. We notice, however, that the specimens are exhibited on the walls of the apartments of the building without the protection of cases, and apparently exposed to strong light, which will assuredly lead to their rapid deterioration. Mr. Hornaday quotes certain pessimistic views as to the prospects of African big game, in which it is asserted that, in from ten to fifteen years, all except that in protected areas will have been practically wiped out.

The June number of the *Quarterly Journal of Microscopical Science* (vol. lv., part ii.) contains a valuable and beautifully illustrated monograph, by Mr. Cresswell Shearer, on the anatomy of *Histriobdella homari*. This very primitive segmented worm is said to be a normal inhabitant of the branchial chamber of the European lobster. The author concludes that the genus Histriobdella must be placed close to Dinophilus, but that it is more nearly related to the rotifers than the latter. Both genera show distinct relationships with Polygordius and Protodrilus, although they cannot be classed with these as true archiannelids. The same number contains Messrs. Allen and Nelson's interesting paper on the artificial culture of marine plankton organisms, already published in the Journal of the Marine Biological Association and noticed in these pages. Mr. Geoffrey Smith continues his studies in the experimental analysis of sex, and describes a case of parasitic castration in a cockerel, due to tubercle bacilli infecting the alimentary and lymphatic organs. He considers this case to be analogous to the parasitic castration of various invertebrates, such as that of the crab Inachus by the degenerate barnacle Sacculina. There are also three protozoological papers by Miss Annie Porter, Mr. C. M. Wenyon, and Mr. H. Lyndhurst Duke, all of a high standard of merit.

In the *Annals of Tropical Medicine and Parasitology* (vol. iii., No. 5), there is a memoir by A. Breinl and E. Hindle on the life-history of *Trypanosoma lewisi* in the rat-louse, *Haematopinus spinulosus*. In experiments carried on for more than a year, the authors have succeeded three times in transmitting *T. lewisi* by means of the rat-louse. Cytological changes in the trypanosomes in the gut of the louse are described and figured. Amongst other articles in the same number, one by Sir Rubert Boyce and F. C. Lewis, on "The Effect of Mosquito Larvæ upon Drinking Water," may be especially noted. It is found by experiment that "the presence of larvæ in drinking water adds very considerably to the number of bacteria present," and Cyclops appears to produce the same effect.

The eighteenth bulletin of the Sleeping Sickness Bureau contains a great deal of valuable information concerning the results of recent research upon all questions bearing directly or indirectly upon the etiology or treatment of trypanosomiases of man and animals. It begins with an editorial article upon the transmission in nature of *Trypanosoma gambiense*, the main point at issue being whether the trypanosome of sleeping sickness is disseminated, under natural conditions, by *Glossina palpalis* alone or by other species of tsetse-flies also. Recent observations tend to arouse the suspicion that *G. fusca* and *G. morsitans* may, under certain conditions in nature, serve as hosts for the human trypanosome, and if this is true, "the difficulty of prevention would be enormously aggravated. The seriousness of the problem . . . makes it imperative that skilled investigations . . . be conducted without loss of time."

The progress of palæobotany is marked by the appearance of a publication, *Die Palaeobotanische Literatur*, of which the first volume, dealing with the literature that appeared in 1908, has been issued by the firm of Gustav Fischer, Jena. The bibliography not only cites papers devoted primarily to palæobotany, but includes papers on recent botany, in which fossil plants are discussed. The

greater part of the volume, which exceeds 200 pages, is taken up by the enumeration of genera and species with references to the various papers where they are mentioned. The compiler, Dr. W. J. Jongmans, of Leyden, makes an appeal for assistance in the shape of literature and papers as published.

THE systematic position of the tropical American genus Phytelephas, well known because the stone-like endosperm furnishes a cheap substitute for ivory, is discussed by Mr. O. F. Cook in vol. xiii., part v., of "Contributions from the United States National Herbarium." The author traces an affinity with Manicaria, a Central American genus, in the number of stamens and the fruit, besides noting an agreement with Attalea in the germination of the seedling. This leads to the formation of a family, Manicariaceæ, connecting the Phytelephantaceæ with the Cocaceæ. At the same time, the author controverts a family relationship between Nipa and Phytelephas.

PROF. H. MOLISCH communicates to the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxviii., part ix.), a note on local coloration of the cell wall in certain water plants induced by manganese compounds. The introduction of manganese salts into cultures of Elodea produces, after a few days' exposure to light, a deposition of brown matter in the outer walls of the epidermis which on continued exposure tends to mask the green pigment in the leaf. The author notes that the deposition takes place only when the plant is exposed to light, and that a similar result was obtained in leaves of Vallisneria, *Ranunculus aquatilis*, and Myriophyllum. The chief point of interest lies in the fact that it furnishes a definite instance of localised action produced by the absorption of a specific element.

DURING the coming December an exhibition is to be held at Allahabad, at which a special feature will be the display of small light machinery for use in agriculture and the allied industries. A pamphlet entitled "Northern India as a Market for Agricultural Machinery" has been issued, not only with the purpose of interesting manufacturers in the exhibition, but to give useful information to those who have in the past found it difficult to ascertain the special requirements of the vast Indian market. It should serve its purpose admirably.

THE fertilising value of seaweed has for some time past been the subject of a long arbitration case in Scotland. From the reports that have appeared in the *North British Agriculturist*, it seems that three farmers were deprived of their rights to gather seaweed when the Admiralty resumed possession of the foreshore at Rosyth for the purposes of naval construction. The facts were not contested, and the only dispute was as to the value of the seaweed. Experts and practical men were called on both sides, and the values assigned varied from 1*s.* per ton to 9*s.* 3½*d.*; in the end the arbitrator fixed 4*s.* 9*d.* and awarded compensation on this basis. As the case has been going on for eight months a considerable amount of money must have been spent, while it cannot be said that any material addition to our knowledge of the subject has been gained in consequence. The problem could only be solved by experiment, and it is reverting to the methods of the mediæval schoolmen to attempt to settle it by collecting "opinions."

THE tobacco produced in India has not hitherto been held in high repute, nor has success been attained by the introduction of American varieties and methods of curing. Mr. and Mrs. Howard have for some time been engaged in a study of the varieties already grown in the country, and have published their results in vol. iii. of the Memoirs of the Department of Agriculture in India. Perhaps no other factor in the production of high-grade tobacco is so important as uniformity in the crop, both as regards growth and also as regards the type of plant grown. Unless the crop ripens evenly the difficulties of harvesting and curing are increased, whilst a crop made up of several types of plant is not readily sorted out into uniform grades. The various types of *Nicotiana rustica* and *N. tabacum* are described in sufficient detail, and typical photographs are given. A great deal of patient work of this kind is necessary before the breeding of new varieties can usefully be begun.

PROF. A. L. ROTCH has contributed to the epitome of the *Aëronautical Annual*, 1910, a useful article on the relation of the wind to aërial navigation. After explaining the methods of investigating the upper air employed at Blue Hill Observatory and elsewhere by means of kites and sounding-balloons, he refers to the results of the upper wind observations in the eastern United States and to the recent discussion of the data by Mr. A. H. Palmer. The surface wind at Blue Hill (200 metres) has a mean annual velocity of 7·1 metres per second (15·8 miles per hour), and increases with height, as follows:—

Height in metres	550	1000	2500	3500	5400	6400
Mean velocity, m.p.s.	9·8	10·7	12·5	15·5	24·9	27·1

and the increase continues to the greatest heights; at 9500 m. it is 35·8 m.p.s. (80·8 miles per hour). The mean range from summer to winter increases very greatly with height:—

Height in metres	200—1000	1000—3000	3000—5000	5000—7000
Velocity in summer	7·5	8·2	10·6	19·1
Velocity in winter	8·8	14·7	21·6	49·3

the velocity of the upper winds in winter being more than double the rate in summer. The velocity increases nearly twice as fast at night as in the daytime up to about 500 m.; above that height there is a decrease, except in winter, up to 1000 m., and then a steady increase. The author points out that at night a suitable level for aërial navigation in summer is 1000 m.; in the daytime it is necessary to ascend above the cumulus clouds. Over the temperate regions the surface winds are obviously constantly changing their direction; above these shifting winds, the balloons sent off from St. Louis showed that the direction is generally westerly. Above the height of a mile the mean direction was from west-north-west.

THE results of a series of investigations by Messrs. de Broglie and L. Brizard, on the ionisation of gases in presence of chemical reactions, are summarised by the authors in the June number of *Le Radium*. Of the three methods adopted by the authors, that in which the ultramicroscope is used has proved the most powerful. The chemical reaction to be investigated is carried out under the microscope and between two charged plates which produce an electrical field across the line of vision. Any charged particles produced by the reaction are moved towards one or the other plate, according to the sign of the charge. A large number of reactions have been observed in this way, and the authors conclude that in none is the ionisation, if produced, due primarily to the chemical reaction, but to secondary effects, such as the bubbling of a gas through a surface of separation of two fluids, or the breaking down of crystalline structure and the projection of particles which become charged by friction with the surrounding medium, or, lastly, to the incandescence produced by the heat of reaction. It will be

evident that many observations hitherto unexplained will be capable of explanation on lines suggested by these results.

IN a paper entitled "Absorption and Adsorption with Reference to the Radio-active Emanations," published in the Bulletin of the Macdonald Physics Buildings of McGill University, Dr. R. W. Boyle shows that the radio-active emanations behave as all ordinary gases in obeying the laws of solution and of gaseous adsorption. In the case of thorium emanation, the experiments described show that the amount of emanation absorbed by charcoal is proportional to the concentration of the emanation in the gas in contact with it. The absorption also depends on the nature of the charcoal and the amount of surface exposed, and, as with ordinary gases, the absorption decreases with increase of temperature. On comparing the results of several experiments, it appears that thorium emanation is four times as soluble in water as radium emanation, but in petroleum the former is only half as soluble as the latter. Experiments with thorium emanation showed that this gas is less soluble in solutions such as copper sulphate and calcium chloride than in pure water, and the most powerful solvents used were petroleum and alcohol. The order of the solubilities of radium and thorium emanations in different solvents was found to be the same. The paper concludes with a brief notice of current ideas on adsorption, and there is appended a bibliography on the subjects treated.

THE University of Illinois Bulletin No. 41 contains an account of tests made on timber beams by Mr. A. N. Talbot. The tests were made with the view of adding data on the properties of timber in the form of stringers, as used in many railroad structures. The timber stringers were 8 inches by 16 inches by 15 feet to 7 inches by 12 inches by 14 feet in size. One hundred and twelve samples in all were tested, including long-leaf pine, short-leaf pine, loblolly pine, and Douglas fir. The load was applied equally at one-third points of the span length. The dimensions of the specimens were such as to bring out the strengths of timber in horizontal shear. The influence of knots, seasoning checks, and wind shakes can be traced in the results. Much of the data in existence is based on tests made on small specimens, and a valuable feature of the present series consists of the results of tests on minor specimens cut from the stringers. The flexural and shearing strengths of these smaller specimens were determined, and the relation of their properties to those of the full-sized stringers may be studied from the results given. In addition to many tables of results, the bulletin includes photographs showing characteristic fractures under the bending and shearing tests.

OUR ASTRONOMICAL COLUMN.

A CENTRAL BUREAU FOR METEOR OBSERVATIONS.—Under the auspices of the Astronomical Society of Antwerp, a central office has been established for the collection and coordination of observations of meteors. A beginning was made in 1907, and in twenty-two months 5960 observations were recorded by forty observers in thirty-six localities. This essay showed that a much wider organisation was desirable, and the new Bureau Central Meteorique hopes to receive the cooperation of all observers of meteors, amateurs and otherwise, the world over. In the Publication No. 1 is given a complete set of directions and advice, so that anyone, astronomer or not, who can observe regularly, may at once join in the international cooperative scheme. In a circular which accompanies the publication, M. Birkenstock points out that the expenses of the new organisation will be large, and asks all those interested in meteoric astronomy to assist by making an annual subscription of at least 5 francs.

THE ROTATION OF SUN-SPOTS.—To No. 4429 of the *Astronomische Nachrichten* Herr P. Kempf contributes some interesting results derived from sun-spot observations made during 1891–3.

A number of solar observers have been unable to establish any definite rotation of sun-spots, but here the observer shows from careful observations that in thirteen cases there was a distinct rotatory movement of the spot about its own centre. Seven of these occurred in the northern, and six in the southern, hemisphere, but there appears to be no relation between the direction of the rotation and the latitude—north or south—of the spot; only in two cases in each hemisphere was the motion in the negative (*i.e.* N.W.S.E.) direction. In one case (Greenwich spot-number 2277, August 5–16, 1891) the spot rotated 139° in eleven days, while the average daily motions ranged between 7° and 37°; for the northern hemisphere the mean was 11°, and for the southern 20°.

HALLEY'S COMET.—An interesting popular summary of the phenomena presented by Halley's comet during its recent apparition is published in the July number of *The World To-day* by Prof. Frost. Discussing the "never-to-be-forgotten spectacle" presented by the 100° tail seen about the time of the comet's passage, Prof. Frost affirms that the earth probably passed through a part of the tail on the morning of May 19, and suggests that we were within the forks, or separate streamers, of it for two days following, hence the east and west tails. The strangely iridescent clouds, with a kind of horizontal "rainbow," seen at the horizon, may also have been due, at least in part, to the presence of cometary dust.

Some excellent photographs were secured by Mr. Ellerman, who led a comet expedition to the Hawaiian Islands.

LARGE METEORITES.—A description of the Guffey meteorite, discovered by two cowboys near Guffey, Park County, Colorado, in 1907, is given by Mr. Edmund O. Hovey in a reprint from the *American Museum Journal*, vol. ix., pp. 237–48.

This object is a siderite 36·5 inches long, 15 inches maximum height, and 8 inches wide. The mass is roughly pear-shaped, and weighs 682 lb. Two sides show well-developed "thumb marks" or "piëzoglyphs," but on another, which is nearly straight, these are not so well developed; the author suggests that the straight edge and lack of marks indicate that the mass split into two or more parts when near the end of its flight, and that another part may, therefore, yet be found. The mass is very homogeneous, and chemical analysis shows it to contain 88·7 per cent. Fe, 10·5 per cent. Ni, 0·5 per cent. Co, with traces of Cr, C, S, and P; the specific gravity is 7·939. It is supposed that this may be the remains of a vivid meteor which was observed to pass over the Fresh-water River region during the autumn of 1906; it now lies in the foyer of the American Museum.

Mr. Hovey also describes two other recent additions to the foyer, viz. a slice and cast of the Gibeon meteorite and the largest known portion of the Modoc meteorite. The Gibeon meteorite, weighing 562 lb., was discovered in Great Namaqua Land (lat. 25° 8′ S., long. 17° 50′ E.), and is in the possession of the Hamburg Natural History Museum. A slice of this and a plaster cast were sent to the American Museum, where it is ingeniously mounted with the slice *in situ*, the two halves of the cast being hinged so as to show the complete form with the polished surface of the slice.

The "Modoc" is the largest known portion (20 lb. 3 oz.) of a meteorite seen to fall near Modoc, Scott County, Kansas, on September 2, 1905. Twenty-five fragments have been found, and, where pieces have been broken off by the plough, the meteorite is shown to be composed of whitish stony material containing bright specks of iron.

Photographs of the Guffey and Gibeon meteorites illustrate the paper.

THE UNITED STATES NAVAL OBSERVATORY.—The report by the superintendent for the year ending June 30, 1909, shows that the Astronomical Council, consisting of the various officers and assistants at the U.S. Naval Observa-

tory, is fulfilling a useful function in formulating the programmes of work for the various instruments. During the year, the 6-inch and 9-inch transit circles were thoroughly examined for their fitness for fundamental work, and various adjustments and modifications were made. The latitude-variation observations made with the prime vertical instrument were compared with those made with zenith telescopes at Philadelphia, Cincinnati, and Gaithersburg, and were found to give different values. The cause of this difference between the values given by the two forms of instrument was carefully looked for in the prime-vertical observations, but could not be found. Prof. Skinner was engaged until the end of the year in preparing material for the discussion of the proper motions of the 8824 stars observed by him, and published in the A.G. Zone Catalogue -13° 50′ to -18° 10′, but the work cannot be carried further until the cataloguing of the Washington zone observations, 1846–52, is completed.

MEASURES OF DOUBLE STARS.—Prof. Burnham continues his record of double-star measures in Nos. 4426–7 of the *Astronomische Nachrichten*, where a large number of measures, made with the 40-inch telescope during 1909, are given. Particular attention was paid to doubles generally neglected or little known, also to measurements for the better determination of the proper motions of faint stars and of doubles where the motions are small or uncertain.

THE BRITISH MEDICAL ASSOCIATION IN LONDON.

THE seventy-eighth annual meeting of the British Medical Association was held in London, for the first time since 1895, on July 26–30, in the buildings of the University of London. There was a very large attendance, which included a number of foreign guests and over-sea delegates and members. The Earl of Crewe and the Right Hon. Walter Long, M.P., were elected honorary members. Reference was made to Mr. Long's work, which resulted in the abolition of hydrophobia from these islands. Mr. Henry T. Butlin, the famous surgeon, was elected president. At the commencement of the proceedings he announced, amid loud cheers, that the King had signified his willingness to become patron, as his revered father was before him. The president in his address directed attention to the persevering work of the association since 1834 in placing the medical profession upon an increasingly satisfactory footing. He referred to the valuable assistance given by the association to the cause of original research. Since 1874, when scientific grants were founded, large sums have been awarded every year for research work. In 1884 two research scholarships were founded to enable men to devote their whole time to particular researches. Mr. Butlin pointed out that it was desirable to encourage research even though there were no prospect of immediate benefit from the particular line of research taken up, and he instanced cases in which an apparently unproductive investigation had led to results of vast practical importance.

At the present time the association consists of twenty-two thousand members in seventy branches. The business of the recent meeting took place in twenty-one sections dealing with particular branches of medical science, and in each section the line of inquiry which is receiving particular attention at the present time was given full discussion, foreign investigators taking a prominent part in the discussions in many of the sections. In the section of radiology and medical electricity, Sir J. J. Thomson, F.R.S., gave an address in which he pointed out that the softer rays given out from an X-ray tube were inevitably absorbed by the glass wall of the tube, and were therefore not available for application in medical treatment. He then directed attention to the researches of Prof. Barkla, of King's College, who found that substances such as metals when exposed to Röntgen radiation emitted secondary rays, the penetrating power of which was specific for the particular metal, and was independent of the penetrating power of the rays which impinged upon it. The rule was a simple one, for the hardness of the ray given out increases as the atomic weight of the metal. The only necessary condition is that the rays emitted from the X-ray tube must be harder than the specific radiation of the substance. Only substances the atomic weight of which is greater than that of calcium are found to give out these secondary rays. We have thus the power of using rays of uniform penetration for medical treatment. Thus if silver be used, the secondary rays which it gives off are about equal in penetrating power to the β radiation of radium. With iron the radiation is considerably less penetrating, while with tin it is more penetrating; with iodine, extremely penetrating radiation is given off. A large number of other papers were read bearing on Röntgen-ray diagnosis and treatment, and the great advance that has been made in Röntgen-ray diagnosis came prominently to the fore. Thus the papers of Dr. H. Orton and Dr. A. C. Jordan on phthisis showed this method to be a most valuable and trustworthy means of detecting phthisis in its early stages, and of determining the extent and position of the lung trouble. In the section of medicine, Dr. A. C. Jordan also read a paper on the Röntgen-ray appearances of thoracic aneurysm, and the lantern-slides with which it was illustrated showed very clearly the condition of the heart and great arteries in this disease. In many other sections the value of Röntgen-ray diagnosis was also evident. Thus the first session of the surgery section was devoted to a discussion of the operative treatment of simple fractures, in which Mr. Arbuthnot Lane described his method of uniting the severed fragments by means of metallic plates and screws, and in his paper, and all those that followed it, the conclusions were founded, to a very great extent, upon the Röntgen-ray appearances of the fractured part.

The discussion on chronic constipation turned very largely on the Röntgen-ray examination of the large bowel after the patient had taken a meal containing an insoluble salt of bismuth. This discussion was opened by Dr. J. F. Goodhart, who pointed out that constipation in old persons was frequently due to failure of voluntary effort. He said he held a brief for the importance and utility of the large bowel in opposition to those who, following the teaching of Metchnikoff, have come to regard the large bowel as a mere place of storage for the waste material of the food, in which poisons were generated which were very apt to be injurious. The large bowel, he stated, is meant to be full, not empty. Mr. Arbuthnot Lane said that in certain cases poisons were actually generated in the large bowel to such an extent that the patient's life was intolerable. In such cases he had removed a part or the whole of the large bowel with great benefit to his patient.

Drs. Dominici and Wickham came from Paris to discuss the subject of radium treatment. They made it clear that cancer in accessible regions can be greatly reduced in size by radium treatment, and can in certain cases be actually cured. In the case of large, deeply seated growths, a cure is not to be expected, although great diminution in size may be effected and much relief afforded. Various special forms of apparatus have been devised for applying radium to internal growths such as those of the throat, œsophagus, and stomach. Early detection of the cancer and early application of radium are the most important points.

In pathology and bacteriology, a number of important papers were read by those most fitted for the task. Thus Colonel Sir David Bruce, C.B., F.R.S., discussed human trypanosomiasis, while the paper of Prof. Wassermann, of Berlin, opened a discussion on the complement-deviation method in diagnosis—the method which he introduced for the diagnosis of syphilis, and which is now used for this purpose throughout the world. Its application to certain other diseases is now being worked out, so that it is one of the most important matters before the pathologists at the present day. A discussion on the lactic acid organisms took place, at which Prof. Hewlett was among those who took part. There was a most important discussion on the effect of digitalis on the human heart, opened by Prof. Wenckebach, of Gröningen. He was followed by Dr. James Mackenzie, Sir Lauder Brunton, and others.

The subject of dental decay was given very full discussion. It is now taught that both doctors and patients should regard decay of the teeth as a serious danger-signal, and the wholesale decay in young people and in many families so prevalent at the present time requires

urgent attention. Foods that are too soft or too finely prepared are frequently causes of dental decay, and many serious illnesses, as well as cases of chronic debility, are due to poisons absorbed from the roots of decayed teeth.

The sour-milk cure, which is now in great vogue, was fully discussed from all points of view, and its benefit in suitable cases was placed beyond doubt. More practical evidence is needed, however, and the discussion will have done much to point out the directions in which this evidence should be sought.

An address on surgery was delivered by Prof. Gilbert Barling, in which he discussed the treatment of cancer. He referred in terms of praise to the work of the Imperial Cancer Research. There was evidence that the tissues resisted the inroad of cancerous growths, though little was as yet known of the nature of the resistance. We had not yet discovered the factors which heighten or lower this power of resistance. In considering the means available for the cure or relief of malignant growths, he discussed the application of X-ray and radium treatment. His conclusions were, on the whole, in agreement with those of Drs. Dominici and Wickham. He emphasised the fact that a genuine cure is not to be expected from these agents in cases of advanced cancer, and he further emphasised the great importance of early detection. Only one real opportunity for cure existed, and this was at the first operation, which should be undertaken at the earliest possible stage of the disease, and advantage of this opportunity should be pressed to its fullest extent.

Dr. J. Mitchell Bruce, in his address in medicine, gave a brief record of the most important additions to medical knowledge during the period since the association last met in London.

First came the discovery of the spirochæte of syphilis; of the part played by the mosquito in malaria and in yellow fever, and by the goat in the diffusion of Malta fever; of the connection of a trypanosome with sleeping sickness; of the Leishman-Donovan body with kala-azar; and of the *Diplococcus intracellularis meningitidis* with cerebro-spinal fever. The existence of typhoid carriers had been fully demonstrated, as well as the dangers of other typhoid products than the stools. The effects of oral sepsis had been worked out, and proved to be so widespread, so multiple, and frequently so grave, as to make us ashamed of our previous blindness to a common source of blood infection staring us in the face all those years. Autointoxication proper had attracted professional—and only too much public—attention, and led to the introduction of a great variety of dietetic and medicinal "cures." Of improved methods of observation and diagnosis, blood examination deserved first mention; and special interest and importance attached to the Widal reaction in typhoid and to the Wassermann reaction in syphilis. Radioscopy, which was coming into clinical use in 1895, had been greatly improved and extended, more particularly in its applications to the investigation of gastric and intestinal disorders and diseases; and the orthodiagraph must be mentioned in this connection. A great impetus had been given to the study of cardiac irregularity, and the sphygmomanometer was now generally employed. A real advance had been made in the introduction of lumbar puncture as a means of diagnosis in cerebro-spinal diseases.

"During these fifteen years several new methods of treatment of the first rank have been either introduced or perfected. Chief of all comes serum-therapy and vaccine-therapy. Of great importance is the employment of spinal analgesia as a substitute for general anæsthesia, the dangers of which have been closely investigated in relation to the status lymphaticus, as well as to post-anæsthetic acid intoxication. Other powerful means of treatment have been discovered in radium, in the Röntgen rays, and in the Finsen light."

A very complete medical museum formed an important part of the meeting. It included a very valuable series of microscopical preparations showing the blood parasites of malaria, sleeping sickness, and other tropical diseases. The Imperial Cancer Research showed a beautiful collection of specimens, lantern-slides, and diagrams giving a very good idea of the valuable methodical work which is being carried out by this institution under the directorship of Dr. E. F. Bashford. In the museum, the value of Röntgen-ray diagnosis was again to the fore, for many of the sections showed negatives, prints, lantern-slides, or diagrams to illustrate the Röntgen-ray appearances in various diseases. There was also a large exhibition in which numerous firms of publishers, instrument makers, chemists and druggists, and manufacturers of special foods and dietetic preparations showed their most recent work. In the electrical apparatus section, the great power of the modern generating apparatus was very obvious, each firm being able to show apparatus capable of giving so powerful a spark that a Röntgen-ray photograph could be taken by a single flash. Different contrivances were shown to accomplish this, including various forms of mercury jet interrupter, of electrolytic interrupter, and the well-known Snook apparatus, in which an alternating current is generated and transformed by means of a step-up transformer placed in a bath of oil, the secondary current being rendered unidirectional by a simple contrivance. A new apparatus was shown by Messrs. Schall for raising the internal temperature of the body by employing the thermal effect from a high-frequency apparatus. In a spark-gap where the electrodes are separated only by the thickness of a sheet of paper, undamped oscillations are generated at the rate of more than a million a second. Similar oscillations are used in wireless telegraphy for the production of continuous oscillations. The voltage of this new type of generator is less than 3000, but currents of 500 to 3000 milliamperes are used, and the patient feels nothing except the rise of temperature. The method is said to be useful in chronic cases of rheumatic and gouty origin.

The social functions included a reception by the Corporation of the City of London at the Guildhall, a garden-party at Ranelagh, receptions at the Natural History Museum and at a large number of hospitals. Special services were held in Westminster Abbey and Westminster Cathedral.

There was a large and distinguished assemblage for the annual dinner, at which Dr. Butlin presided. The Earl of Aberdeen, Lord-Lieutenant of Ireland, emphasised the good work of the British Medical Association, and expressed his opinion that those responsible for measures of social and hygienic reform should come to the association for direction as to the best means by which such reform can be carried out. As an example of a much needed reform, he dwelt on the unnecessary and noxious fumes from motor-cars. In referring to the valuable scientific papers delivered at the various sectional meetings, he selected for special note the paper by Sir J. J. Thomson, the eminent Cambridge physicist, in which he pointed out that certain substances could be made to give out a radiation which had much the same physical properties as some of the radiation given out by radium, and suggested that these radiations might be found to have the same effect upon the tissues as those at present obtained by the application of radium.

The Bishop of Kensington, speaking at a breakfast given by the National Temperance League, said that temperance owed no small debt to the British Medical Association for the new light it was constantly throwing on scientific investigation. It was to the professional men rather than the politicians that we must look for the solutions of the social problems of the day, foremost among which was that of temperance.

Thus medical progress was discussed in all its aspects at this—the greatest annual meeting by far ever held by the British Medical Association—and the discussions added new vigour to the work of observation and investigation.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE summer meeting of the Institution of Mechanical Engineers took the form of a joint meeting with the American Society of Mechanical Engineers. More than one hundred and fifty members of the latter society took part in the meeting, which opened in Birmingham on Tuesday, July 26. The reading and discussion of papers occupied the mornings of Tuesday and Wednesday, and on Thursday the party proceeded to London, where a conversazione was held at the Institution House in Westminster. On Friday morning further papers were read and discussed in the lecture hall of the Institution of Civil Engineers, kindly lent for the occasion. The institution dinner took place

on Friday evening. The many excursions and visits to works were attended by large numbers of members of both societies and their lady friends.

At Birmingham, four papers on the handling of locomotives at terminals and running-shed practice were contributed by Messrs. F. H. Clark, F. M. Whyte, H. H. Vaughan, and W. Forsyth, all members of the American Society, and one on the same subject by Mr. Cecil W. Paget, member of the British Institution and general superintendent of the Midland Railway.

In the latter paper, Mr. Paget gives plans and description of two of the most recent sheds built in this country, viz. the Great Western sheds at Old Oak Common, of the centre turntable or round-house type, and the London and South-Western shed at Eastleigh, of the through straight type. Straight sheds are economical in first cost and maintenance, but unless they are of the type known as "through sheds" they are awkward to work; the latter class are necessarily draughty. The centre turntable type, though more expensive to build, possesses considerable advantages of working, because engines can be easily got in and out without moving others, and, in addition, better lighting and convenience in getting about and in bench accommodation are possible. There is, however, the disadvantage that when the turntable requires lifting for repairs it throws the whole of the pits served by it out of use whilst the repairs are going on. So far as possible, engines are allotted to and kept for the same drivers, and this is almost universally the rule in the case of passenger engines on most English railways. By this plan casualties are lessened owing to the greater care taken by the driver in working the engine and in properly reporting defects; as a result, the coal consumption is generally less.

Mr. F. M. Whyte, of New York, describes American methods of handling locomotives at terminals. To insure uninterrupted turntable service, two turntables may be supplied in a circular engine-house, the house being divided into parts, each having a turntable. Mr. Whyte deals very fully with the question of pooling locomotives, *i.e.* the system of increasing the service of the locomotive by placing any crew on any locomotive for service instead of holding it until its assigned crew could obtain the necessary rest. Extensive experiments have been made to determine the relative costs of the assigning and the pooling systems, and in some of these experiments no material difference in cost has been found. There probably is some loss in trustworthiness of service in pooling.

Some very good drawings and photographs of American engine-houses and their appliances are given by Mr. F. H. Clark, of Chicago. A common length of turntable for new installations is 80 feet. For boiler-washing, recent installations are the National, in which the steam and water blown off from the engines are used for washing out and for heating fresh water, and the Raymer system, which is of the enclosed-heater type, and performs similar functions. Mr. W. Forsyth, of Chicago, describes the arrangements of the Pennsylvania Railroad at East Altoona, Pa. The engine-house is in diameter and cross-section the largest structure ever erected for this purpose, having an exterior diameter of 395 feet and a turntable of 100 feet. There are fifty-two stalls, each 90 feet deep. Mr. Forsyth states that the reduction in boiler pressure from 225 lb. to 160 and 180 lb. has also reduced the number of boiler failures, and has permitted the more continuous use of locomotives which results from the pooling system. Mr. H. H. Vaughan, of Montreal, considers that in passenger service pooling is objectionable under any conditions, and should be avoided if possible. In freight service he considers that pooling is advisable if conditions are such that engines cannot be run with assigned crews. His experience is that where assigned crews can be used on engines, the cost of repairs, the amount of fuel consumed, and the class of service obtained will all be more satisfactory.

Other papers read at Birmingham were one on tooth gearing by Mr. J. D. Steven, of Birmingham, and another on interchangeable involute gearing by Mr. Wilfred Lewis, of Philadelphia, Pa. Mr. Steven considers the involute form of tooth only, as being that which is in most general use, and would welcome uniformity of opinion in the matters of cutting and using gearing. If a new form of tooth is desirable, it is his opinion that the stub form with 20 degrees angle of pressure would be a change in the right direction for the following reasons:—it can be used right down to twelve teeth in its true form, and cut on either a single cutter or on a generating machine; it is a stronger form than that most commonly used at present; a very large proportion of its face does useful work; the possible objections on the score of less contact and greater bearing pressure are so slight as to be nearly negligible.

Mr. Wilfred Lewis is chairman of a committee of standards for involute gears appointed about a year ago by the president of the American Society of Mechanical Engineers. Twenty-five years ago, as a result of investigations made on behalf of the firm of Wm. Sellers and Co., he recommended the adoption of a pressure angle of 20 degrees in place of 15 degrees commonly used. This practice has been since followed by the firm, and has given satisfaction in a general way. Mr. Lewis has since advocated an obliquity of 22½ degrees as giving less interference on twelve-toothed pinions. Experiments on behalf of the author's committee are being made at the Massachusetts Institute of Technology, and, although not conclusive, enough has been done to indicate that the friction loss in gear-teeth is influenced to a greater extent by the length of the addendum than by the obliquity of the system.

The papers read and discussed in London dealt entirely with problems connected with the electrification of railways. These were contributed by Messrs. F. W. Carter, of Rugby, H. M. Hobart, of London, W. B. Potter, of Schenectady, L. R. Pomeroy, of New York, and G. Westinghouse, of Pittsburg, the latter being the president of the American Society of Mechanical Engineers.

Mr. Carter directs attention to electrification as a means of recovering traffic drawn away from the railway by tramcars and motor-omnibuses, an expedient which has invariably been found successful in regaining much of the lost traffic. Modern electric railway apparatus leaves little to be desired in the matter of freedom from breakdown. There are about 200 miles of electrified route in this country, for the most part worked by motor coaches, employing a multiple-unit system of control. There appears little prospect of general electrification of the railways of this country, as no advantage is apparent which would in any way justify the expense.

Mr. Hobart draws comparison between systems employing series wound, continuous-electricity train-equipments, and the single-phase system. Continuous equipment provides, per ton of equipment, 11 horse-power at the axles (averaged over the journey), as against 6 horse-power per ton in the case of single-phase equipment. Mr. Hobart gives figures showing that 10 per cent. less of the takings are available for dividend paying in the single-phase system than in the continuous-current system.

Mr. Westinghouse is convinced that the extended distribution of electricity for industrial purposes can be secured only by the generation of alternating currents of high voltage and their conversion by static transformers into currents of various voltages, and has developed his business along these lines. He earnestly recommends to the serious consideration of railway engineers and those in authority the pressing need of determining the system which admits of the largest extension of railway electrification, and of a prompt selection of three standards of electrification which will render possible a complete interchange of traffic in order to save expense in the future and to avoid difficulties and delays certain to arise unless some common understanding is arrived at very shortly.

Mr. Potter considers that the development of apparatus for higher voltage direct-current has so far increased its scope that direct current at 600 volts or higher may be considered the most economical for city and interurban service. Single-phase and three-phase stock equipments are applicable only to exceptional conditions.

Mr. Pomeroy deals with the electrification of trunk lines, and concludes with the following paragraph, which called forth the commendation of Mr. Aspinall, the president of the Institution of Mechanical Engineers. The idea is all too prevalent with the public, and even with some of the bodies that have been given legal power of supervision over railway companies, that any expenditure which can be

forced upon the railway companies is just so much gain for the public. Never was there a more absolute fallacy. In the long run, the cost of every bit of railway improvement must be paid for by those who buy tickets and ship freight. Economy in the administration of our railways is just as important in the interest of the general public as if the railways were actually under Government ownership.

THE BRITISH PHARMACEUTICAL CONFERENCE.

THE forty-seventh annual meeting of the British Pharmaceutical Conference was held at Cambridge on July 26, 27, and 28, under the presidency of Mr. F. Ransom. The presidential address dealt mainly with pharmaceutical research, and Mr. Ransom indicated certain directions in which progress may be anticipated. He deplored the fact that a better organisation did not exist to bring together the two classes of investigators—pharmacists and pharmacologists. If a joint committee consisting of medical men and pharmacists were appointed with the object of organising research work, investigations might be directed in the proper channels, and better results would be obtained. The president dealt at some length with the question of the cultivation of medicinal plants, and commented upon the attempts which had been made to obtain plants of more or less standard alkaloidal content. He suggested that a subject inviting investigation was whether the variations in the constituents of drugs were due solely to the seasons, or whether they depended upon other conditions. Referring to the subject of the standardisation of disinfectants, which has recently received much consideration, he said that neither the chemical nor bacteriological processes which had hitherto been devised seemed to be applicable in all cases, although for specific purposes comparisons of efficiency might be deduced.

In addition to the president's address, twenty-one papers were communicated, the larger number of which were of purely pharmaceutical interest. The papers which aroused the most considerable discussion were those dealing with the testing of disinfectants.

In a paper contributed by Prof. Sims Woodhead and Dr. C. Ponder, the authors made clear their position in regard to the question of standardisation of disinfectants. On analysing the Rideal-Walker drop method, they picked out and gave consideration to the following factors:—organisms to be acted upon; number of micro-organisms and amount of organic matter to be added; strength and number of dilutions; time during which the disinfectant is allowed to act; temperature. Prof. R. T. Hewlett in his paper criticised the Woodhead-Ponder method, but expressed the opinion that the use of *B. coli* instead of *B. typhosus* is perhaps a desirable change, although further investigation is necessary.

Mr. C. T. Kingzett and Mr. R. C. Woodcock contributed a paper, in the course of which it was pointed out that while the Rideal-Walker test may very well serve to determine the relative germicidal values of similarly prepared preparations of a coal-tar nature, it is not applicable for ascertaining the real or relative value of other disinfectants of a different chemical nature. Dr. D. Sommerville also read a paper. There was a long discussion on these papers, in which Dr. Rideal, Dr. E. Feilmann, Mr. J. E. Purvis, and others took part, and in the course of reply Prof. Sims Woodhead said he did not wish to doubt the value of the Rideal-Walker method, because he thought it was of extreme value, but they must not be expected to accept it as a final standard.

Another paper to which reference may be made is that by Mr. J. F. Tocher, last year's president of the conference, in which the author describes a modification of Mendeléeff's classification of the elements; the suggested new arrangement, which the author thinks may ultimately prove to have a satisfactory theoretical basis, places elements of like properties in similar positions, while elements with unlike properties are separated by distances proportional to the intensity of their differences.

In a paper on the interpretation of water analysis reports, Mr. J. E. Purvis pointed out the impossibility of fixing any standard by which waters can be judged and condemned; but, he said, there were certain rules which appeared to be necessary before a final judgment could be delivered upon any water. These were briefly as follows:—(1) the history of the water should be supplied to the analyst; (2) the rainfall before and after the analysis should be obtained, because a heavy rainfall before analysis means that the amounts of the constituents are not the same as compared with the analysis before the rainfall; (3) the method of storage and of distributing the water should also be considered; (4) the surface drainage may be a factor; (5) a bacterial analysis should go hand in hand with a chemical analysis; (6) the final judgment with regard to the quality of a water should rest with the chemist and bacteriologist in collaboration.

Mr. P. E. F. Perrédès described an insect pest in belladonna (*Epitrix atropae*, Foudras, a small beetle belonging to the tribe Halticæ of the series Phytophaga), and suggested a method of eradication.

As a result of a chemical examination of the rhizome of *Cimicifuga racemosa*, Mr. H. Finnemore found distinct reactions for alkaloids, but the amount present is very small.

The meeting, as a whole, was one of the most successful which has been held for many years. The attendance was somewhat larger than usual, and the interest taken in the papers was evidenced by the excellent discussions thereon.

ASSOCIATION OF ECONOMIC BIOLOGISTS.

THE ninth annual meeting of the Association of Economic Biologists was held on July 6, 7, and 8 in the Beyer Buildings of Owens College, Manchester. The association was indebted in particular to Profs. Hickson and Weiss for kindly hospitality, and to Mr. J. Mangan for the arrangements he had made as local secretary. Prof. G. H. Carpenter, of the Royal College of Science, succeeded Mr. A. E. Shipley, F.R.S., as president, and in the course of his address dwelt on the close interdependence of research in so-called "pure" and "applied" science. The original discovery of minute protozoal parasites in the blood of various animals was apparently perfectly "useless," yet it prepared the way to modern methods of dealing with terrible diseases of the tropics, such as malaria and sleeping sickness. Similarly, the more recent researches of workers intent primarily on alleviating these diseases have resulted in many discoveries of great theoretical significance.

Turning to another topic, Prof. Carpenter reported that a new crop—tobacco—in Ireland had brought to notice fresh pests, amongst others, a spring-tail new to science. He suggested that this was not a new introduction, but more probably an animal hitherto present in small numbers, which had multiplied under the stimulus of an ample supply of a congenial food plant.

A very interesting discussion arose out of Prof. S. J. Hickson's paper on the place of economic zoology in the modern university. The author pointed out how at present the demand for trained men capable of dealing with agricultural and other pests is in excess of the supply, especially in the colonies. He outlined a scheme for securing to students an efficient grounding in general science combined, by cooperation with experiment stations, with proper practical experience. Stress was laid on the importance of the fourth year's work, and the advisability of securing, if possible, training at a central agricultural college or experiment station, *e.g.* in India or Ceylon, for those destined for a tropical career.

Another well-discussed and important topic was the problem of wild-bird protection, introduced by Mr. W. E. Collinge, who pointed out that under the restrictions imposed by the Wild Birds' Protection Acts some birds had apparently multiplied to an excessive degree. He advocated securing definite knowledge as to which birds were harmful, and taking steps to secure their diminution, *e.g.* by placing in schools specimens of the eggs of such birds, and offering rewards for their collection. The discussion brought out prominently the difficulty of determining exactly whether certain birds, *e.g.* the rook, were beneficial or harmful in all districts and at all seasons; and practical suggestions, some of which are already being utilised, for acquiring this necessary knowledge were made.

Prof. F. E. Weiss contributed the results of observations on the garden Tropæolum, some plants of which bore flowers of different colour at different seasons of the year. These and other cases of differing flower coloration, *e.g.* in *Anagallis arvensis*, are under investigation to ascertain to what degree they are hereditary characters, and to which factors the changes are to be attributed.

Animal pests naturally received considerable attention. Dr. R. Stewart MacDougall emphasised the importance in dealing with coleopterous enemies of trees of taking account of the length of life passed in the various stages, whilst in a second paper he dealt with the sheep-maggot fly (*Lucilia sericata*) and the problems suggested by its life-history, and announced the first record in this connection of *Protocalliphora azurea*. Other pests dealt with were the warble-fly of the reindeer, by the president; a species of Rhabditis injurious to cress, by Mr. G. O. Sherrard; the horse bot-fly, by Mr. Collinge; and the larch saw-fly, by Mr. Mangan. Dr. Malden dealt with the diseases of bees, and Mr. W. G. Freeman with the economic importance of the cambium in plants.

The members of the association attended the formal opening of the Biological Experimental Laboratories at Fallowfield, when Sir Thomas Elliot, of the Board of Agriculture, spoke of the harmonious relations now in existence between practice and science, and the welcome degree to which the agriculturist is prepared to appreciate the aid of the man of science in attempting to solve difficulties. The new Manchester laboratories owe their origin to such calls for aid, and Sir Thomas indicated that the Board of Agriculture would be prepared to assist financially, so far as it could, the local efforts in providing the means for research in economic biology. W. G. F.

THE FIRST INTERNATIONAL AGRO-GEOLOGICAL CONFERENCE.[1]

SOME time ago the Royal Hungarian Geological Institute sent out letters of invitation to those interested in soils in the various countries of Europe and America asking them to attend an International Conference in Budapest, where some attempt would be made at standardising methods and objects. Some degree of uniformity is urgently needed. "Plus que partout ailleurs," says the secretary in his introduction to the present volume, "il y règne une disparité d'idées, de méthodes, de procédés, une divergence de vue sur le chemin à prendre et sur le but à atteindre, un chaos dans l'usage des termes scientifiques, des mesures, des figurés, des noms et des classifications: divergence qui se manifeste non seulement de pays à pays, de langue à langue, mais aussi entre les œuvres d'un même pays et dans la littérature d'une même langue." Some confusion is for a time inevitable in a borderland subject like the present, that joins up with geology, botany, and chemistry, and is closely connected with agriculture; indeed, even its very name has not yet been settled, for we find the subject of the conference referred to as agrogeology, agricultural geology, pedology, or simply "the science of the soil."

The results of the conference are now issued in the volume before us. Several of the papers are descriptive of the soils of the countries in which the respective writers are working, among them being accounts of the soils of European and Asiatic Russia, of Norway, of Rumania, and Bohemia. As an illustration of the method adopted, Prof. Glinka's account of the Russian soils may be noted. There are six main zones recognisable, running in belts from north-west to south-east, and corresponding fairly completely with the climatic and vegetation zones. The most northerly is the Tundra zone, practically destitute of vegetation higher than lichens and mosses. The soils have been but little investigated, but appear to be generally acid and rich in partially decomposed organic matter. South of this lies the Podzol zone, covered with forest, or in lower lying places with marshes and lakes. The typical podzols may be sands, loams, or clays; they are white when dry, acid, generally poor in mineral plant food, but contain a fair amount of organic matter, and they are porous. There is either a pan or else a good deal of concretionary matter in the subsoil, the former being usual in the sands, the latter in the loams and clays. This zone covers an enormous area in Russia and Siberia; it is not much cultivated, the method adopted usually being to clear a part of the forest, crop for a few years, then leave to run wild again, and move on to some freshly cleared ground; to the south, however, the agriculture is much more advanced. Throughout this zone the low-lying soils differ somewhat in type by reason of the accumulation of humus and the presence of reduction products such as pyrites, marcasite, and others; they are more like moorland soils.

The next zone is the famous black earth or Tschernosiom zone, but in between the two is a transition zone occupying the region of the prehistoric steppes now in forest, so that the original steppe soil has become modified. The calcium carbonate originally present may still be found lower down in the soil, and there is also more food material than in the soils further north; still, in the main, these soils are of the podzol type. The black earth proper stretches from the Carpathian to the Ural mountains, and thence across to Siberia; it covers Volhynia in the west and Perm in the east. It is characterised by a dark grey or black layer rich in humus and granular in structure, overlying a subsoil rich in calcium carbonate; this subsoil may originate either from loess, drift clay, or marine deposits. There are no forests, except in the north, as already mentioned, the whole region being steppe country now largely in cultivation producing cereals. Several other types of soil scattered as islands over the zone are described in the paper, but need not concern us here.

Southwards come the chestnut-coloured soils of laminate, and not granular, structure, where the black humus layer is thinner or absent, although calcium carbonate is found in quantity, as in the soil underlying the black earth. We are now approaching the dry steppes, a pastoral region inhabited by a nomad population. Alkali soils are not uncommon in this and the lower zones.

Below this come two others in the semi-desert region, where the rainfall is 8 to 12 inches per annum only, the northern layer being brown and the southern grey or white. They have not been much studied as yet.

We have dwelt at some length on this paper because it illustrates the difficulties in the way of introducing any uniform international system of soil classification. Any attempt to arrange British soils in zones in this way would fail; indeed, in one paper where a very broad system was used, all British soils were classed as of one type. After looking through the descriptions of the soils of the other countries we feel bound to agree with Prof. Hilgard that each region should adopt its own classification. Distinctions of colour, he points out, are not of sufficient general significance to form a basis of uniform soil classification, yet in a particular region they may be of vital importance, and would form the only basis useful in practice. Ramann has drawn up a scheme of classification, so also has Sibirtzeff, both admirable so far as they go, yet neither will fit the soils of California. Indeed, the various authors at the conference were looking at the subject from at least two different points of view: some were considering the zones of continental areas, others confined themselves to the soils of small regions. Climate reacts on soil to a marked extent. The soils of arid and of humid regions differ fundamentally, as Hilgard has shown. To take an illustration from Prof. Glinka's paper, the difference between the black earth and the chocolate-coloured or grey soils further south may arise entirely from climatic causes. Over continental areas, therefore, climatic zones will furnish a useful method of grouping soils in the first instance; but it is not complete, for marked variations occur among the soils in the same zone, necessitating a more detailed classification which would take account of the presence or absence of calcium carbonate, and the "lightness" or "heaviness" of the soil on cultivation. Probably several systems of classification would be found necessary to fit the various climatic regions. If the conference failed to come to any agreement on this subject, it at any rate did much useful work in bringing out the inherent difficulties.

Another matter was dealt with which ought to be capable of arrangement. At present no two countries adopt

[1] "Comptes rendus de la première Conférence internationale agrogéologique." Publié par l'Institut géologique du Royaume de Hongrie. (1909.)

the same methods of soil analysis. This would not matter much if the methods were all absolute; unfortunately, they are mainly conventional. Thus an English analyst will say that a soil contains 0·2 per cent. of total potash, meaning by this the amount extracted by hydrochloric acid under particular conditions, although the *real* total is probably three or four times this amount. Continental and American analysts, working on the same soil, but using different methods, would reach wholly different results. The trouble is still worse in the mechanical analysis of soils. "Clay" in Great Britain means material less than 0·002 mm. in diameter, in the United States it stands for particles less than 0·005 mm. in diameter; elsewhere a widely different limit—0·01 mm.—is adopted; so with the other terms. In consequence, one can never compare mechanical analyses made in one country with those made in another; the same terms are used, but they denote different things. The confusion thus introduced into an already difficult subject is most unfortunate. One great advantage of international conferences of this sort would be to prevent such confusion arising in the future.

E. J. RUSSELL.

SCIENCE IN SOUTH AFRICA.[1]

THE Royal Society of South Africa consisted at the time of its annual report (April, 1909) of forty fellows and 160 members; it had held six meetings during the preceding year, ten papers altogether being read. Part i. of the Transactions, in which these papers appear, contains 334 pages; part ii. contains the papers read at subsequent meetings, and has expanded to 477 pages, since there were nineteen papers in place of ten. Most of the papers deal with local matters; only about half a dozen are concerned with general problems, and of these three are mathematical.

The local papers are mainly botanical. Dr. Schönland, of the Albany Museum, Grahamstown, gives a full description of *Haworthia truncata*, Schönl., the only species of Haworthia with strictly distichous arrangement of leaves. The leaves are to a large extent underground, while the exposed parts resemble small pebbles, so that the plant may be classed among the so-called "mimicry plants." Its structure is well adapted to its peculiar mode of life. The truncate apex is without chlorophyll, and thus forms a "window" through which light can pass by way of the central transparent tissue to the assimilating tissue which extends to the underground basal parts of the leaves. Dr. Marloth describes other plants possessing the same structure.

Experiments were also made to find out whether the aërial parts of plants, particularly those growing in arid regions, can absorb moisture from the air. In the Karroo there is commonly a fall of dew at night. Dr. Marloth's experiments indicate that the native plants can take sufficient moisture from this source through their leaves to satisfy their requirements. Dr. Schönland, on the other hand, is not satisfied on this point; the plants examined by him did not appear to absorb from the air anything like a sufficient quantity.

Mr. A. L. du Toit, of the Geological Survey, describes the evolution of the river system of Griqualand West. This system is very complex, but its history can be traced to a remote geological period. In Palæozoic times a continent, at a level lower than the present, extended over this area, the drainage from it being directed southwards mainly along the Kaap valley. At the close of the Carboniferous epoch this continent was intensely glaciated, and finally buried beneath the Permo-Triassic Karroo deposits; upon the surface thus formed the modern drainage system was initiated. In later periods—in late Jurassic, Cretaceous, and Tertiary times—there has been a succession of uplifts, but the rivers have been enabled to cut a peneplain. One of the most important of these surfaces extended from the Stormberg probably into Griqualand West, where it is represented by the Kaap Plateau. This surface has suffered denudation, and the rivers have cut down and laid bare the pre-Karroo floor with its drainage lines.

Dr. Broom discusses the relationship of the South African fossil reptiles to those found in other parts of the world. The Lower Karroo fauna of South Africa shows many points of resemblance to the Permian in America; it seems practically certain that both are modifications of an earlier fauna which probably inhabited a southern continent joining Brazil and South Africa. The American types are considered to be nearer the ancestral, though considerably specialised; the African, probably owing to their living in the swamps of the Karroo, developed greater length of limb and tended to become more active; but in South Africa the conditions must have been such as to promote rapid evolution, for many new types soon appeared, the most remarkable being the Anomodonts, which probably originated there. Towards the end of Permian times a land connection with Europe seems to have formed, by which the pareiasaurian fauna passed into Europe; still later—in the Upper Triassic beds of Burghersdorp—a number of European types passed into Africa without, however, any of the Cynodonts, highly characteristic of this period in Africa, passing back in return. In Lower Jurassic times land connection was well established. There is evidence of continuous land between Africa and Australia in Upper Triassic times.

The mathematical papers by Dr. Muir deal with a theorem regarding a sum of differential coefficients of principal minors of a Jacobian, an upper limit for the value of a determinant, and Borchardt's form of the eliminant of two equations of the *n*th degree. Other papers deal with the spectrum of the ruby, snake venom, the rainfall of South Africa, evaporation in a current of air, a list of the flora of Natal, and so on.

The *South African Journal of Science* is the organ of the South African Association for the Advancement of Science, its objects being to give a stronger impulse and a more systematic direction to scientific inquiry, to obtain a more general attention to the objects of pure and applied science, and the removal of any hindrances barring the progress of science. Instead of issuing one large annual volume, like our own association, a small journal is sent each month to the members. The numbers of the present volume (vol. vi., beginning November, 1909) contain the presidential addresses and some of the papers read before the sections; notes and articles from other sources are, however, included. The papers, nearly sixty in all, have the general merit of dealing with local phenomena, thus putting on record something that may pass away and be lost, or else attacking problems that can only be investigated on the spot.

It is eminently satisfactory to find that sufficient material exists to keep going these and the other scientific journals and societies of South Africa, including the geological, the chemical, and the engineering societies. South Africa has hitherto loomed so largely in the political and commercial worlds that it will come as a surprise to some to find that research work has been going on quietly and steadily for several years. The foundation has been laid on which a great superstructure may be raised; it has been proved that the fauna and the flora show in relation to their surroundings many features of very general interest and importance; a number of problems have thus been suggested for future workers to attack. Most important of all, however, is the fact that the spirit of research is abroad in South Africa at a time when colleges and universities are being founded and agricultural departments developed. There is, in consequence, the prospect that these new foundations may be started in the right direction at the outset, and so attain a position worthy of the vast possibilities of the country. The men who are now devoting themselves to research work are therefore making more than an examination of local problems, important as this is in a developing country where development often means extermination of species and obliteration of old records. They are creating an atmosphere in which the college and departmental staffs can do research work, in which, indeed, men will feel impelled to investigate. To do this in a busy commercial country like South Africa is no small achievement.

[1] Transactions of the Royal Society of South Africa, vol. i., 1910. The South African Journal of Science, vol. vi., 1909–10.

INDIAN PALÆONTOLOGY.

THE Geological Survey of India continues to publish well-illustrated and exhaustive memoirs on the fossil invertebrate faunas of the region with which it deals. Two more on the Himalayan Trias have lately appeared, and are of much interest for study in connection with recent work on the Triassic fossils of other areas. The first memoir (*Palaeontologia Indica*, ser. 15, vol. vi., No. 1, 1909), on the Lower Triassic Cephalopoda from Spiti, Malla Johar, and Byans, was begun several years ago by the late A. von Krafft, who collected much of the material. It has now been revised, completed, and brought up to date by Prof. C. Diener. It begins with a synopsis of the marine Lower Triassic formations of the Himalayas, which are proved to constitute a remarkably complete series. The detailed descriptions of the fossils which follow show that at least four distinct and successive faunas occur in the rocks of the district under consideration. Of these, the lowest or earliest is perhaps the most interesting, because it seems to represent the dawn of Triassic life in the sea. It is noteworthy for the complete absence of the numerous types of Palæozoic Brachiopoda, which are the predominating element in the Permian rocks of the Salt Range and the Himalayas. Both in the Alps and in the Himalayas the Permian and Trias are connected by an uninterrupted sequence of sedimentary deposits. The second memoir, by Prof. Diener (*loc. cit.*, No. 2), is more special, treating of the fauna, chiefly Cephalopoda, of the Traumatocrinus Limestone of Painkhanda. He returns to a discussion of the age of this limestone, and shows that enough of its ammonites are identical with (or closely allied to) species found in Europe to justify its correlation with the Julic horizon, or zone of *Trachyceras aonoides*.

Another memoir just received from the Geological Survey of India, though dated 1908, contains a valuable description of the Devonian faunas of the northern Shan States by Mr. F. R. Cowper Reed (*Palaeontologia Indica*, n.s., vol. ii., No. 5). The fossils are chiefly corals, bryozoa, and brachiopoda, with only few representatives of other groups, but they constitute the richest collection of Devonian age hitherto described from south-eastern Asia. Most of them were obtained from Padaukpin, and many appear to be identical with European species which characterise the lower part of the Middle Devonian. The marine faunas of Middle and Upper Devonian times prove to have been remarkably cosmopolitan, but in all cases, as at Padaukpin and other places in eastern Asia, there is also a local element giving them a special character.

DUTCH METEOROLOGICAL WORK IN THE EAST.[1]

(1) WE have to chronicle the issue of a new set of meteorological charts for the part of the Indian Ocean around Cape Guardafui. It is issued by the Meteorological Institute of the Netherlands to replace a set of similar charts published in 1888 which is now out of print. The observations are now sufficiently numerous to justify the subdivision of the restricted area under discussion into squares measuring 12′ by 12′, so as to bring out variations over short distances.

Special attention has been given to currents. Nearly 4000 observations, extending over the period 1888–1908, have been used, and these are all based on astronomical observations made at intervals of six or eight hours. The results are represented by "current roses," giving for each subsquare the mean velocity observed from each of sixteen directions. This method of representation gives an excellent idea of the varying nature of the currents; thus some of the roses quite near to Cape Guardafui are very nearly symmetrical stars, showing that currents from all directions may be encountered. We rather miss an indication of the number of observations used in computing each vector. Some must be based on very few observations, while others represent the mean of a considerable number of records, and we cannot help thinking that it would be useful both to the mariner and to the student to be in a position to weight the results.

The charts which follow give for each month and for each subsquare the averages for wind, pressure, temperature of the air, and temperature of the water. In the last the extraordinary low temperature of the surface water off the coast south of Cape Guardafui during the south-west monsoon is well shown. In July we find a reading of 18·8° C. (65·8° F.) slightly south of Ras Hafun, while in the Gulf of Aden, slightly west of Guardafui, a subsquare has a mean temperature of 30° C. (86° F.). Nevertheless, there is a caution in the introduction against relying on low surface temperatures to give warning of the proximity of land during hazy weather, for warm water is occasionally encountered south of Guardafui.

It has been found necessary to represent the monthly results for each element on a separate chart. Our first impulse when dealing with charts of this nature is to compare the results for different elements, and for this it is very laborious to have to refer to five different charts bound in different parts of the volume. We admit that there is danger of overcrowding, even if different colours are used for different elements, but it is a great advantage to be able to survey the complete data for a month with a minimum of cross-references.

(2) The rainfall volumes for the Dutch possessions in the East Indies form the thirtieth issue of the series. The first of the two volumes for 1908 gives daily observations of rainfall for 272 places. In the second volume we have statistics of the number of rain-days, greatest rainfall in a day, and comparisons with averages, and also a discussion of the records of eight autographic gauges. The publication, especially the first volume, which gives the names of all the observers for each month separately, seems at first sight unnecessarily detailed, but in a country where the rainfall is of such great economic importance such details are necessary, and do much to ensure accuracy.

[1] (1) Koninklijk Nederlandsch Meteorologisch Instituut, No. 105. Oceanographische en Meteorologische Waarnemingen bij Kaap Guardafui. Pp. 38. (Amsterdam: H. G. Bom, n.d.) Price 6.00 florins.
(2) Regenwaarnemingen in Nederlandsch-Indie. Dertigste Jaargang 1908. Deel i., Dagelijksche Regenval. Pp. vi+392. Deel ii., Uitkomsten. Pp. xii+190. (Batavia: Landsdrukkerij, 1909.)

PRACTICAL SPECTROSCOPY.

A NOVEL and very compact form of mounting for concave gratings is described by Mr. Albert Eagle in No. 2, vol. xxxi., of the *Astrophysical Journal*. Such a mounting has been erected, and found very satisfactory, in the spectroscopic laboratory of the Royal College of Science, and it is the experience obtained from this that has led to the publication of the details for general use.

In the Rowland form of mounting in general use there are serious disadvantages, the chief of which is that a large and darkened room must be devoted solely to the spectrograph when in use; the difficulty of efficient temperature control is also a serious one. In the new form most of the disadvantages are eliminated, and no serious new ones are introduced. The whole spectrograph for a 10-foot grating is, in the new form, contained in a box 11 feet 1 inch in length, 25 inches broad, and 22 inches deep, and the plates reproduced in the paper prove conclusively the efficiency of the apparatus under the ordinary conditions of laboratory work. On a photograph of the cyanogen band at λ 3883, taken in the fifth order with an exposure of forty minutes, lines only 0·05 Ångström are distinctly resolved. The temperature is maintained constant by lagging the double walls of the camera tube with slag wool, and the reproduction of part of a first-order iron spectrum, given four separate exposures of ten seconds at intervals of an hour, shows how efficient it is; this spectrum was taken without any special precautions whilst other work was proceeding in the well-lighted laboratory as usual, and yet the close pair of lines, separated by only 0·118 Ångström unit, at λ 4240 is resolved. Other advantages claimed for the new mounting are its comparatively low cost, its rigidity, a slightly increased dispersion, the use of higher orders than in the Rowland mounting, and the fact that the orders on either side of the normal may be employed. Against these are to be set two or three apparent disadvantages, of which, at first sight, a slight departure from normality appears to be the most serious; but, as pointed out by the author, an observer always has to construct a curve of errors when reducing observations, and such a curve would include this slight

deviation from the normal, which, taken over a 3-inch range in the first-order spectrum, only amounts to 0·2 Ångström unit.

The important part played in solar and stellar spectroscopy by the H and K lines of calcium renders it essential that the absolute wave-lengths of these lines should be known with the greatest possible accuracy. For this reason Mr. C. St. John, working at the Mount Wilson Solar Observatory, has recently made a series of wave-length determinations for these lines in the arc, spark, and electric furnace, and in No. 2, vol. xxxi., of the *Astrophysical Journal* he gives his results in terms of the secondary standards of Fabry and Buisson adopted at the Meudon meeting of the International Solar Union. The mean results are 3968·476 and 3933·667 for H and K respectively, and are estimated to be certain within 0·001 Angström. Mr. St. John also discusses the behaviour of these lines under the various conditions employed, and, from his results, concludes that the wave-lengths are identical for the absorption and the fine emission lines, and are the same in arc, spark, and furnace. The mean ratio of the width of K to H is 1·28, and the mean ratio of the respective intensities is 1·47. The experiments described were preliminary to an exhaustive comparative study of the corresponding solar lines.

PLANT DISTRIBUTION.

TWO recent papers furnish a supplement to the magnificent phytogeographical memoir on South Africa by Dr. R. Marloth. The one is an article, by Dr. L. Diels, on formations and flora-elements in the north-west of Cape Colony, published in Engler's *Botanische Jahrbücher* (vol. xliv., part i.). This is a detailed and localised account of botanical observations made in the country lying between the mouth of the Olifant River, Clanwilliam, and Calvinia. Near Clanwilliam lie sandy stretches where Compositæ and Scrophulariaceæ provide the bulk of the conspicuous vegetation. As the land rises, succulents, notably species of Euphorbia and Crassulaceæ, become predominant. At a height of 500 metres the vegetation begins to show elements natural to the true Cape flora, culminating in a "proteaceous-macchi" association on the Bokkeveld ridge. A special object of the trip was the exploration of the Hantam-berg flora, which is classed by the author with the botanical formations associated with Namaqualand.

The second paper is a contribution by Dr. H. H. W. Pearson to the Royal Geographical Society, published in the *Geographical Journal* (May), giving a general sketch of a botanical expedition through the dry western districts of Cape Colony and the adjoining German territory to Luderitzbuch, and thence from Mossamedes in Angola to Ft. Rosadas on the Kunene River. The regions of vegetation through which Dr. Pearson travelled are very clearly set out in the accompanying map. The succulent Karroo vegetation was first traversed until this gave place to a composite flora near Calvinia. Further north, floras known as the Namaqualand montane and Bushmanland were met with. The former is characterised by the presence of *Aloe dichotoma*, *Vogelia africana*, and other plants, while species of Aristida and *Parkinsonia africana* are typical of the latter type. The district lying immediately south of Mossamedes is the historic locality in which Welwitschia was discovered, and here the author found it more at home than in Damaraland, which suggests that it is a tropical species, and therefore more closely related to the genus Gnetum than to Ephedra.

Attention is frequently directed to weeds produced in new countries by exotic plants. There is, however, more interest attaching to the spread of indigenous plants caused by a disturbance of natural conditions, of which a striking instance in the case of *Celmisia spectabilis* is described by Dr. L. Cockayne in the Canterbury Agriculturists and Planters Association's Journal (April). This plant is a composite and endemic, growing naturally with other species of the genus at elevations above 3000 feet. It has a woody, creeping stem furnished with numerous cord-like roots. The end of the stem bears a rosette of thick tomentose leaves with long sheathing bases; the rosettes are crowded together, forming a circular mat or cushion. Within the shelter of the leaves lies the bud, which throws out daisy-like flowers above the leaves, and subsequently develops downy fruits. As a result of burning and over-grazing, the tussock formations at a lower level, which consist of useful grasses, are being replaced by the Celmisia. The remedy suggested is to reinstate natural conditions, when the grasses should win back the lost ground.

Captain A. A. Dorrien-Smith contributes to a recent number of the *Kew Bulletin* (No. 4) an account of his botanical excursions in Chatham Island with the primary object of collecting specimens of *Olcaria semidentata*, *Aciphylla Dieffenbachii*, and other local plants for introduction into the Scilly Isles. In the south and boggiest part of the island *Olcaria semidentata* covers acres of ground, and here the author discovered a pure white form of this normally purple daisy-like flower, and his companion found a pink variety. The article provides an interesting sketch of the vegetation, and is illustrated with several photographs, two of which represent bushes of the normal type and white variety of the Olearia respectively.

THE MAINTENANCE AND ADMINISTRATION OF ROADS.

AUTHORITIES having control of highways have now to consider the problem of road construction and maintenance from a new point of view in consequence of the conditions of modern traffic. The problem is an acute one everywhere, and various solutions of it have been put forward by highway engineers. Evidence of experts as to the causes of the increased wear and tear of roads and their opinions as to remedies will be found in the report of the important conference on roads, held last year at the Institution of Civil Engineers, and also in various publications of the Roads Improvement Association and the Royal Automobile Club. The subjoined extracts from these publications, and summaries of papers, provide the essence of a large amount of evidence given by road engineers before several conferences and associations upon important questions relating to roads.

A very large number of our roads, except those of recent construction, may be said to have grown, or developed, rather than to have been made. Many of them were originally mere tracks, and have arrived at their present state through the accretion of coats of ground-up stone, often of poor character, possibly faced with a thin crust of granite or some inferior material. The fact that many roads have been built up by the use of metalling, without foundations, other than the subsoil upon which the metalling is placed, accounts for the difficulties, troubles, and expensive maintenance now experienced in connection with most existing rural main roads, for where the foundation of a road is weak, the surface is always difficult and costly to maintain.

The greatest practicable improvement in the construction of macadamised roads is to be found in the use of the very hardest and toughest coating materials well consolidated by rolling, with the addition of just sufficient fine chippings during the consolidating process to fill completely the spaces between the stones. The common method (condemned by every road engineer) of binding together the aggregate of an ordinary macadam road by the use of road scrapings is productive of the greater part of the mud and dust found so objectionable. One of the resolutions referring to macadamised roads adopted by the International Road Congress held at Paris in 1908 was:—"To use as far as possible only hard and homogeneous road materials, regularly broken; to make choice of a binder suitable to the structure of the road material used, reducing, moreover, the binder to a minimum."

As to the wearing characters of various rocks used as road metals, some definite information is available. The Town Council of Hornsey possesses a machine by which the effect of wear and tear on road stones can be tested. The stones to be tested are all broken to a 2-inch gauge and placed in cast-iron cylinders, which are made to revolve 8000 times at a speed of twenty revolutions a minute. They are tested both wet and dry, and as the result of the shaking they receive a certain amount of chips and dust is produced. The percentage loss of weight experienced by the stones is then determined. As the treatment is the

same in every case, the machine enables an estimate to be obtained of the relative power of road stones to withstand the wear and tear of traffic, and the rubbing action which takes place at the surface of a macadamised road. A series of tests with this machine was made a few years ago in connection with an examination of the constitution of the stones by H.M. Geological Survey, and the results were published in a work entitled "Attrition Tests of Road-making Stones." The table given below shows the average loss per cent. of a few typical rocks used for road-making:—

Stone	Quarry or Locality	Average Percentage of loss in dust
Quartzite	Wick, Glos.	4·0
Ferruginous Quartzite ...	Winford, Somerset... ...	4·4
Quartz Porphyrite	Quenast, Belgium... ...	3·7
Quartzite	Cherbourg	5·7
Biotite-hornblende Granite	Mount Sorrel, Leicestershire	6·6
Chalk Pit Flints	Grays, Essex	10·4
Gabbros	St. Sampson's Guernsey	10·7
Calcareous Sandstone ...	Liphook, Hants	17·3
Foraminiferal or Mendip Limestone	Winford, Somerset ...	19

It will be seen from this table that quartzites stood the test best, that flints came out fairly well, and that sandstones and limestones are at the bottom of the list. Though the final test of a road metal can only be known by wear and tear upon the actual road, yet the results obtained by the systematic testing of stones under precisely the same conditions serve as a guide in the selection of suitable materials. They give no indication, however, of resistance to crushing. Flints only lose a small percentage of their weight by rubbing together, but they are crushed into dust by heavy traction-engines.

There can be little doubt that poor materials, with road sidings used for binding, are largely responsible for the unsatisfactory condition of many roads. A limestone road-metal is undesirable for most districts, and flints make bad roads when they are used where heavy traction-engine traffic occurs. In the long run it is less expensive to use a good road-metal than a cheap one. It does not seem to be recognised that good material can be carted as cheaply as bad, and that, properly applied, the former lasts years longer than the latter.

Assuming that a macadamised road has been properly constructed, it is worth while to consider the chief causes of damage to it. It is often said that motor-cars are responsible for the chief part of the damage; but that is not really the case. If a newly made road be noticed, it will often be seen that the ordinary motor-car traffic scarcely wears the road at all in the tracks where the wheels go, whereas the part where the horse traffic goes is worn hollow in the middle, being dug out by the hoofs. Motor-cars probably do less damage to a good road than horses. Moreover, the damage done by a 2-ton pneumatic-tyred pleasure car is superficial compared with that done by a motor-waggon with a total weight of 12 tons. The wear and tear is caused by (1) the heavy weight per axle carried; (2) the speed at which the heavy motor-car runs. Under the Heavy Motor-car Order, a car weighing 3 tons unladen, and having a load of more than 5 tons (making a total of above 8 tons), must not exceed a speed of five miles an hour, with or without trailer; but this weight and speed are constantly exceeded. It is the combination of illegal speed with illegal weights carried that is largely responsible for much serious wear and tear of roads.

It is generally believed that ordinary motor-cars cause much damage to roads by what is described as the "sucking action" of pneumatic tyres; but this action has never been proved to exist. The action which undoubtedly does remove the small particles of the road is due to a scouring or brushing of the surface by the tyres, thus leaving the large particles to be crushed into dust by the rigid wheels of other vehicles. In the case of steel-studded pneumatic tyres the brushing action is, of course, greatly increased, and is accompanied by crushing forces. To sum up, the causes of damage due to altered conditions of traffic are:—(1) Traction engines: great weight of engine; excessive vibration, rigid and ribbed construction of tyres. (2) Heavy motors with trailers: vibration, weight, rigid tyres running over road at high speed. (3) Pleasure cars: scouring action of the pneumatic tyres of cars travelling at high speed.

The chief cause of dust, as apart from its method of production, is to be found in the use of unsuitable road material. As already stated, the horse is a serious factor in the creation of dust; and the 5-cwt. battering-ram, as each leg of the horse has been called, gives a road a succession of heavy blows, apart from the screwing or puddling action, and disintegrates the surface far more than is generally realised. The motor-car, on account of its tyres and the rapidity of its movement, though it raises and scatters dust to a greater extent than any other vehicle when going very fast, does far less to create it than is generally imagined.

The dust nuisance may be lessened greatly by using nothing but high-class road metal, reducing the quantity of binding material, and reducing the cross-fall or camber of the road, so as to ensure that the traffic spreads itself over the whole width instead of always being driven to the crown of the road; but Mr. Walker Smith, in an exhaustive book recently published on "Dustless Roads and Tar Macadam," points out that even when these conditions are satisfied no very substantial improvement can be looked for. "Even when the best material and the best methods of binding are introduced, the road will always remain a pervious road. The moisture in wet weather, which tends to hold the particles of the road together, will, on being evaporated in the dry weather, leave the surface loose and friable and a ready prey to the disintegrating forces, the shock of the horses' feet, the abrasion of the steel-studded vehicle, and the scouring action of the soft-tyred ones." Mr. Walker Smith says very strongly that the binding is undoubtedly the crux of the whole question of efficient road-making and maintenance. The binding makes or mars the macadamised road, and it is, and ever has been, the weak spot in the ordinary macadam road. The Dust and Dustless Roads Committee of the Royal Automobile Club reports that, in the opinion of the whole of the road engineers with which it has been in touch, if macadam roads are to be constructed to meet the needs of the present-day traffic, with the searching demands that the traffic makes on the road surface, a bituminous binding or matrix must be employed.

The committee states that, setting aside the temporary palliatives of watering roads with chemical preparations which keep the road damp by the absorption of moisture from the air, the treatment which has been most successful in rendering roads dustless has been the surface application of tar applied either by hand or by machine. By this method great lengths of road have been rendered dustless for a whole summer season, the mud in the winter following has been reduced in quantity, and in some cases the application has lasted for more than one season. Moreover, there is almost unanimous testimony that the whole cost of the treatment is more than saved by the increased durability of the road, and already many surveyors are able to make a strong case for the extension of the treatment solely on the ground of economy alone.

The most permanent mode of treatment is that of re-making the whole of the surface of the road with tar macadam, and when a road has to be re-surfaced this treatment is also the most economical in the end.

The use of calcium chloride to keep down dust is not recommended, one reason being that the keeping of the roads moist and soft tends to the more rapid wear of the surface.

The Roads Improvement Association has issued a report showing the extent and result of the treatment of roads by tarring. From this it appears that the road must be thoroughly cleansed before treatment; about six square yards of surface can be treated per gallon of tar; sand or granite chippings must be applied after treatment; the average cost is about 1*d.* or 1½*d.* per square yard when a machine is used, and 1½*d.* to 1¾*d.* when the tar is applied by hand; at least one treatment per annum is required; the road should be dry when treated. Excellent results have been obtained at the cost of about 40*l.* per mile, and with a small consumption of tar—about one-sixth to one-fifth of a gallon per square yard.

No suggestion of tarring is, however, of any use unless the road itself is constructed of good materials, so that, with the exception of some main roads, few roads in rural districts are at present in a condition for such treatment, though the changed conditions of traffic demand a change in the character of the roads. The new conditions demand increased expenditure upon maintenance both on main and secondary roads. The annual outlay in maintenance and repair of the main roads in England and Wales has steadily increased from an average of 76*l.* a mile in 1901 to more than 100*l.* a mile in 1909. Here is an average increase of 25 per cent. in eight years, and there is no prospect that the rate of increase will diminish. It would seem that a road system which requires an outlay of about 100*l.* a mile upon the 150,000 miles of road in England must be inefficient and costly. The explanation is probably to be found in the fact that the maintenance of our highways devolves upon local authorities. It is instructive to compare our system with that followed in other countries; and this comparison is made by Mr. L. W. Page, director of the U.S. Office of Public Roads, in a paper on road administration and maintenance published in the May number of the Journal of the Franklin Institute. Subjoined is a summary of a part of this paper.

Systems of Road Administration.

The basis of the French system is the School of Roads and Bridges, one of the finest technical schools in the world, and maintained at the expense of the national Government. From the graduates of this school are chosen the highway engineers who are entrusted with the building and maintenance of the roads in France. At the head of the administrative organisation is an inspector-general of bridges and highways, under whom are chief engineers in charge of the road work of single departments and communes. Single subdivisions of departments are under the direction of district engineers and assistant engineers, the latter being equal in rank to non-commissioned officers in the army. The subdivisions are under the direction of principal conductors and ordinary conductors. Next in line come the foremen of construction gangs, the clerks employed at headquarters, and finally the cantoniers or patrolmen, each having from 4 to 7 kilometres of highway under his immediate supervision. This great administrative machine, working in complete harmony with definite lines of responsibility clearly established, accomplishes results with military precision and regularity.

In England, jurisdiction over the road is vested in, first, the county boroughs; second, the county councils; third, the urban district councils; fourth, the rural district councils. In most counties the maintenance of the highways devolves upon urban councils in the urban districts and rural councils in the rural districts. The only exception to the control of the urban and rural district councils is in the case of main roads which are highways between large towns, and the maintenance of these roads devolves upon the county councils. As to skilled supervision, it may be said that no qualifications are required by law to be possessed by the men in charge of road building and maintenance, but it is the general practice, at least in important districts, to appoint experienced highway engineers for this work. It will thus be seen that the English system lacks strong central control in the counties, there being four different classes of Government units, each acting largely independently of the others.

Germany is a confederation of States, and it follows that road administration is conducted separately by each State of the Empire. The Imperial Government exercises very little control over the highways, and does not in any way contribute toward their construction or maintenance. The Kingdom of Saxony may be taken as a representative State of the German Empire. In Saxony the highways are divided into State roads, county roads, and private ways. The State roads comprise those which are built and maintained by the State. The county roads are generally termed communicating roads, and are built and maintained at the expense of the parishes through which they lead. A striking feature of the Saxony road system is the practice of planting fruit trees along the road. The fruit yields a revenue of about 8000*l.* a year from the State roads, while the amount obtained from the fruit grown on the county roads represents a much larger sum.

The State roads are cared for by a commission of engineers. The kingdom is divided into seventeen road districts, in each of which there is a road inspector. Under these inspectors are road masters, who are employed constantly throughout the year. Each road master has about thirty-seven miles of road under his direction, and a road force of about fifteen men. In the case of the minor roads, the direct responsibility is borne by the county authorities. They levy and collect the revenues necessary for maintenance and new construction. The communities engage the road employees for the continued care of the highways. The technical supervision, however, is exercised by the road masters of the State force.

The road system of Switzerland is local in character, the various cantons having jurisdiction over the roads within their respective borders. Each canton has at the head of its road system an engineer with capable assistants. In the canton of St. Gaul, which is fairly representative, there are under the control of the engineers five inspectors or road masters who are assigned to certain districts in the canton. The engineers and their assistants must have an academic education and possess a diploma from the Polytechnic Institute, while the road masters are required to have a good technical education.

It is apparent from the foregoing that while the units of administration in European countries range all the way from the localism of England to the highly centralised system of France, through varying degrees, skilled supervision is provided for by all the systems, as well as an ample cash revenue sufficient to enable the engineers to carry out the plans for improvement and maintenance. England is the most striking example of extreme localisation, and, it is a significant fact, also the most striking example of lack of uniformity in road work and of excessive expenditure in proportion to mileage. It is also significant that the most perfect road system is that of France, which is admittedly the most highly centralised of all the road systems. France, with a total mileage of about two and one-third times that of England, expends about the same amount annually for maintenance. Certainly the inference must be plain, that centralisation makes for economy and efficiency in the administration of the public roads.

When we turn to the subject of road administration in the United States, we find that about half the States are operating under practically the same road laws as prevailed in England when America was a colony. This system of road administration provides for the payment of road taxes partly in labour, and localises the work to an extreme degree. Organisation is almost entirely lacking, and no requirements are made to secure skill or knowledge on the part of the road officials. With few exceptions, no system of accounting is in force, and no definite lines of authority are established, such as would guarantee the wise and equitable conduct of the work.

The erroneous impression often prevails that when a so-called permanent road is constructed the expense has practically all been met in the first cost. An investigation of the cost of maintaining roads in the leading countries of Europe shows how incorrect is this view. In 1901 England and Wales maintained 26,598 miles of main road at a cost of 74*l.* per mile. In 1907 England and Wales maintained 27,556 miles of main road at a cost of 89*l.* per mile, or in six years the cost of maintenance had increased 15*l.* per mile, an increase of about 20 per cent. In France the increase in cost of maintaining the national roads was about 5 per cent. in the same period. The cost of maintaining main and urban roads in England and Wales in 1905 and 1906 was 88*l.* per mile. In France the cost of maintaining all roads during 1904 was 48*l.* per mile. While these last figures are not strictly comparable, one being for 1904 and one for 1905, yet the mere fact of one year's difference in time fails to explain the difference of 40*l.* per mile in cost of maintenance—the natural inference being in favour of the superiority of the French system.

These figures express most forcibly two facts: first, that even the best of improved highways are not self-maintaining, and second, that the cost of maintenance varies tremendously with the degree of centralisation of the administrative organisation which has the roads in charge.

France, with its most highly centralised organisation, is maintaining her roads at about 54 per cent. of what it costs England and Wales with her very local and loosely centralised organisation. Furthermore, the alarming increase in the cost of maintenance has been far more rapid in the countries with local and poorly organised systems of highway administration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SHEFFIELD.—The council has appointed Mr. A. E. Findley to the newly instituted post of lecturer of applied chemistry in the University. Mr. Findley is at present assistant lecturer in chemistry at the Bradford Technical College.

THE Mercers' Company has made a donation of thirty guineas to the South-eastern Agricultural College library for the purchase of books of reference. The Fruiterers' Company has also presented a very fine copy of that scarce work, "The Herefordshire Pomona," and the Carpenters' Company a work on forestry, to the college library.

THE July issue of the *Battersea Polytechnic Magazine* shows how successfully the authorities of the polytechnic encourage an all-round development of their students. The magazine contains two general articles; one, on the house-fly, is based on the published papers of Dr. C. G. Hewitt, and the other deals with the discharge of electricity through high vacua.

AN open competitive examination for not fewer than seven situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in September next. The examination will commence on September 26, and forms of application for admission to it are now ready for issue, and may be obtained on request addressed by letter to the Secretary, Civil Service Commission, Burlington Gardens, London, W.

ACCORDING to the *Revue scientifique*, a national office of French universities and schools has been inaugurated under the presidency of M. Paul Deschanel, of the French Academy. Prof. Paul Appell, of the University of Paris, and Prof. Georges Lyon, of the University of Lille, have been elected vice-presidents. Dr. Raoul Blondel has been appointed director. The new department is to be installed at the Sorbonne, and its object will be to make known to foreigners the educational resources of France.

AT the close of the term of the Royal Agricultural College, Cirencester, on July 27, the principal, Prof. J. R. Ainsworth-Davis, announced that the council of the University of Bristol has enacted a temporary ordinance, which will probably be made permanent in the autumn, making the college part of the University for higher teaching in agriculture and forestry. He also announced that Mr. H. J. Elwes, F.R.S., has placed a portion of his afforested land at Colesborne at the disposal of the college for research purposes.

WE are glad to receive a copy of the July number of the *Science Journal* of King's College School, Wimbledon. It is a special photographic number of twenty-four pages with several inset plates and sheets of illustrations, and is evidence that photography at Wimbledon takes a very noteworthy place among the out-of-school subjects that engage the boys' attention. Of the thirteen papers or essays, all except two seem to be by the boys themselves, and they deal with camera construction, exposure, development, printing, optics, enlarging, sports photography, and colour photography. It is gratifying to see that the greater number of the articles refer to the writers' own experiences, and are evidence of intelligent work. There may be room for different opinions as to the usefulness of a table of poisons, with the symptoms when taken and the ordinary antidotes, because it may be thought preferable for a lad to get assistance rather than to attempt to diagnose and treat a case of poisoning himself, but with reasonable care such cases of need will never arise.

THE report (Cd. 5257) has been issued of the departmental committee appointed to consider the statement of claims to additional State assistance, and estimates of the amounts needed for the respective services, which have been supplied by the Scottish universities at the request of the Government, and to report for what objects and to what extent assistance, if any, should be granted from public funds in the interests of the proper development of the work of the universities. The committee reports that a good claim has been made out for an additional grant to Scottish universities, and recommends 40,000*l.* as a fair contribution to their more pressing needs. This sum it proposes should be allocated as follows:—Edinburgh, 12,500*l.*; Glasgow, 12,500*l.*; Aberdeen, 9000*l.*; St. Andrews, 6000*l.* The grants, it is recommended, should be on condition that their administration should be in the hands of the respective University Courts, which should submit annual reports to the Treasury. Not less than 1500*l.* of the grant to St. Andrews University is to be devoted to the conjoint Medical School at Dundee. It is further recommended that, in addition to the 40,000*l.*, 3000*l.* should be paid annually to University College, Dundee, and that the grant at present received from the University Colleges (Great Britain) Grant should be discontinued.

THE antagonism which exists in England between the mathematician and the "practical man" is so deeply rooted that any attempt to break down existing prejudices will be studied with the keenest interest. In his presidential address to the Mathematical Association last January, Prof. H. H. Turner gave a remarkable account of the efficient development of the Egyptian Survey under the direction of Captain H. G. Lyons, F.R.S., in which he states:—"Now it will be readily imagined that for work of such extent and variety it is not easy to get a suitable staff of assistants. Scientific knowledge is necessary, but so also is a knowledge of Arabic and a physique which will stand the hot climate; so also is a business capacity and a faculty of detecting the truth in its Oriental disguises. It might well be that any one of these qualities was essential, while the rest, though desirable, might have to be dispensed with; or it might be that some rare combination of them must be sought with toil. It will probably be admitted that the final opinion of a man who has gone through the trying experience of getting together a staff suitable for such work, and finds himself ultimately satisfied as to the right course, is worth hearing; and hence I feel that the association will learn with peculiar pleasure that Captain Lyons's final method is to take able mathematicians from Cambridge or Oxford and trust to luck for the other qualities. The one thing he finds needful is that when some strange situation occurs, they should have a firm grasp of the fundamental principles, and not merely a knowledge of the rules deduced, which may fail to meet some unforeseen contingency. And this essential condition Captain Lyons has found to be fulfilled by mathematicians when others have failed to meet it. His faith in them has been justified in cases where a breakdown might have possibly been admitted. Even the most complete knowledge of mathematical or physical principles could scarcely be expected to inspire a man in dealing with an Arab camel-driver who was shamming sick; or with the organisation of the commissariat for a journey in the desert; or with an unexpected attack by wandering tribes which necessitated addressing them with dignity from the hump of a camel with three rifles pointed at one's chest. But it has been proved in the best possible way, viz. by actual experience, that such situations are dealt with capably by young men selected for their mathematical ability, with no special training for the contingencies of life beyond what undergraduates all pick up from life in one of our great universities. This is a lesson which we may well lay to heart."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 25.—M. Émile Picard in the chair.—H. **Deslandres** and J. **Bosler**: The phenomena presented by the tail of Halley's comet during the passage of May 19 last. From a discussion of various observations, especially those made by R. T. A. Innes at Johannesburg, it is concluded that the tail of Halley's comet was repulsed by the earth, and the evidence is in favour of this repulsion being due to electrical causes.—P. **Villard** and

H. **Abraham**: Explosive potentials. A study of the phenomena of the spark discharge. In a previous paper a description was given of the results obtained when the changes of potential were slow; the present note deals with the effects of high-voltage alternating currents.—D. **Gernez**: The colours arising in colourless solutions of coloured bodies at the moment of the solidification of the colourless solvent. Colourless solutions of mercuric iodide in various solvents (naphthalene, stearic acid, chloral hydrate, phenol, &c.) become yellow on solidification, owing to the separation of the dissolved iodide in the unstable yellow modification.—A. **Lacroix**: Some minerals formed by the action of sea-water upon Roman metallic objects found off the coast of Mahdia, Tunis. A sheet of lead gave crystals of cotunnite ($PbCl_2$); transparent brilliant crystals of phosgenite ($PbCO_3.PbCl_2$) were also found. Two copper minerals are also described, covellite (CuS) and chalcosite (Cu_2S).—L. **Mangin**: New observations on callose. This name is applied to a new substance obtained from the membrane in fungi; it is differentiated from cellulose by several reactions, especially by its insolubility in Schweitzer's reagent, and by its rapid solution and destruction by glycerol at 300°.—A. **Ladenburg**: Racemic and liquid combinations. The results of experiments on the melting points of mixtures of inactive pipecoline containing variable quantities of *d*- or of *l*-pipecoline are shown in the form of a curve. The existence of the racemic pipecoline in solution is clearly demonstrated.—A. **Calmette** and L. **Massol**: The precipitation reactions of serums from tuberculous subjects, and of the serums from animals hyperimmunised against tuberculosis in presence of the tuberculins.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1910. The results are collected in three tables, giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Jean **Mascart**: Photographs of Halley's comet. Reproduction of photographs taken from Mt. Guajura, Teneriffe, at an altitude of 2715 metres.—D. **Eginitis**: The physical phenomena presented by Halley's comet.—R. **Bricard**: Concerning a claim for priority by E. Study.—Paul **Dienes**: A problem of Abel.—Stienne **Mazurkiewicz**: The theory of *ensembles*.—A. **Korn**: The biharmonic problem and the fundamental problem in the theory of elasticity.—E. **Pringsheim**: The emission of gases. A reply to some remarks by M. Bauer on some experiments by the author.—Gabriel **Sizes** and G. **Massol**: The harmonics of wind instruments.—L. **Hackspill**: The electrical resistance of the alkali metals. The metals cæsium, rubidium, potassium, and sodium were distilled directly in a vacuum into the tubes used for the measurements, and the electrical resistance determined at temperatures ranging from 55° C. to the boiling point of liquid air. The figures are somewhat lower than those given by previous observers; a trace of oxide appreciably raises the resistance.—A. **de Gramont**: The place of ultimate lines in spectral series.—G. **Reboul**: Chemical reactions and ionisation. The experimental results are in general accord with those given by MM. de Broglie and Brizard.—Abel **Buguet**: The cryoscopy of the naphthylamines and addition compounds.—E. **Briner** and A. **Wroczynski**: The action of pressure and temperature upon cyanogen. Prolonged heating at 220° C. under a pressure of 3/4 atmosphere was without effect upon cyanogen; at the same temperature, under a pressure of 300 atmospheres, 10 per cent. of the gas was converted into paracyanogen in six hours. At the ordinary pressure a temperature of 310° C. is required to effect an appreciable change; under high pressures the change commences at lower temperatures, and in the latter case, in addition to *para*-cyanogen, some carbon and nitrogen are produced by the decomposition of the gas.—Henri **Bierry**, Victor **Henri**, and Albert **Ranc**: The action of the ultra-violet rays upon certain carbohydrates. Under the influence of the ultra-violet rays the molecule of *d*-fructose undergoes a profound degradation, formaldehyde and carbon monoxide being produced.—Daffy **Wolk**: Aluminium nitride, its preparation and fusion. The temperature of formation of aluminium nitride from aluminium and ammonia is 820° C. to 850° C.—Miroslaw **Kernbaum**: The decomposition of steam by the brush discharge. Working at the ordinary temperature, the brush discharge converts water vapour into hydrogen and hydrogen peroxide. At higher temperatures the latter substance is decomposed, and a mixture of hydrogen and oxygen is observed.—V. **Grignard**: The decomposition of phenol ether-oxides by mixed organo-magnesium derivatives.—Gabriel **Bertrand** and G. **Weisweiller**: Researches on the constitution of vicianose. The products of the diastatic hydrolysis of vicianose have been found to be *d*-glucose and *l*-arabinose.—G. **Friedel** and F. **Grandjean**: The anisotropic liquids of Lehmann.—Leclerc **du Sablon**: The theory of periodic mutations.—M. **Hue**: The variation of the gonidia in the genus Solorina.—J. **Virieux**: The sheaths and mucilages of the fresh-water algæ.—Audebeau **Bey**: Experiments carried out in Egypt with the view of determining the influence of the level of the underground water of the Delta on the growth of cotton.—MM. de Drouin **de Bouville** and L. **Mercier**: The appearance of the *furonculose* in France. This formidable disease of the trout has appeared at Bellefontaine, near Nancy.—O. **Duboscq** and B. **Collin**: The sexual reproduction of a parasite of *Cyttarocyclis Ehrenbergii*.—J. E. **Abelous** and F. **Bardier**: An attempt at the immunisation of animals against urohypotensine: the antitoxic action of the serum of immunised animals.—E. **Tassilly** and R. **Cambier**: The abiotic action of ultra-violet rays of chemical origin. The light from a carbon bisulphide flame burning in nitric oxide possesses a distinct, though feeble, sterilising action.—E. **Gley**: The modes of extraction of secretine. A new stimulant for the pancreatic secretion.—A. **Briquet**: The genesis of relief forms in the Gallo-Belgian region.

CONTENTS.