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THE PLANT AS MACHINE.

Plant Response as a Means of Physiological Investigation. By Prof. Jagadis Chunder Bose. Pp. xxxviii+781; with 278 illustrations. (London: Longmans, Green and Co., 1906.)

THE emotions that will be aroused by this book in different classes of readers may well be very dissimilar. A biologically equipped reader with no special knowledge of plant physiology will experience dazzled admiration for the logical, progressive way in which the author builds up, not in words, but actually experiment on experiment, a complete functioning plant from three simple conceptions. These conceptions, which will be critically considered later, are briefly the following:—*stimulation*, the transference of external energy to the plant; *contraction*, the constant "direct response" of plant-cells to stimulation; *expansion, including growth*, the "indirect response" to stimulation.

This present book, big as it is, is devoted almost entirely to the mechanical responses of plants; another volume is promised on electrical responses. By mechanical responses we are to understand all movements, in the widest sense, not only the obvious movements of sensitive and sleeping plants with all geotropic and heliotropic movements, but also the movements of expansion in growth and the pumping of water up the plant, and, further, "death-spasms" and all the minute shrinkages of unspecialised cells produced by stimulation. All these vital manifestations are dealt with in sequence, passing from the simple to the complex, and in them the author finds nothing that cannot be interpreted in terms of his three primary conceptions.

Another type of reader, a student of plant physiology, who has some acquaintance with the main classical ideas of his subject, will feel at first extreme bewilderment as he peruses this book. It proceeds so smoothly and logically, and yet it does not start from any place in the existing *corpus* of knowledge, and never attaches itself to it with any firm adherence. This effect of detachment is heightened by the complete absence of precise references to the work of other investigators. The student, puzzled by the number of original conceptions, may hesitate between accepting and rejecting the whole book, and will probably wait, with judgment suspended, until someone with more conventional ideas of the plant than Dr. Bose has re-investigated the phenomena and interpretations here brought forward.

The extreme isolation of this book is no doubt to be explained by the author's scientific past. Dr. Bose was, we believe, a physicist originally, and has been drawn into biology by following up the similarities which he has announced between the electrical and other responses to stimulation given by metal bars and by living animal or vegetable cells (see "Response in the Living and Non-Living," 1902). Dr. Bose preaches the continuity of response in all matter, living or non-living, in metal wires, muscle fibres, sensitive plants, and vegetable cells in general, and has described effects in metals corresponding to fatigue, latent period, summation of stimuli, temperature-optima, and other characteristic vital phenomena. From this similarity of the effects of stimulation he passes to assuming a similarity of mechanism in all these cases. In metal bars the mechanism is, of course, physical, and there is no question of stored chemical potential energy liberated on stimulation: this purely physical interpretation is by him extended to living cells; molecular change of protoplasm, not chemical change, is all he recognises, and when a temporary storing of energy has to be admitted he considers it a purely physical accomplishment.

The originality of this and of other fundamental views stated or implied in this book makes it more important for a reviewer to consider these conceptions critically than to give an outline sketch of the whole book, interesting and stimulating though it is.

Dr. Bose conceives the living organism as a delicate responding physical machine the responsive movements of which are brought about entirely by external stimuli. All external stimuli, chemical, thermal, mechanical, photic, &c., produce the same *direct response*, namely, contraction of the cells with active expulsion of water, a negative turgidity-variation, and a negative electrical variation.

These effects are observable, not only in so-called "sensitive" plants, but in all living parts of plants, and it is a definite advance, due to Dr. Bose's delicate experimentation, to have it shown that all radial organs, stems, styles, stamens, &c., shorten on stimulation.

In addition to the direct response of contraction there is also an opposite effect, the so-called indirect response of expansion, which is produced at a distance from the stimulus by the water expelled in contraction causing distension or expansion of cells elsewhere, with accompanying positive turgidity-variation and positive electrical variation. Of this nature, an indirect effect of stimulation merely, is the characteristic vital phenomenon, growth.

Much, then, is made to depend upon stimulation, yet the author holds the astonishing view that all the work done by the plant is the real equivalent of energy received by the impact of stimuli from without. The author does not even attempt to impart verisimilitude to this view by including food materials among his stimuli. For him the living organism is not a combustion engine doing work by the energy liberated chemically in oxidising carbon compounds, but it is just such a physical machine as a windmill, requiring blows rather than food to make it work, and the last picture in the book is indeed a figure of this windmill. We fear that, valiant and thorough as Don Quixote in his attack upon this misconceived phenomenon, the author hardly avoids a similar fate by starting with an inverse misconception.

It is easy to see that Dr. Bose acquired this view of stimulation originally from his experiments on the

responses given by metal bars. In these experiments the work done on the bar, generally by torsion, greatly exceeded the output of energy in the electrical and other response produced. There is no liberation of stored potential energy in such a case, therefore there is really no similarity with the mechanism of the living cell, though molecular change no doubt occurs in the protoplasm as it does in the metal wire.

Just as we hold that Dr. Bose has transferred from his physical experiments a conception of biological stimulation which is inadmissible for either animal or vegetable cells, so it seems to us that his conception of contraction is derived only from the activity of animal muscles, and is inadmissible for the mechanical response of plant cells. There is really no evidence that these two phenomena are of quite the same order and both due to active contraction of the living part of the cell, though an *a priori* philosophical outlook has led many to assume it.

When the irritable stamens of Centaurea are touched they shorten, even to one-third of their length, which diminution is accompanied by an extrusion of a corresponding amount of cell sap from the cells into the intercellular spaces, and by comparative flaccidity of the cells.

Now the vegetable cell, unlike the muscle cell, is at its maximum rigidity when at rest, being distended by the osmotic force of molecules dissolved in its sap. These molecules are kept in by the protoplasmic lining of the cell, which is impermeable by them though freely permeable by water. The tenacious and elastic cell-wall, itself freely permeable to everything, is able, owing to its tenacity, to protect the protoplasm from being ruptured by the osmotic pressure, which reaches several atmospheres.

Whether one holds the view that the shrinkage which occurs on stimulation has, as its antecedent stage, decomposition of some of the osmotic molecules, or sudden permeability of the protoplasm, the contraction itself cannot be attributed to active contraction of the living part, but must be due to the forceful elastic contractile recovery of the dead cell-wall, now no longer distended through osmotic force. It is incredible that the stimulated protoplasm, so watery in texture, can contract actively against an extending force of several atmospheres and actively expel cell-sap. Unlike muscle, the "contracted" plant cell is flaccid, and the protoplast does its mechanical work while recovering from contraction, in again extending its wall ready to react to fresh stimulation. This corresponds to the relaxation time of a muscle, so that the two machines are quite different in their phases.

Further, another fundamental difference lies in this, that a muscle does not really contract in volume when stimulated; it merely alters its shape, becoming shorter and broader, a special property exhibited by a number of non-living peculiarly organised structures, india-rubber strips, for example. The plant cell, on the contrary, really contracts in volume; whether it alters its shape depends upon the relative extensibility of the different walls. Again, this contractility of plant cells is inherent in the very organisation of the cell, and is found in all primitive types and in all young cells, and is not a specially evolved mechanism like the contracting muscle fibre. It is finally interesting to note that it has not been really proved that heat production is associated with the contraction of plant cells rather than with the subsequent expansion when work has to be done by the protoplast.

Dr. Bose's conception of growth is more elusive and still more isolated. Growth, the indirect remote response to stimulation, is due to that part of the energy of a stimulus not used in direct response. This energy is held to be communicated hydraulically to the growing point as pulsations, and of these pulsations graphic records are given. Stimuli applied directly to the growing region must, of course, cause contraction, *i.e.* retardation of growth, as their direct response; therefore the pulsations of the growing point are attributed, as indirect responses, mainly to excitatory reactions occurring below the zone of growth.

Dr. Bose's book abounds in experimental evidence on all points, a feature of the greatest merit, yet we must say that many of the fundamental experiments are not nearly critical enough. For example, one reads continually of the striking effect of *thermal* stimuli: these are produced by the electric heating of a platinum-wire-frame which surrounds the living stem; when a succession of stimuli is wanted it is produced by passing and cutting off the current alternately. In relation to this treatment we are given no idea of the temperature that the wire or the plant attains, or of how far the temperature of the plant actually oscillates under this alternately hot and cold environment. The effects produced in this way are very extraordinary—longitudinal contraction of stems, styles, and other radial organs, stimulation of *Mimosa* pulvini, &c.—but there is no attempt to trace the transition from such effects to those of surrounding high temperatures which are kept uniform.

The reader rather distrusts the author's views on thermal effects on finding him propose seriously to examine (chapter xliv.) the effect upon growing parts of "thermal radiation" apart from the effect of the actual temperature of the part. This distinction is surely confusion of thought, and the differences recorded are no doubt due to actual difference of temperature, for the method of experiment is quite fallacious. It is, indeed, supposed that a plant surrounded with a hot radiating platinum spiral, the whole being enclosed in an experimental chamber, will be at the same temperature when there is a heat-proof screen between the plant and the radiating spiral and when this is removed, and this just because a thermometer somewhere in the general air of the chamber keeps a uniform constant temperature all the time!

The apparatus and the experimental methods employed show great ingenuity and a praiseworthy simple directness of attack which, however, occasionally passes into *naïveté*. One feels that valuable results are to be got with the delicate optical lever, the kunchangraph, the balanced crescograph, the

morograph, &c., instruments which measure changes of one-hundredth of an inch or less, though their very delicacy must introduce sources of error, about which nothing is to be found in the book. Workers on growth will be forced to abandon their primitive and clumsy methods, and much good will result from the refinements here introduced.

In conclusion, we can only say that there are literally scores of special points of the greatest interest raised in the course of this book, which cannot, of course, be dealt with here. If the primary desire that these points raise is the desire to cross-examine, it is to cross-examine, not the author, but the plant itself which bears such uniform and honestly-intentioned testimony in favour of Dr. Bose's views. All such experimental cross-examination will make for the progress of knowledge, and we think that Dr. Bose can claim that his book will be an external stimulus (if not in his sense at least in ours) to the growth of plant physiology and the responses of future investigators. F. F. BLACKMAN.

THE NORSEMEN IN THE ORKNEYS.

Monumenta Orcadica. The Norsemen in the Orkneys and the Monuments they have left. By L. Dietrichson. With original drawings and some chapters on St. Magnus Cathedral, Kirkwall, by Johan Meyer. Pp. xiv+200. (Kristiania; London: Williams and Norgate, 1906.) Price 3*l.* net.

THIS handsome quarto volume from the pen of the learned head of the Art Museum of Christiania is issued in a bi-lingual form, being divided into two parts; the first is an abridgment in English of the second, which is in Norwegian. It appears at an opportune time, when the ties connecting the two kingdoms are closer than they have ever been since the separation of the islands with which it deals from the Scandinavian kingdom on the marriage of the daughter of Christian I. to the Scottish king in 1469.

Based chiefly upon the importance of the Orkney Islands to Norway as a basis in the Middle Ages, and on the historical interest attaching to the architectural remains of the centuries during which they were ruled from that country, the author's task has been a scientific inquiry into every detail connected therewith. He displays throughout a most intimate knowledge, not only of the Sagas, but of the writings of those authors on both sides of the German Ocean who have essayed to identify the sites and fix the questions of the dates and details of construction of the more important erections; and during a visit to the islands half a dozen years ago, when he was accompanied by Mr. Myers, he had an opportunity of personal inspection of the remains, and has produced a work that will be heartily welcomed by all students of the archæology, history, and architecture of our northern isles.

The introduction deals with the Orkneys and their connection with Norway, and with the Orkneys in literature, in which the author, after enumerating all the islands and parishes with their Norse derivatives, adjusts a few of them according to his own researches, describes their scenery, climate, and natural history, and gives a list of many Norse words surviving in the names of homesteads and in the dialect; the Roman, Norse, and Scottish authors whose writings have constituted the sources of the history of the islands are also briefly referred to. In order to present the work as a continuous whole, the author has included the pre- and post-Norwegian periods, and divided it into three books, dealing respectively with the prehistoric, the Norwegian, and the Scottish remains. He is in full accord with all other Norse scholars in repudiating the idea of a Scandinavian origin for the sepulchral chambers, stone circles, standing stones, and brochs which abound all over the islands; these he briefly describes, without, however, committing himself to any of the various theories that have been urged regarding them, and relegates them all to a period anterior to A.D. 600.

From that period to A.D. 872 is assigned to an early Celtic Christian occupancy, that of the Peti and Papæ. The distinguishing architectural features of their chapels are pointed out, six existing ruins are enumerated, while from saintly dedications and Saga records the sites of eight additional ones that have disappeared have been identified.

The Norse period 872 to 1468 is the most important and interesting portion of the work; there is already a large amount of literature dealing with this period, and to those who have been nurtured on the contributions of Munch, Dryden, Anderson and others there may be much of detail to unlearn by those who accept the author's views. At the same time, the older works suffer nothing by the comparison; in fact, any faithful interpretation or correlation of facts, both historical and monumental, could hardly have been looked for until after the publication of the Rolls edition of the Icelandic Sagas in 1887. Prof. Dietrichson opens it with a wave of emigration from Norway to the island of Sanday, where he supposes the first stronghold of the earls to have been established. The monuments are chronologically arranged; the first group comprises the remains assigned by the author up to the end of the tenth century, and embraces the tumuli bearing the names of the Saga characters who are recorded as having met their death in the Orkneys and as far south as the Oykell in Sutherland, the Norse burial mounds being distinguished from the Celtic "cairns" by their having been constructed, not of stones, but of earth "barrows," as well as a few churches and the Norse earls' palace as Birsay.

With the eleventh century the interest increases; among the more important items which are new may be mentioned the confirmation of the opinion that the Thing-stead was held in Rendall, in opposition to the popular belief that it was at Stenness. The question of the time of the erection of the unique St. Magnus Church on Egilshay, which has been a puzzle to antiquaries for a long time, has been focussed for various assigned reasons into the three years immediately following the murder of the earl on that island, that is, 1135–8.

Ecclesiologists who have been searching for the

missing monastery recorded by Fordun as existing in the Orkneys, and for which sites have been claimed in Helliarholm and Stromness, will be interested to know that the hitherto disregarded buildings in the immediate vicinity of the chapel on Eynhallow are recognised by the author as part and parcel of one whole establishment, which he is satisfied is none other than the Cistercian monastery presided over by Laurentius until he was transferred to Melrose in 1175.

Coming to speak of the cathedral of St. Magnus, "the grandest building in the Orkneys, next to Trondhjem Cathedral the mightiest monument of the whole of ancient Norway," he looks upon it as the living embodiment of the idea that when the war-like spirit of the Vikings sank to rest their intellectual strength and civilising power came into play. Mr. Myers contributes chapters on the architecture and the architectural history of the cathedral, also a comparison with buildings of the same period elsewhere. On entering the building he is appalled by the vulgarity that dominates the whole of the modern decoration, especially the painted wooden screen, the hideous galleries, and the walled-up triforium, and appeals to the noble Scot by picture and pen to remove the disturbing additions and regain the grand effect of an unbroken interior.

These chapters will be read with great interest, the more so as a recent large legacy is available for the repair and restoration of the building. They are given in full in both languages, characterised by strong individuality in the method of treatment, and exhibit a wider range of professional knowledge of the subject than has hitherto been displayed in its investigation, entering minutely into details of construction and ornamentation, as well as interpreting the thoughts of the various builders to whom he has assigned the different additions and alterations. He introduces many ideas that will be new even to those most familiar with the building and who have given it much consideration. The result of his comparison with Durham, Southwell, Dunfermline, the late lamented Selby and some others leads him to conclude that the artistic tendencies which produced the original structure issued mainly from the north of England, probably Durham, and spread not only to Orkney, but to the west of Norway. Passing on to other buildings of the Norwegian period, the author traces from the existing ruins of the bishop's palace at Kirkwall the form and subdivisions of the original structure, describes the more modern additions, and mentions several points on which his conclusions differ from those of former writers. He says of the palace:—

"There is no building in the Orkney Isles that is more revered by us Norwegians than the palace in which our greatest king died."

A short account of the Norse earls' palace at Birsay and Notland Castle in Westray ends the Norse period.

The Scottish division treats of the Stuarts' palaces at Birsay and Kirkwall, and of the style of building in town and country, in which Norse characteristics blend more or less with the now almost all-prevailing Scottish style.

The five appendices to the volume comprise a lengthy Orkney chronology; lists of Orkney earls and bishops; the island names mentioned in the Sagas, Fordun, and other authors, down to the most recent chart in a carefully tabulated form; and a table of the genealogy of the Orkney earls. The work is profusely and beautifully illustrated, chiefly by original drawings executed by Mr. Myers. The cover bears the arms of Kirkwall emblazoned on it. The book is one of the most valuable contributions to the historical literature of our islands, if not the most, that has appeared since the time that Barry first published his "History." J. W. CURSITER.

ORGANIC CHEMISTRY FOR STUDENTS.

Cours de Chimie organique. By Fréd. Swarts. Pp. 669. (Paris: A. Hermann, 1906.)

ACCORDING to the preface, this book is intended for medical, engineering, pharmaceutical, and other students who, having attended lectures in organic chemistry, desire to increase their knowledge of the subject without expending the time necessary for a more advanced course. It is founded on the author's lectures delivered to students commencing the study of organic chemistry at the University of Ghent. To these lectures Prof. Swarts has added, as far as possible, the descriptive material which he considers necessary for the study of elementary organic chemistry, as also the discussion of the theoretical points omitted from the lectures in consequence of lack of time. The distribution of these theoretical discussions throughout the text is preferred to their collection in an introduction, as giving the student an opportunity of first becoming acquainted with the substances concerned, only the more typical of which are specially described.

Such a book is admirably planned to assist the student who has had the stipulated preliminary training in realising the close connection which exists between the experimental facts and the theories of organic chemistry. It is, therefore, all the more to be regretted that, after opening the introduction with a few historical remarks, the author has inserted a number of short sections on such subjects as isomerism, metamerism, polymerism, tautomerism, multiple linkings, and stereoisomerism. In any case these are subjects which are bound to be referred to in the descriptive text. This, in fact, happens, stereoisomerism, for example, being discussed in a far more satisfactory manner with the crotonic acids and with fumaric and maleic acid.

These matters are followed in the introduction by the usual few pages devoted to an account of qualitative and quantitative elementary organic analysis. It seems to the present writer that however useful such pages may be in the ordinary text-book on organic chemistry, in a book which lays special stress on the theoretical as opposed to the descriptive side

of the subject it would have been better to omit these and to have utilised the space so saved in filling up some of the gaps left in the theoretical treatment, and to which we refer later. The same remarks apply to some extent to the sections on the separation of organic compounds, which are valuable in so far as they treat of the law of partition and the distillation of mixtures of miscible and of non-miscible liquids, but much space is taken up by descriptions of working methods unnecessary to the student who has attended an experimental course in the subject, and insufficient for the instruction of the inexperienced. Again, in a book of limited space, why lavish two whole pages on illustrations of a large table carrying a small combustion furnace, with tube and fittings, and of an ordinary type of reflux apparatus! The book could hardly have suffered from the omission of these, together with most of the remaining illustrations, the instructional value of which, for example, of the sketch of the superseded distilling tube of Le Bel and Henninger, or of the large acetylene burner on p. 95, is not always apparent.

Having found fault so far with the introduction, and that chiefly because of its failure to reach the standard of excellence set up by the preface, we must state that the theoretical discussions throughout the remainder of the book are clear and satisfactory, as are also the later portions of the introduction dealing with the calculation of formulæ and molecular weights, the thermochemistry of carbon, and the general properties and classification of the compounds of carbon according to their structure.

Of the 585 pages remaining after the introduction, 317 are devoted to the consideration of the alicyclic compounds and thirty-nine to the cyclic groups intermediate between these and benzene. This, with its derivatives, is described in 175 pages, leaving only fifty-four for the discussion of the heterocyclic compounds, the glucosides, the albuminous substances, and the soluble ferments. As the book contains comparatively little small print and the margins are ample, it follows that some of the groups must be treated in but a scanty manner, if at all, those included under the three last headings being the chief sufferers from this cause. Certainly in the space at his disposal the author gives a surprisingly comprehensive review of the more important of the heterocyclic compounds.

The arrangement of the alicyclic compounds differs in several respects from that to which we are accustomed. The esters appear under the old name of "compound ethers" amongst the ethereal derivatives of the alcohols, whilst we do not make acquaintance with the ketones or the aldehydes until after the description of the monocarboxylic acids and the substances derived from these. A few helpful tables are given showing the principal mono- and di-basic acids with their main physical properties, and of the aldoses with the corresponding penta-hydroxy-acids. The carbohydrates are followed by a succinct account of the derivatives of carbonic acid.

In the course of the chapters on the alicyclic compounds, optical activity and the hypothesis of the asymmetric carbon atom, the dynamics of esterification, the nature and properties of the pseudo-acids, the constitution of the complicated derivatives of cyanogen, and the employment of the inversion of cane sugar in the measurement of the strength of acids, are clearly if briefly explained. Similar concise discussions of the question of the structure of the benzene nucleus—including the arguments in favour of the centric formula, the application of Thiele's hypothesis of partial valencies, and the bearing of the optical properties—and of the constitution of the diazonium salts and the diazotates and their relation to the nitrosamines are to be found in the chapters on the aromatic compounds. We must remark at the same time that there is no mention of several important matters, such as the difficulty of esterifying certain carboxylic acids by boiling with alcohol and an acid, and Victor Meyer's explanation of this on the assumption of the so-called "space interference," nor can we find any account of Gustav Komppa's synthesis of *r*-camphoric acid.

References to the original literature are of great value in all beyond the most elementary text-books, and would have been specially so in a work intended for the use of students otherwise unguided; here such references are entirely wanting. Only occasionally even does the description of a reaction, a synthesis, or a theory suggest its author's name.

The book is provided with a subject index, but not with a table of contents; fortunately, the page-headings are well arranged. Although some portions of the book are decidedly disappointing, on the whole it can hardly fail, if conscientiously read, to broaden the views even of students considerably beyond an elementary stage of knowledge in organic chemistry.

G. Y.

SOME OPINIONS ON TEACHING MECHANICS.

The Teaching of Elementary Mechanics. Discussion which took place at Johannesburg at the British Association Meeting in South Africa on August 29, 1905, in Section A, Prof. Forsyth, President of the Section, in the Chair, together with written criticisms and a paper by C. E. Ashford, M.A. Edited by John Perry. Pp. 74. (London: Macmillan and Co., Ltd., 1906.) Price 2*s.* net.

THIS little book is another addition to many outcomes of Prof. Perry's never-failing activity and energy in trying to improve the teaching of our schools in matters connected with elementary science. At the British Association in Johannesburg last year, Prof. Perry, in the midst of his arduous duties as general treasurer of the association, found time to open a discussion on the teaching of elementary mechanics, and, not content with this, he collected the remarks of all the speakers at the meeting, and specially engaged a "chiel takin' notes" to keep a record of their speeches. He next wrote round to a large number of teachers and others in England,

and if he only received eleven replies it cannot be denied that the writers of these replies fairly represented all sorts and conditions of men, and that the subject has been discussed, (1) in its academic aspect, (2) from the point of view of the experienced schoolmaster, and (3) from the standpoint of the engineer. The book contains a reprint of the recommendations of the Committee of the Mathematical Association on the Teaching of Elementary Mechanics.

What conclusions can the average reader infer from the divergent opinions expressed in this book?

(1) There is a general consensus of opinion that the teaching of mechanics should be more experimental and less dogmatic.

(2) Prof. Perry condemns the use of costly and complicated laboratory apparatus, and considers that more can be learnt from a cheap screw jack and a rusty old pulley than from costly Atwood's machines. In this he is perfectly right.

(3) If the teaching of mechanics is to be made more practical, greater attention should be paid to friction and other resistances which occur in nature. So long as friction is shelved into the background, mechanics cannot be anything but the study of what would happen under impossible conditions.

(4) The advocates of the poundal and the advocates of the slug will never agree.

(5) The academic side does not wish the poundal adopted for practical purposes (p. 13). In examination papers answers are never—well hardly ever—asked for in poundals, and generally a candidate would lose marks by giving the pull of a railway engine in poundals or tonals. But the academic teacher strongly objects to swallowing the slug, and not without reason.

(6) The engineering side is trying hard to force the slug down the throat of the academic teacher, its main plan of campaign consisting in attacking the poundal as unit of force.

(7) Both sides seem willing, up to a certain point, to allow beginners to solve elementary problems by the use of Newton's laws, according to which change of motion is proportional—not equal to the impressed force—a method which avoids both the poundal and the slug. But they still cling tenaciously to the modern substitute for Newton's statements.

(8) The engineering side has had to accept the C.G.S. dynamical units, and there seems no reason why schoolboys should not leave the equation $F=ma$ until they learn to work with the metric system.

(9) The universal adoption of the metric system affords the most probable direction for a compromise.

(10) Prof. Perry advocates (p. 61) teaching mechanics through force rather than through mass as the fundamental notion; and yet some remarks seem rather to indicate that he wishes *every schoolboy* to realise that force is the vector time flux of momentum.

(11) Many teachers condemn tonals, velos and celos, others strongly advocate them. One critic (p. 55) goes so far as to express regret "that for units of momentum and mass-acceleration we have no suitable names at all"; but does not the *poundal* meet his requirements when regarded as the unit of *mass-acceleration*? Surely it is the use of this unit for measuring *forces* (by naval engineers and others) that is open to the serious objections raised on p. 64.

(12) The same differences exist in regard to centrifugal force.

We have no wish to reopen controversies on these questions, but we cannot help thinking that if every schoolboy is to know the laws of motion, it is also important that every schoolboy should know a great deal about the laws of the country he lives in. He should also learn something about economics, something about choice and chance, in order that he may not develop into a gambler, some experimental and geometrical optics, and many other things besides, which he does not now learn. That "it must be good for all boys to learn something of measurement and how to use their hands" is a point on which all can agree with Prof. Perry. G. H. B.

OUR BOOK SHELF.

What Are We? By Leonard Joseph. Pp. xiii+394. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1906.) Price 15*s.* net.

"They say the owl was a baker's daughter. Lord, we know what we are, but know not what we may be." A certain incoherence in Ophelia's words would have prevented us at one time from regarding her as a possible authority on the metaphysical questions raised by the title to this book, but she is soundness, suggestiveness, and lucidity themselves when compared with Mr. Joseph.

Three peculiarities in this pretentious work will strike the observant reader:—(1) Excellent as "Chambers's Encyclopædia" and the paper called *Answers* are in their own place—and Prof. York Powell is said to have thought highly of the latter—we doubt if there are many scientific works of the first rank in this country in which these are paraded in the foot-notes or in the list of books consulted. (2) Mr. Joseph poses in the opening paragraphs as an orthodox believer whose motto is "Search the Scriptures, watch and pray," but confesses in the end, with much pride, that this is merely a device to secure for his pages a reading from unreasonable and stubborn church-goers. It would have been more tactful to assume that all his readers were reasonable human beings, or that, at any rate, the weight of the arguments adduced would of itself overcome all initial distrust. (3) Mr. Joseph argues soberly—if the term sober can be applied without contempt to one who apparently abhors total abstainers as amongst the most depraved of men—for sexual promiscuity. This is bad; indeed, it is even worse than the unsound physiology that defaces the last page, or than the wealth of padding which surrounds and encompasses what might have received adequate treatment in a sixpenny pamphlet.

The Human Mechanism, its Physiology and Hygiene and the Sanitation of its Surroundings. By Prof. Theodore Hough and Prof. W. T. Sedgwick. Pp. ix+564. (Boston and London: Ginn and Co., 1906.) Price 8*s.* 6*d.*

Many writers of text-books on physiology for the lay public are quite incompetent to act as teachers of their fellow men, because they are unacquainted with the

science they profess to write about, or imagine that a description of the bones and a few other anatomical facts constitutes physiology so far as the general public are concerned. There are, of course, some books which are notable exceptions to this rule, but we never remember to have seen one before which so admirably fits the purpose for which it is written as the little treatise before us, which the authors have labelled "The Human Mechanism."

A little anatomy has, of course, to be introduced, but this is kept in the background; what comes to the front is the study of function; this is well up to date, and the first half of the book is a clear and succinct account of modern physiological knowledge. It avoids unnecessary details, but omits nothing essential. It is so lucidly written that the wayfaring man will have to be a terrible fool if he does not understand it.

From such a sure bed rock, the authors pass on in the second part of the book to the application of physiological laws, and treat of personal, domestic, and public hygiene in turn. We can award to this part no higher praise than to say that it is as excellent as the preliminary physiological portion. It teems with sound practical common sense; it points out convincingly, avoiding too great technicality, the scientific reason for their faith. If the people at large and their rulers could be induced to act on its precepts, preventive medicine would indeed make a great stride in the battle man is always waging against disease and the consequences of his misdeeds.

Arithmétique graphique. Introduction à l'Étude des Fonctions arithmétiques. By G. Arnoux. Pp. xx+226. (Paris: Gauthier-Villars, 1906.) Price 7.50 francs.

ASSISTED by M. Laisant, the author has put into an interesting and occasionally novel form the elementary theory of congruences, indices, and residues of powers. He has also given various examples of the use of Galois's imaginary units, and of the solution of cubic congruences by means of Cardan's formula. There is nothing essentially new in the book, but it is entertaining as the work of an amateur who has looked at the subject in an independent way, and has occasionally put the facts into an unusually vivid form, for instance when he gives a chess-board diagram showing the solutions of $x^2+y^2 \equiv 2 \pmod 5$, and so on.

Familiar Trees. By Prof. G. S. Boulger. Pp. vi+160. (London: Cassell and Company, Ltd., n.d.) Price 6*s*.

As the author informs us in his preface, the book is an endeavour to describe the beauties of our familiar trees. He further points out that "Their many associations have interests that appeal to the historian and the moralist, to the student of literature and of folk-lore, but little less than to those interested in botany." . . . "The time has gone by when we could be content to stand agape at the wonders and beauties of the world of Nature; we require now some attempt, at least, at an analysis of the origin, purpose and significance of the objects of our admiration." Mr. Boulger has certainly given a fairly interesting account of a few of the commoner trees and shrubs. In his introduction he defines trees as perennial plants with a principal stem of some considerable diameter, rising from the ground and forming wood. Their woodiness distinguishes them from all herbs, and their one principal stem from shrubs. In spite of this, however, he includes in his book of familiar trees shrubs and even climbers, while such familiar trees as the oak, beech, and the lime are omitted and the Scots pine dismissed with a passing reference.

The author has, however, brought together a considerable amount of interesting material concerning the species with which he deals, and the value of the book is greatly enhanced by the many beautiful coloured plates and photographs. The appearance of the cross-section of the wood of the various species is well illustrated by selections from Mr. J. A. Weale's unique collection, and these, like the other plates and figures, do great credit to the artists by whom they were produced.

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.*]

Radium and Geology.

AFTER reading Arrhenius's vivid account[1] of the bombardment of the earth by electrically charged solar dust, one is prepared to appreciate Prof. Joly's hypothesis as set forth in his letter in NATURE of January 24. On the other hand, Mr. Strutt's analysis of granite affords strong support to the view that the radium it contains is of terrestrial origin. The concentration of this constituent in the biotite might conceivably be due to the absorption of percolating water containing radium in solution, but not in the zircon, a mineral which is as impermeable as quartz. A mineral analysis of Cornish granite from Penrhyn, made by Miss Davies in our geological laboratory, gave the following results:—orthoclase, 24·62 per cent.; albite, 13·42 per cent.; quartz, 40·23 per cent.; muscovite, 10·05 per cent.; biotite, 11·46 per cent.; magnetite and zircon, 0·16 per cent. The heavy portion of the Cornish granite analysed by Mr. Strutt, which was insoluble in hydrochloric acid, consisted of silica hydrate and zircon, and if the latter mineral was present to the extent of 0·16 per cent. only, it must have contained, judging from the analysis, $0{\cdot}637 \times 10^{-12}$ gram of radium per gram, or a little less than was found in crystals of zircon from North Carolina. In the consolidation of granite, the zircon crystallises out first, then the biotite, next the muscovite, afterwards the albite, and, finally, the orthoclase and quartz; but the concentration of radium diminishes in a similar order, a correspondence that can hardly be the effect of chance.

In the formation of granite, water has undoubtedly played a large part, and may have had a good deal to do with its differentiation from the parent magma. Water forms one of the constituents of biotite, sometimes to the extent of 10 per cent. Thus it is possible that the richness of granite in radium is due to the removal of this constituent in solution from the general mass of a magma and its concentration in certain portions which were converted by hydration into granite.

But if this be true of granite, may it not be true as well of basalt and other basic rocks in which also water plays its part, though to a less extent? All the igneous rocks to which we have access are very superficial parts of the earth's crust, and it is unsafe to reason from them to the deeper underlying regions. There may be other causes, apart from solution, by which electrically charged atoms like those of disintegrating radium have found their way up from below to enrich the outermost layers of our planet. In any case, the assumption that radium is uniformly distributed through a crust forty-seven miles in thickness seems to require support from independent evidence, and until that is forthcoming it is equally open to us to assume a thick crust, 800 miles, consisting of silicates, with radium distributed through it according to some unknown law, but with a rapid increase towards the zone affected by highly heated waters.

January 26. W. J. SOLLAS.

[1] Arrhenius, "Lehrbuch der kosmischen Physik, 1903," p. 149. (Leipzig.)

The Mathematical Tripos.

IN NATURE of January 17 (p. 273) there is a long article by Prof. Perry which contains a one-sided account of the new regulations for the mathematical tripos. So far as I can see, no new arguments are suggested, for every statement has been already fully discussed and as, I believe, thoroughly answered. To repeat all these at length would take too much space and time; but perhaps the Editor of NATURE will allow me to remark on two or three assertions which can be answered in a few words.

Prof. Perry speaks of those who vote "non-placet" as the opponents of reform, yet these "non-placets" have continually urged the necessity of reform. It is only this particular reform that they object to. It was proposed in the Senate House (*Reporter*, p. 325) to have joint meetings of the two parties and to agree on some common action. It has also been suggested that we might use the Smith's prizes to separate the different kinds of students. It is, therefore, *the "placets" whom we ought to designate as the opponents of reform* when they refuse even to consider such proposals. So also in the circular (December, 1906) issued by our committee, we say that in the event of the regulations being rejected, we are ready to cooperate in promoting such measures as would, while preserving the best features of the present system, at the same time remedy its admitted defects.

In another place Prof. Perry tells us that one of the most important regulations is that a student may take part i. in his second term. He gives no explanation why this regulation has been objected to, yet this makes all the difference. If students can pass part i. in first-class honours in their second term, the subjects cannot be much more than schoolboy knowledge, and do not deserve Cambridge first-class mathematical honours. These subjects are fewer in number than those of the existing part i. Others have been curtailed, for example, the *uses* of the binomial, exponential, and logarithmic theorems, and also those of Taylor and Maclaurin are required, but *without their proofs*. Is a tripos *which does not include these proofs worthy of first-class university honours in mathematics?* It is a new thing that a mathematician should learn theorems *by rote* without understanding the reasons.

In regard to the higher studies, there is only space to notice that the existing part ii. has been generally regarded as a complete failure, yet its theory and practice are to be retained in the new programme.

The proposed scheme was signed by fifteen only out of the twenty-five members of the Mathematical Board, the remainder not voting. Among *college lecturers in mathematics*, our count makes the majority opposed to the scheme, and the same is true of *resident graduates* in *mathematical honours*. Almost all the training for part i. is now done by the lecturers and teachers in the various colleges. It is only with these that the mathematical undergraduate is brought into close contact, and it is to them rather than to the professors (who necessarily confine their lectures to the highest subjects) that we should look for guidance on the needs of their pupils (see the "non-placet" circular).

The name of a distinguished mathematician is claimed as a supporter by Prof. Perry. The name of Lord Kelvin here comes naturally to our remembrance, as he is our greatest natural philosopher. If the mention of the first name is an argument, how much more that of Kelvin? Yet Lord Kelvin is opposed to the new "so-called" reformation. His opinion of the university training has been given to us in his fly-sheet. Other old members have also explained the good they derived from their "old-fashioned" Cambridge course.

Prof. Perry states that if the "non-placets" should succeed in reversing the decision of the Senate, they are establishing a precedent which cannot conduce to the smooth working of the University. He must have forgotten the precedent set in 1872–3, when a proposal making Greek non-compulsory in the *previous* was carried in 1872, only to be rejected when it came up again a few months later in 1873. No constitutional difficulties appear to have followed. It was proposed in the Senate House by one at least of the supporters of the scheme that if the October decision is reversed they should *repeat the voting term after term* until the opposite side was wearied out. Is it considered that such a course will conduce to the smooth working of the University? So strange a plan appears to be void of all argument, and if even partially adopted will throw the whole Senate into confusion.

There are many points in Prof. Perry's summary of the regulations which would require an answer if they had not already been so fully replied to. I hope I have shown that some of his statements, at least, require verification.

EDWARD J. ROUTH.

Fertilisation of Flowers by Insects.

DR. ALFRED RUSSEL WALLACE, in an article entitled "Creation by Law," contributed to the *Quarterly Journal of Science* in October, 1867, alluded to a Madagascar orchis (*Angraecum sesquipedale*) with a nectary varying in length from 10 inches to 14 inches, and prophesied that a hawk-moth will be discovered with a tongue of equal length to fertilise it. "That such a moth exists in Madagascar may be safely predicted, and naturalists who visit that island should search for it with as much confidence as astronomers searched for the planet Neptune—and they will be equally successful!" Will someone kindly tell me if this prophecy was fulfilled; if so, when, and the name of the moth?

E. W. SWANTON.

Dr. Jonathan Hutchinson's Educational Museum, Haslemere, Surrey, January 17.

IN reply to Mr. Swanton's letter, I have not heard of any moth from Madagascar with an exceptionally long proboscis. I think, however, I did hear of one from East Africa with a proboscis nearly the length required; but as entomologists do not usually open out and measure the length of proboscis of all the large Sphingidæ they receive, some of the required length may exist unnoticed in our public or private collections. An inquiry at the insect departments of the Natural History Museum, and also of that of the Jardin des Plantes, would perhaps afford Mr. Swanton the required information.

ALFRED R. WALLACE.

The Immortality of the Protozoa.

IN a footnote to p. 42 of Coleridge's "Biographia Literaria" (Bohn's Library) occurs the following statement:—

"There is a sort of minim immortal among the *animalcula infusoria* which has not naturally either birth or death, absolute beginning or absolute end: for at a certain period a small point appears on its back, which deepens or lengthens until the creature divides in two, and the same process is repeated in each of the halves now become integral."

As I understand (for I am no biologist myself), the theory of the immortality of the protozoa was, according to the generally accepted view, first definitely formulated by Weismann in his lecture "Ueber die Dauer des Lebens" in 1881. It had been indicated before, but never definitely stated. But an examination of the passage quoted above, with the context in which it occurs (which is too long to be inserted here), shows that already in 1815 Coleridge could allude to this conception as one the truth of which was already accepted among biologists. For Coleridge is not stating the fact for its own sake: he introduces it merely as an illustration of a fact of etymology. Moreover, it is not merely to the phenomenon of multiplication by fission that he alludes, but to the conception to which (at some period subsequent to its discovery) it gave birth.

Coleridge took a keen interest in biology, and was, no doubt, widely read in biological literature. It is possible, indeed, that his statement is based, not on anything that he had read, but on what he had heard in conversation with men of science of his day. It would be interesting, however, to know if the conception had been definitely put forward in writing at this time, and I should be much obliged if you would give me, through the medium of your columns, an opportunity of clearing the question up.

J. SHAWCROSS.

28 Oberstein Road, New Wandsworth, S.W., January 19.

Perception of Relief by Monocular Vision.

A STRIKING example showing how any large lens can "see" in relief (see NATURE, January 3, p. 224) may be demonstrated to an audience.

An electric glow-lamp is lit in an optical lantern, and the image of the filament projected on to a screen. This image is only sharp in parts.

A card with a small hole in it ($\frac{1}{2}$ inch) is now placed close in front of the lens; this sharpens the image on the screen.

The card should now be moved backwards and forwards; the image *changes* in a remarkable way with every movement, showing that the lens sees the filament from a different point of view from each point of its surface.

Photographs taken with the "stop" at either side of the lens make a good stereoscopic pair.

A. E. SMITH.

8 Farringdon Avenue, E.C., January 19.

THE RUWENZORI BOUNDARY DISPUTE.

THE dispute which has arisen as to the ownership of the Ruwenzori Mountains between the British and the Congo State Governments is the latest example of the danger of a fixed and definite boundary agreement based on unfixed and most indefinite geographical data. So long as an elementary knowledge of geography—especially of the conditions and methods which govern geographical map making—forms no part of the educational equipment of our political staff we shall have these unscientific and clumsy disputes which may easily cost the country as much as a small war.

In this instance the agreement indicated, as the boundary between the Congo State and Uganda, "a frontier following the 30th meridian east of Greenwich up to its intersection by the watershed between the Nile and the Congo, &c." Presumably some sort of a map was consulted, but in 1894, when that agreement was drawn up no map could have existed which could claim to be more than approximately accurate in respect to any position fixed relatively to the meridian of Greenwich, and in the absence of detailed topography it must have been impossible to foretell whether the demarcation of such a line was even practicable. For a political boundary to be of any value it must either be carried by some well-marked natural feature or pass through country where artificial demarcation is possible. Consequently, of all dangerous boundary definitions that which involves a straight line through unmapped regions is perhaps the most unsafe. It might be urged that in the absence of all topography it was necessary *faute de mieux* to make use of an hypothetical line. In that case, treating all existing maps as a blank (which would have been the safest course), it was only necessary to express a doubt as to the finality of the arrangement whilst drafting the agreement.

In the present instance probably no one will be much the worse for an unscientific boundary muddle. A certain nervous anxiety to avoid international complications has led to our hasty abandonment of a strip of country which lies between what is now determined as the thirtieth meridian east of Greenwich and that line which was supposed to represent it when the agreement was made. The strip is about twenty-five miles in width, and the Congo officials have already taken possession and forbidden the entry of any white men unless engaged on scientific investigation. It may be a valuable strip for rubber production or it may not. Whatever it is, it has practically been given away (like many another more important field of international frontier dispute) for the want of a little scientific knowledge of the limitations of geographical definition.

THE ART OF THE LAPIDARY.[1]

BOOKS dealing with precious stones which have made their appearance in the past may be divided into three classes. First, works of exact science written by competent mineralogists, like the well-known treatises of Church, Max Bauer, and Kunz; secondly, treatises of an antiquarian character, of which the well-known works of C. W. King are the most conspicuous examples; and thirdly, books written from the commercial standpoint, like those of Messrs. Streeter and Emmanuel. All these classes of books treat, it is true, more or less incidentally of the lapidary's art, but the information on the subject is often second-hand and sometimes not very trustworthy.

It may be readily understood that a skilful lapidary, who is constantly handling different gems from the

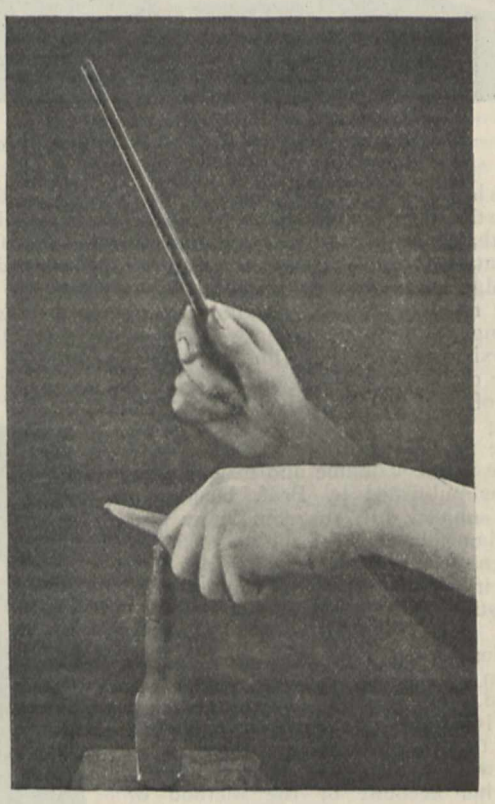


FIG. 1.—Diamond Cleaving. From "The Gem-Cutter's Craft."

most varied localities, must acquire an eye- and hand-knowledge of the objects of his craft of a very special kind; and the opinions of such men, based as they are on the results of constant observation and experience, may often be worthy of the attention of men of science. A book written by a practical lapidary may thus be expected to have a peculiar interest of its own—one of a totally different character from that which attaches to the kinds which we have enumerated above; and thus it comes about that the work before us constitutes almost a new departure in the literature of precious stones.

It is only fair to the author to point out that—while justly insisting on the importance and value of the practical knowledge of gems gained by constantly handling them and by noticing their

[1] "The Gem-Cutter's Craft." By Leopold Claremont. Pp. xv+296. (London: George Bell and Sons, 1906.) Price 15s. net.

behaviour on the lapidary's wheel—he fully recognises the great importance of the exact and quantitative methods of the mineralogist. The chapters dealing with the scientific methods for identification of precious stones are, on the whole, fairly complete and accurate, though evidently the information is to a great extent second-hand and sometimes wanting in precision. We notice that the suggestion of the cadmium borotungstate as furnishing a dense liquid for the separation of gems is ascribed to Prof. Church, and not to W. Klein; while the recommendation of the use of the mixed silver and thallium nitrates is accompanied by no hint of the limitations to the use of this substance imposed by its high price and tendency to change colour. The Abbe refractometer is described as a means of determining refractive indices, with no suggestion as to the existence of simpler and cheaper instruments, like those of Prof. Bertrand and Mr. Herbert Smith. The use of the Röntgen rays in differentiating between the various gems and paste is described, but no reference is made to the valuable and exact observations published by Prof. Doelter on this subject. In the same way antiquarian subjects, like the classical and biblical names applied to gems, are dealt with in a very perfunctory manner, the uninstructed reader being left in ignorance as to the wide differences of opinion which exist as to the identification of the particular substances referred to by ancient authors.

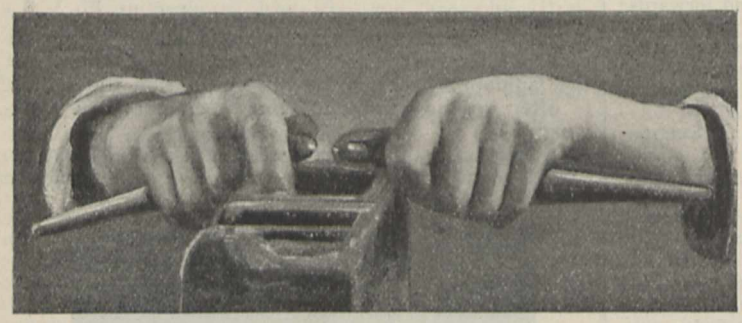


FIG. 2.—Diamond Bruting. From "The Gem-Cutter's Craft."

It is when the author comes to deal with the practical work of gem-cutting that we feel that he is on safer ground, and his account of the method of cutting and polishing both diamonds and the softer precious stones, fully illustrated as it is, has all the completeness which we might expect from one practically engaged in the industry.

The ordinary methods of "soldering" diamonds into cones of metal (consisting of two portions of lead to one of tin), and grinding and polishing facets by pressing them against a rapidly revolving wheel armed with diamond dust, are well known. Perhaps less familiar to most persons is the series of operations—known as "slitting," "cleaving," and "bruting"—by which diamonds are made to assume approximately the required shape, before the formation of the series of facets by means of the polishing wheel ("skeif"). Diamonds are sometimes sawn across by means of the ordinary lapidary's wheel, a thin iron disc the edge of which is armed with diamond dust but on account of the equal hardness of the dust and the stone the work is very slow and laborious. Much more frequently the form of the gem is modified by "cleaving," advantage being skilfully taken of the natural octahedral parting-planes of the diamond. The method adopted is that familiar to mineralogists, and is illustrated in the accompanying diagram, Fig. 1.

"The diamond to be cleaved is cemented upon the end of a wooden stick or holder in such a position that the plane of cleavage to be used in the operation lies parallel to the length of the stick, which is firmly fixed into the centre of a weight projecting from the wooden bench in front of the operator. A steel blade is held against the diamond in the desired position, and by means of a smart blow upon the back of it, the stone is caused to divide along the cleavage plane."

The process called "bruting" demands equal delicacy and firmness of hand, aided by a skill which can only be attained by long practice.

"The bruting of diamonds consists of rubbing two diamonds together in such a way that by continual friction each can be made to assume the required shape. Each diamond is cemented upon the end of a stick or holder about a foot long, and the operator firmly holds one end of each stick in either hand. The stones are then rubbed and pressed one against another over a wooden trough containing a very fine metal sieve, into which fall the particles of diamond dust rubbed from the stones. In order to obtain sufficient leverage the holders which support the diamonds are held against little metal projections on either side of the trough" (Fig. 2).

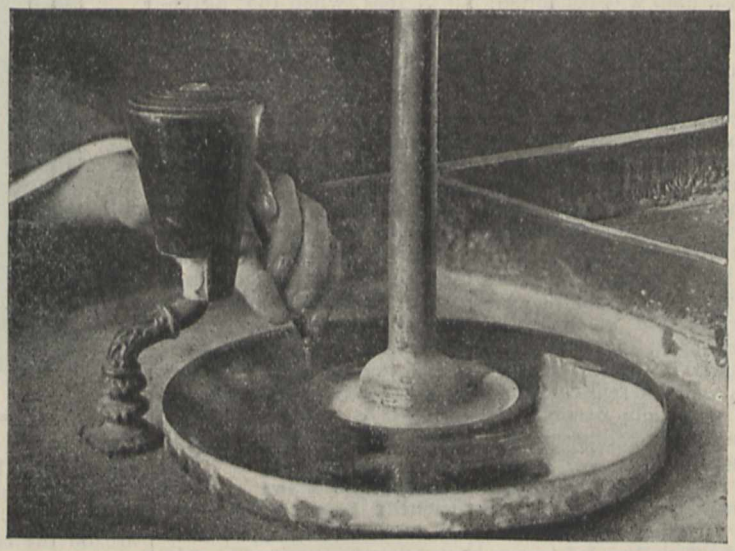


FIG. 3.—Gem held in position against the wheel. From "The Gem-Cutter's Craft."

In reading the work before us the mineralogist recognises the fact that a skilled lapidary with powers of acute observation may detect phenomena that could scarcely reveal themselves in any other circumstances. Among these may be noticed the statement

that diamonds that have been cut by the lapidary's wheel lack some of the brilliancy found in gems that have been simply cleaved. It appears, too, that the diamonds of different districts differ to a very marked extent in their degree of hardness; the diamonds of New South Wales, indeed, are so much harder than those from other districts that they can only be cut and polished with their own powder.

Rubies, sapphires, emeralds, and other coloured stones are of less hardness than diamonds, and their cutting and polishing can be effected by means of diamond dust, carborundum, corundum, or emery. But in the case of these softer gems great delicacy of touch, rather heavy pressure and friction are required for their successful facetting. The gems to be polished are cemented on the end of a holder made of hard wood about the size of a short penholder, and are cut and polished by being held against metal discs ("laps") supplied with the abrasive and polishing powders (Fig. 3).

The latter portion of the book, which deals with the nature, localities, and treatment of the various kinds of gem-stones, presents few features of interest as compared with other works of the kind. On some points, as, for example, in the remarks on the artificial production of precious stones, the information given is neither very complete nor very exact; but even in this part of the work there are occasional observations which are of considerable interest to the mineralogist.

J. W. J.

NOTES.

AT the moment of going to press we learn with the deepest regret of the sudden death of Sir Michael Foster.

THE fourteenth International Congress for Hygiene and Demography will be held at Berlin on September 23–29. All papers and particulars referring to the congress may be obtained from the general secretary, Berlin 9 W., Eichhornstr. 9.

HERR E. L. BEYER, the founder of the world-famed colour factory at Chemnitz fifty years ago, died at San Remo on January 2 at the age of eighty-two years. The direction of the factory has for some time now been in the hands of his son-in-law, Herr Th. Körner.

THE organisations committee of the sixth International Congress held at Rome finds itself with a balance of about 20,000 francs. This sum of money it is proposed to divide into honoraria of 1000 francs each, to be given to young Italian chemists to enable them to be present at the next international congress, to be held in London in 1909.

A REUTER message from Brussels reports that at a meeting held on January 29 at the residence of M. Beernaert, Minister of State, it was decided in principle to organise a new Belgian South Polar Expedition. A scientific committee will determine the programme. The meeting appeared to be in favour of the scheme of oceanographic research submitted to the Mons Congress by M. Arctowski.

AT the recent annual meeting of the Royal Microscopical Society, the following officers were elected for the ensuing year:—President, Lord Avebury; vice-presidents, Mr. Conrad Beck, Mr. A. N. Disney, Dr. J. W. H. Eyre, Dr. Dukinfield H. Scott; treasurer, Mr. Wynne E. Baxter; secretaries, Rev. Dr. W. H. Dallinger and Dr. R. G. Hebb.

AT the annual meeting of the Entomological Society on January 23 it was announced that the following officers had been elected for the session 1907–8:—President, Mr. C. O. Waterhouse; treasurer, Mr. A. H. Jones; secretaries, Mr. H. Rowland-Brown and Commander J. J. Walker, R.N. The outgoing president, Mr. F. Merrifield, delivered an address in which he discussed some of the causes of the persistent abundance or scarcity, generally or locally, of species and varieties of insects, and the relative importance of the consumption of their food and the attacks of their enemies. Reference was made to striking characters that seem of no biological importance, to habits and activities not directly concerned with nutrition or reproduction, and the manner in which they are affected by external conditions, and to structure and fixed habits indicating their ancestral history and affecting their present capabilities.

PROF. M. I. KONOWALOFF, professor of chemistry in, and at one time director of, the Polytechnikum in Kiev, died in his forty-ninth year as the result of an accident on December 24, 1906. After passing through the physico-mathematical faculty of the Moscow University, he became first an assistant and then a docent of chemistry in the same university; in 1896 he was appointed professor of inorganic chemistry at the Petrowskoje-Rasumowskoje Agricultural Academy, near Moscow, leaving there in 1899 for the new polytechnic at Kiev, in the building and equipment of which he had taken an active interest. In 1902 he was elected director, but owing to a number of unpleasantnesses having arisen he resigned in 1904. His most important scientific investigations dealt with the composition of the Caucasian petroleums; the nitration of various organic compounds; preparations of aldehydes and ketones; syntheses of aluminium haloids and their isomers; refractivity of nitrogenous organic compounds; nitrogen compounds of the terpene group and the methane series, &c.; the similarity between the iron salts of organic acids and the nitro-compounds. In addition to having displayed great scientific activity, Prof. Konowaloff was always a strong advocate of public lectures, especially for the working classes.

AN Association for the Promotion of Flight is in course of formation. The association will aim at assisting inventors and investigators to carry out experiments in artificial flight. In order to secure that no funds shall be subscribed by speculators with any hope of return, it is proposed that, in the case of its ultimate success in its object, the valuable assets, such as a facility for constructing practicable flight machines, should be handed, free of cost, to the nation. A provisional committee has been appointed, which includes the Hon. C. A. Parsons, F.R.S., Sir William Crookes, F.R.S., Major B. F. S. Baden-Powell, and others. Major Baden-Powell, who is the president of the Aëronautical Society, in a letter to the *Times* explains how the new association differs from the Aëronautical Society and the Aëro Club. He points out that the newly-formed association has for its main object the acquisition of a fund to be devoted to the purpose already explained. The intention is to make a public appeal, and it has been considered that this could be done better by an independent body than by the existing society. It is, however, clearly understood that the association shall work in entire accord, not only with the Aëronautical Society, but also with the Aëro Club.

THE birds of Irene, near Pretoria, by Mr. L. E. Taylor, illustrated by a plate of the eggs and nest of the black duck, and notes on a collection from N.E. Rhodesia, by Messrs. W. E. Stoehr and W. L. Sclater, form the sub-

ject of the two chief original articles in the Journal of the South African Ornithologists' Union for December last.

In the fourth volume (pp. 173–192) of *Marine Investigations, South Africa*, Dr. W. G. Ridewood describes a new species of the hemichordate genus Cephalodiscus, obtained from a considerable depth in the Cape seas. The new form brings up the number of known species to seven.

The report of the Felsted School Scientific Society for 1906 is illustrated with reproductions of photographs taken by the members of that body. The most interesting of these represents a nest, with eggs, of a moorhen, built on some sticks in the river Pett, about 3 feet from the bank, with the base of the structure touching the water. The society appears to be in a thriving condition.

The Hon. Walter Rothschild has just presented to the British Museum (Natural History) a fine mounted specimen of a male Alaskan elk, or moose (*Alces machlis gigas*), which has been temporarily placed in the central hall behind the African elephant. The Alaskan elk, we may remind our readers, is the largest representative of its species, although some of the estimates of its height are almost certainly exaggerated.

We have received the report of the museum committee for the County Borough of Warrington for the past year. It appears that Warrington was the first town in the United Kingdom to establish (in 1848) a rate-supported public library, and a tablet with an inscription to that effect has recently been placed in the building. The excavation of the site of the Roman station at Wilderspool has, for the present, been brought to a conclusion, and the spoils are in process of being arranged for exhibition.

The fourth part of vol. iii. of the Transactions of the Hull Scientific and Field Naturalists' Club contains a coloured plate of the four known British-laid eggs of Pallas's sand-grouse. These constitute two complete clutches, both taken on the high wolds near Beverley in 1888, one on June 15 and the other on July 5. The only other known instance of this species breeding in the British Isles rests on the evidence of a young bird found in Morayshire. The eggs are the property of Mr. T. Audas.

Under the title of "Nature Names in America," Mr. Spencer Trotter, in the January number of the *Popular Science Monthly*, gives some interesting information with regard to the origin of the vernacular designations of many of the animals and plants of the United States. Raccoon, opossum, skunk, chipmunk, and moose are, it appears, taken direct from the Algonquin language. Miss L. P. Bush contributes a translation of a valuable article by Mr. Anton Handlirsch, of the Vienna Museum, on fossil insects and the development of the class Insecta.

Many naturalists will remember that after the fresh-water jelly-fish Limnocodium was discovered in 1880 and its little polyp stage also described, a very similar polyp, the *Microhydra ryderi*, was found in a back-water of the Delaware River, near Philadelphia, in the United States. In 1897 the veteran naturalist Mr. Edward Potts, of Philadelphia, described in the *American Naturalist*, without illustrative figures, the production of a medusa or jelly-fish by this little Microhydra. The observation escaped the notice of most zoologists, and it is therefore a matter of congratulation that Prof. Ray Lankester has obtained from Mr. Potts a full description of the budding of Microhydra and of the medusa produced by it, accompanied by numerous excellent drawings. These are published in the December (1906) number of the *Quarterly Journal of Microscopical Science*. Figures are given for comparison of the medusa and polyp (Limnocodium) from Regent's Park (1880), and of the medusa of Lake Tanganyika (Limnocnida) described in 1893. Mr. Potts sent a preserved specimen of the North American fresh-water medusa to Prof. Lankester, who submitted it for examination to Mr. E. T. Browne, well known as a specialist on the medusæ, and a report and figures by him are published together with Mr. Potts's memoir. The medusa of Microhydra differs greatly from that of Limnocodium, although the polyp form has many curious points of resemblance in the two genera. Only very young liberated medusæ of Microhydra have, as yet, been observed. There is obviously an opportunity for further study of a very interesting kind in regard to this last discovery made by Mr. Edward Potts, so well known to zoologists by his researches on fresh-water sponges.

The methods of preparing an accurate survey of the plants growing in a plot of pasture or meadow-land is the subject of a small brochure by the Rev. E. A. Woodruffe-Peacock, published as No. 9 of the Rural Science Series. The system here explained in detail is recommended to the consideration of students taking up flora analysis from a biometric standpoint.

Selecting as his subject the financial success of forest management, Dr. W. Schlich, F.R.S., delivered a lecture before the students of the Royal Agricultural College, Cirencester, that is published in the December (1906) number of the *Agricultural Students' Gazette*. While the lecture contains no new facts, it provides an excellent summary of guiding principles, and as a practical illustration Dr. Schlich quotes from the working plan drawn up by him for the Alice Holt crown forests in Hampshire.

A question that must frequently occur to fruit-growers is concerned with the causes that control the time of flowering of trees. An attempt to calculate in a general way the number of heat units received in different years is discussed by Mr. E. P. Sandsten in Bulletin No. 137 issued from the agricultural experiment station of the University of Wisconsin. As would be expected, conditions during the previous summer and autumn are no less potent than temperatures in the spring, while less important factors are connected with the condition of the soil and the characteristics or state of health of each individual plant. The author mentions that the number of units required to bring a tree to flower varies from year to year, but does not state whether the proportion of heat units required by different varieties remains constant, although it would appear that data suitable for deciding this point were collected.

The Engineering Standards Committee has issued tables of British standard Whitworth screw threads, of British standard fine screw threads, and of British standard pipe threads. The tables can be obtained, post free, for a penny, from the offices of the committee, 28 Victoria Street, Westminster.

In the discussion on Mr. H. Campbell's paper on suction engines and gas plants, read before the Institution of Engineers and Shipbuilders in Scotland (Transactions, vol. l., part iii.), Mr. F. J. Rowan gave a bibliography of the subject, bearing witness to the enormous amount of investigation and research that has been carried out during the past two or three years.

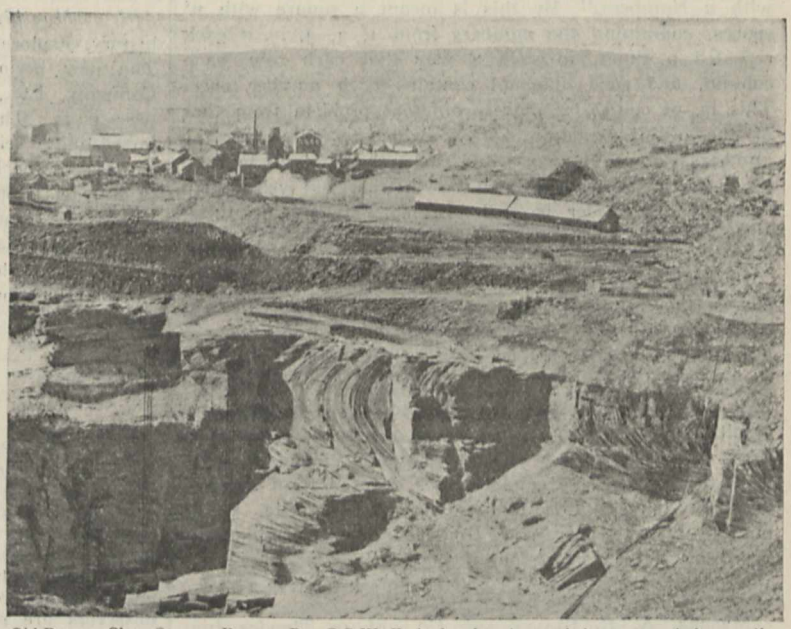
INVESTIGATIONS have shown that the yellow crystalline substance deposited from solutions of ammonium molybdate has the composition H_2MoO_4,H_2O. It was noticed as early as 1876, identified in 1882, and a crystal measurement made in 1903. The properties of this interesting chemical curiosity form the subject of a paper by Mr. J. H. Graham in the Journal of the Franklin Institute (vol. clxiii., No. 1).

IN the *Engineer* of January 25 plans are given of the handsome and commodious new headquarters of the great American engineering societies in New York provided by the liberality of Mr. Andrew Carnegie. The two top floors are devoted to the libraries of the several societies, and it is intended so to administer the library of each that by bringing them together there may be created an extremely complete and valuable library of engineering science and practice.

STRIKING evidence of Japan's native industrial capacities is afforded by an admirably illustrated description, by Mr. O. G. Bennett, of Sumitomo Bessi, the great copper mine of Japan, in the *Engineering Magazine* (vol. xxxii., No. 4). Copper mining has been carried out for centuries at this peak of sulphide copper ore near the centre of the island of Shikoku. At the present time, 9000 tons of ore are raised daily by plant, modern in all engineering details, the transformation from the primitive methods having been wrought without the direct assistance of a single foreign engineer.

THE presidential address delivered by Mr. F. W. Taylor, of Philadelphia, to the American Society of Mechanical Engineers is summarised in the *Engineer* and in *Engineering* of January 11. The author, one of the inventors of the modern high-speed steels, has written an address on the art of cutting metals that deserves to become one of the engineer's classics. It is probably, both on account of its length and on account of the matter it contains, one of the most remarkable that has ever been offered to a learned society. It contains the main results of twenty-six years' study of the question of obtaining the maximum output from machine tools. As the best high-speed tool steel the author recommends a steel of the following composition:—vanadium, 0·32 per cent. to 0·29 per cent.; chromium, 5·95 per cent. to 5·45 per cent.; manganese, 0·07 per cent. to 0·11 per cent.; tungsten, 17·81 per cent. to 18·19 per cent.; carbon, 0·682 per cent. to 0·674 per cent.; and silicon, 0·049 per cent. to 0·043 per cent. He has succeeded in establishing formulæ sufficiently trustworthy for the production of slide-rules by means of which it is possible to determine in a few minutes the best speed and feed to use in executing any given piece of work in any given lathe, and with any given set of tools.

IN one of the very valuable Bulletins (No. 275, Washington, 1906) recently issued by the United States Geological Survey, Mr. T. Nelson Dale describes the slate deposits and slate industry of the United States. It covers 154 pages, with twenty-five plates and fifteen illustrations in the text, and deals with the origin, composition, and structure of slate in general, and the slate deposits of the United States in particular. A full bibliography of slate and a glossary of geological and slate-quarrying terms are appended. The classification of slates adopted by the author is as follows:—I., aqueous sedimentary: A, clay slates, B, mica slates; (1) fading: (*a*) carbonaceous or graphitic, (*b*) chloritic, (*c*) hæmatitic and chloritic; (2) unfading: (*a*) graphitic, (*b*) hæmatitic, (*c*) chloritic, (*d*) hæmatitic and chloritic. II., igneous: A, ash slates, B, dyke slates. The scientific basis for these subdivisions is explained, and the microscopic and chemical analyses of typical slates are given. The Old Bangor quarry, Northampton County, Pennsylvania, is the largest slate quarry in the United States. The deposit measures 1000 feet along the strike, 500 feet across it, and 300 feet in depth. The general structure is a close, overturned synclinal crossed by almost horizontal cleavage. The thickest bed of good slate is 9 feet thick. The product from the large beds is used for roofing, but that from the ribboned beds goes into mill stock. The value of the United States slate production in 1904 was 1,103,439*l*.



Old Bangor Slate Quarry, Bangor, Pa., S.S.W. End, showing the eroded overturned close sycline crossed by almost horizontal cleavage.

A PAPER on internal-combustion engines for marine purposes, by Mr. J. T. Milton, was read at the Institution of Civil Engineers on January 22. The economy and the increasing use of internal-combustion engines on land has led to considerable interest being taken in their application to marine purposes, and already a large number of such engines have been fitted in small craft on the Continent, in most of which heavy mineral oil is the fuel used. On land, various fuels are used for these engines, namely, petrol, refined oil, heavy oil, coal-gas, producer-gas, coke-oven gas, and blast-furnace gas, but for marine purposes generally producer-gas and heavy oil are at present the only available fuels. The special conditions required for a successful marine engine are:—(*a*) the engine must be reversible; (*b*) it must be capable of being quickly

stopped and of being quickly started, either ahead or astern; (*c*) it must be capable of being promptly speeded to any desired point between full speed and dead slow, which latter speed ought not to be greater than one-quarter of the full speed; (*d*) it must be capable of working well, not only in smooth water, but in heavy weather in a seaway in which the varying immersion of the propeller causes rapidly changing conditions of resistance. In marine engines the revolutions are practically proportional to the speed of the ship, and as the vessel's resistance increases much more rapidly than the speed, it follows that for a reduction of speed of revolution the mean effective pressure must be reduced much more than in proportion to the revolutions. This is a much more difficult problem in marine engines, where no fly-wheel is practicable, than on land, where the use of a heavy fly-wheel permits the suppression of alternate fuel charges.

A LITTLE essay of twenty-four pages has been published by M. Prosper de Lafitte on "The Magic Square of n with n Numbers." By this is meant a square with n^2 spaces, containing the numbers from 1, 2, 3, . . n each repeated n times, in such a way that each row, each column, and each diagonal contains each number once. This is, of course, a slightly different problem from that of the ordinary magic square, which contains all the numbers from 1 up to n^2; and the author's claim to have produced a paper calculated to instruct as well as to entertain the reader is well justified. Messrs. Gauthier-Villars, of Paris, are the publishers.

IN the *Atti dei Lincei*, xv., 10, Dr. Pietro Macchia discusses the relations between thermal conductivities at ordinary and at low temperatures. In determining the conductivity, observation is made of the distribution of temperature in a rod subject to surface radiation, when the flow of heat has become steady. Even at moderate temperatures results based on Stefan's law are shown to be better than those derived from Newton's law of cooling. Thus for pure lead, the ratio of the conductivities deduced from Stefan's law, for temperatures 18° and 100° respectively, works out at 1·016; Jäger and Diesselhorst's determinations, based on the consideration of non-stationary states, give 1·015, while the assumption of Newton's law gives 2·01.

MESSRS. A. E. STALEY AND CO., of 19 Thavies Inn, Holborn Circus, E.C., have submitted for our inspection a pair of their new "Nikos," 8×, prismatic binoculars, which are sold at the low price of 6*l.* 10*s.* The instrument is beautifully finished in Russia leather, and is of a very compact, light, and handy form, whilst its performance optically satisfied the critical tests to which we subjected the pair examined. There is a common focussing screw for both eye-pieces, one of which is fitted, however, with a separate arrangement, and the bending bar is adjustable to the distance between the observer's eyes by simply bending it the required amount. Both the special focussing arrangement and the bending bar are provided with scales, so that the habitual user may adjust the glasses before using them without having to make a series of trials each time. A pair of studs projecting from the object-glass end of the glasses enables the latter to stand flat on any horizontal surface.

THE issue of "Hazell's Annual" for 1907 is now available. The alphabetical arrangement of this cyclopædic record reduces the trouble of reference to a minimum, and the comprehensive character of the contents makes the volume of wide interest.

A THIRD edition of "The Mechanism of Weaving," by Mr. Thomas W. Fox, of the Manchester Municipal School of Technology, has been published by Messrs. Macmillan and Co., Ltd. The opportunity has been taken to revise the text carefully, to add matter relating to recent developments in weaving, to introduce numerous new illustrations, and generally to enhance the value of the work from the points of view of teachers, students, and men actively engaged in the cotton industry.

THE thirteenth edition of "Practical Sanitation," by Dr. George Reid, has been published by Messrs. C. Griffin and Co., Ltd. The appendix on sanitary law, by Mr. H. Manley, has been entirely re-written, and other parts of the work have undergone detailed revision, particularly the chapter which deals with sewage disposal. The work provides medical officers of health, sanitary inspectors and others interested in sanitation with a comprehensive survey of the practical and scientific aspects of sanitary science.

WE have received a copy of the first number of the *African Monthly*, a magazine to be devoted to literature, history, exploration, science, and art, as well as fiction. The new periodical is published by the African Book Company, Ltd., of Grahamstown, Cape Colony, and its price is 1*s.* The contents of the first issue are varied and interesting; scientific subjects are represented by two articles, "The Bantu in the Tenth Century. As described in Extracts from the 'Golden Meadows' of Al Mas'udy," by Mr. W. Hammond Tooke, and "Merino Sheep Breeding in Australia," by Mr. R. H. Harrowell. The magazine may be obtained in this country from Messrs. Wm. Dawson and Sons, Ltd., Cannon House, Breams Buildings, London, E.C.

OUR ASTRONOMICAL COLUMN.

THE RECENT TOTAL ECLIPSE OF THE SUN.—A telegram received by Prof. Kreutz from Prof. R. Schorr at Dschisak, in the province of Samarkand, states that during the whole time that the sun was eclipsed on January 14 the sky was totally obscured, and snow fell heavily. Only meteorological and some photometric observations were possible (*Astronomische Nachrichten*, No. 4150).

Herr Archenhold has received a similar message from another observer at Samarkand, whilst the Moscow observers are reported to have obtained no results even in the meteorological and photometric programme (*Das Weltall*, January 15).

THE SOLAR RADIATION.—The depression of the "solar radiation" during 1903, as observed at Warsaw, is dealt with in a paper communicated to the *Bulletin météorologique du Département de l'Hérault* by M. Ladislas Gorczyński. The observations showed that between December, 1902, and February, 1904, the radiation was abnormally low as compared with the mean for the years 1901–5. This phenomenon has previously been commented upon by various observers, and is supposed to have been due to the large amount of volcanic dust in our atmosphere. Two other abstracts from the same bulletin deal respectively with the variations of the intensity of the solar radiation with the height of the sun, and the amount of the insolation at Warsaw, Treurenberg, and Montpellier.

PHOTOGRAPHS OF GIACOBINI'S COMET (1905*c*).—The way in which a comet's tail develops as the comet approaches perihelion is beautifully shown by a series of photographs of Giacobini's 1905 comet which are published in Bulletin No. 25 of the Lowell Observatory. The series extends from December 14, 1905—eight days after the comet's discovery—when the object showed only a well-defined nucleus, to January 7, 1906, when three distinct tails are shown, the middle one extending to a distance of 10° from the head.

On December 29 two tails were shown, one of which was made up of four distinct streamers with nebulous matter between them; two of these streamers were crossed so as to present a twisted appearance, whilst the two outside ones diverged in the usual manner. On no two negatives are the images the same, the day-to-day development being very marked. Between January 3 and 4 there was a decided change in the position-angle of the extremity of the tail, which is shown in a striking manner by the superposition of the two oriented images, and is somewhat similar to that recorded by Prof. Barnard in the case of Brooks's comet 1893 iv.

THE RED SPOT ON JUPITER, 1905–6.—The results of Mr. Stanley Williams's observations of the Great Red Spot during the opposition of 1905–6 appear in No. 4150 of the *Astronomische Nachrichten*. The transit times of the spot were all observed by simple eye estimates, care being taken to avoid looking at the Red Spot Hollow, which, as compared with the spot itself, was a very conspicuous feature. The rotation period, as determined from 635 rotations, was found to be 9h. 55m. 41·46s., a value slightly less than that determined from the 1904–5 opposition. The mass of dark material, which circles round the belt in which the spot is situated, overtook the spot during the last week in March, 1906.

Micrometer measures made during the period November, 1905, to February, 1906, showed the mean longitude of the Red Spot Hollow to be 29°·41, a position some 1°·3 following the spot itself. Mr. Williams discusses the relative accuracy of the micrometer method at some length, and, from his experience, arrives at the conclusion that it is likely to introduce errors due to the alteration of the appearance of the observed feature caused by the superposition of the micrometer wires, a conclusion which is confirmed by other observers of Jovian phenomena.

A PECULIAR SHORT-PERIOD VARIABLE (155.1906 CASSIOPEIÆ).—From a number of observations made at Potsdam during 1906, Messrs. Müller and Kempf find that the sixth-magnitude star B.D.+68°.200 is a variable, with a period of 1·95 days and a remarkably small range of light variation, the whole amplitude amounting to only 0·33 magnitude (*Astronomische Nachrichten*, No. 4148).

THE BRITISH SCIENCE GUILD.

THE first annual meeting of the British Science Guild was held at the Mansion House on Monday, January 28. Just fifteen months have passed since the inauguration of the Guild in October, 1905, and the very large gathering of sympathisers with the new movement was eloquent of the fact that the hopes and confident expectations of its organisers have not been disappointed. The Lord Mayor, Sir W. Treloar, presided, and was supported by the president, the Right Hon. R. B. Haldane, and Sir Norman Lockyer, the chairman of committees. Many eminent representatives of science, industry, and the educational world were present.

The Lord Mayor having opened the meeting by offering a warm welcome to the Guild, Sir Norman Lockyer gave an outline of work accomplished since its inception, touching on the main points mentioned in the report, of which the following is an abstract. The first part was purely historical. It stated what the committees have done. Though their activities have not figured so prominently before the general public outside, it must be remembered that the more important the work was going to be, the more quiet must it be in the first instance. The first public outcome of the Guild was connected with the report of the Departmental Committee appointed to consider the question raised by the proposed new Technological Institution at South Kensington, and the fear that the scheme might be delayed in consequence of certain differences of opinion as to the constitution of the governing body. The result was the letter to the *Times* last year, in which the Guild urged most strongly that neither the question of the ultimate and final relationship of the new institution to London University nor any other matter should be allowed to interfere with the immediate appointment of at least an organising governing body.

The next important point to which the report refers was that of the grant to the National Physical Laboratory; it described the happy result of Mr. Haldane's interposition with the Treasury in obtaining an increase of the grant from 5000*l.* to 10,000*l.*

At the request of various bodies, the Guild has taken part in several important deputations. Sir John Cockburn represented the Guild on a deputation to the President of the Board of Trade urging the importance of the compulsory working of patents.

On account of certain changes contemplated by the Government, the council of the Royal Society of Edinburgh asked for the support of the Guild in the matter of obtaining suitable buildings to house the society, and also a suitable grant for yearly expenses. This support was most cordially given by the executive committee. The sum originally proposed to be expended by the Government on the new buildings was 14,000*l.*, but the final result of the action of a committee and of the representations made by the deputation, on which the Guild was represented by Sir W. Ramsay, K.C.B., was to secure for the society a sum of 25,000*l.* for the purchase of a building, 3000*l.* to cover the expenses of fitting it up, and a yearly grant not exceeding 600*l.* a year. The council of the Royal Society of Edinburgh has expressed the opinion that these arrangements are quite satisfactory (see p. 205).

Several communications were received from the officers of the Marine Biological Association urging the Guild to form part of a deputation to the Chancellor of the Exchequer on the subject of the continuation of the grant in aid of the International Fisheries' Investigations. Sir Michael Foster, K.C.B., was nominated to represent the Guild on the deputation, which, introduced by the Right Hon. Austen Chamberlain, M.P., was, in the unavoidable absence of the Chancellor of the Exchequer, received by the Parliamentary Secretary, Mr. McKenna, M.P., on December 18, 1906 (see p. 185).

In June the Guild received a communication from the anthropometric committee of the British Association, in relation to a deputation to the Prime Minister urging him to appoint a commission to carry out a periodic anthropometric survey of school children and adults. It is proposed that this commission shall be constituted on the same lines as the advisory council recommended by the Physical Deterioration Committee, and preferably should be under the direct control of the Prime Minister, like the Defence Committee. The proposed anthropometric survey would also be on the lines recommended by the Physical Deterioration Committee. The executive committee considers the proposed survey as a most important application of science to statecraft, and has nominated a representative of the Guild to attend the deputation which the Prime Minister has consented to receive after the recess.

The education committee has had before it a proposal to form two new committees, one dealing with elementary and secondary education, especially in relation to the introduction of leaving certificates from the primary school, and the importance of practical scientific training in both. It was proposed that the second educational committee should consider the question of an increased endowment of universities by the State. Referring to this committee, Sir Norman Lockyer remarked that the private endowment of American universities last year amounted to five millions sterling. It is hard for us as a nation to compete with that. Germany is strengthening its universities just as thoroughly as it is strengthening its Fleet, a reminder that we ought to be able to compete with other nations in the preparation and equipment for industrial progress, as well as for war.

The report recorded the overtures made to the Franco-British Exhibition Committee, as the outcome of which the exhibition committee's desire to include science in their programme was stated. The assistance of the Guild was asked in the formation of the science section, and it was now proposed that lectures should be given during the continuance of the exhibition by British and French men of science.

The progress of the Guild was indicated by the membership of 599, and by the fact that already branches are being formed in Canada and Australia.

Mr. Haldane then rose to move that the record of action summarised in the report be approved. He endeavoured, first, to answer a possible criticism of this record. Some might think that it was not startling or striking, and foretold no revolution to be effected. But the founders of the Guild never believed that progress could come rapidly. Nothing but strenuous labour in educating the public would bring home to the public mind the depth and reality of the conviction on which this British Guild of Science was based, that Knowledge was Power. Nevertheless, Mr. Haldane disavowed a pessimistic outlook. There was much that was encouraging. Go where they would, applied science was taught in a fashion in which it was never taught a few years ago, and he instanced three universities which he had himself recently visited—Glasgow, Manchester, and Liverpool; at Birmingham and London also the tendency was not less visible. We did not notice it, but it had been noticed by the Continent. "I have been struck more than once by the emphatic testimony given by Continental experts to the progress which has taken place in Great Britain, which is, they say, at the present time, relatively speaking, more rapid than the progress in other parts of the world. Well, we have much to make up. America has been ahead of us, and I do not think it is only endowment. I think it is the practical spirit of the American people which has made them realise how essential it is to a country which is leading the industrial world that the best science should be at the disposal of all the manufacturers. Canada herself is in some respects ahead of this country. There is a technical equipment in the McGill University, Montreal, the like of which we hardly know, and it is not contrary to what one likes to see that our own young men should be taking advantage of the opportunity which that University offers to go and get the highest training in some branches of applied science under the British flag."

Mr. Haldane attributed some good in this respect to the fiscal controversy. It was demonstrated that we had gone back, because we were using antiquated methods in competition with those who used new and more scientific methods. All this had stirred up many of our great captains of industry, and to-day brains had a better market than they had had for a very long time past in Great Britain. Reviewing all these things, Mr. Haldane thought they ought to make us hopeful. Scientific education was no longer at a discount. He directed attention to his own department of administration at the War Office, for this new movement was not confined merely to private industry; we train our young officers, he said, as they were never trained before, and we have an average of scientific attainment among our young officers such as has not been seen at any previous time in the British Army. Then he pointed out another thing which, he thought, lent itself to the objects of the Guild, and that was the extent to which the private employer is giving way to the joint-stock company. The joint-stock company had its disadvantages, but under it more and more the price of brain was the price which was paid to the manager, and less and less to the private capitalist. More and more science was thus levelling opportunity, and giving to everybody the chance of making himself a power among his fellowmen.

Mr. Haldane concluded his interesting speech with these words on the relation of the State to science:—"All this costs money, and, if the State is to play its part in it, it must cost the State money. Well, but the national income is increasing. These very things give a reward which is four-fold or ten-fold more than the expenditure necessary to earn it. There are those who put our national income somewhere between 1600 millions and 2000 millions at the present time. Well, our expenditure under the Imperial Government is well within 10 per cent., even if you take the lowest of those figures, and surely 10 per cent. is not much for a people to contribute to get advantages so enormous as we see on every side to-day. Education, improved surroundings, equality of opportunity to a degree we have never known before, increase of the national production—all these things are well worth purchasing at an expenditure which means only a fraction of that 10 per cent., and I say that if the State only spends its money wisely the State will make no better investment for those for whom it is responsible than an adequate expense on the development of scientific method. Our problem is to awaken our country. There are many others engaged in that work. This Guild is only one of several organisations, but it contains on its roll perhaps more distinguished men of science than any other society which is engaged in a like work. Our business is to act in the true missionary spirit, and, acting in the true missionary spirit, we have to see to it that our energies do not flag and that we do not allow the sun to go down before our labours are complete."

The Hon. and Rev. E. Lyttelton, the headmaster of Eton College, followed Mr. Haldane. He had been astonished at the zeal shown by the committee, and his agreement with the previous speaker's hopefulness was shown by the remark:—"I have never yet taken part in any movement which seemed to me so absolutely certain to have a lasting and deep effect upon the life of the country than this one." He was greatly struck with the progress of the scientific spirit in the educational world. There was no subject now taught in schools in the same way as it was taught in schools thirty years ago. "If that has been done at a time when many schoolmasters have been vocal with indignation at the encroachment of science on their private domain, how much more will be done in the next thirty years, when we have grown wise enough to see that whatever be the blessings of a literary education, there is not the slightest reason why in every school there should not be a combination of literary education with scientific training." This much-agitated conflict between literature and science in university circles was commented on in a striking way by a later speaker—the Vice-Chancellor of Cambridge University, Dr. E. S. Roberts. The Vice-Chancellor of Oxford University was, unfortunately, unable to be present, but Dr. Roberts pointed out as a happy omen the fact that that gentleman, as well as Mr. Lyttelton and himself, were all representatives of literature, and yet were all very keen advocates of science.

Mr. Alfred Mosely offered some interesting remarks on the teaching of science in America, and Prof. Meldola took the opportunity of correcting a notion which existed in some quarters that the Guild was specially interested in the practical and industrial application of science. He wished to see the encouragement of scientific method as a cult. The work of the Guild, he hoped, would be to raise the level of public opinion towards abstract science itself. The rest would follow.

The other business resolutions included one to permit of distinguished Americans and foreigners being elected honorary members—an extension of the basis of the Guild due to the courtesies and offers of information from eminent Americans.

The following executive committee for the ensuing year was elected. The new members are indicated by italics:—*President*, Right Hon. R. B. Haldane, M.P., F.R.S.; *hon. treasurer*, Right Hon. Lord Avebury, F.R.S.; *hon. assistant treasurer*, Lady Lockyer; *trustees*, Sir James Blyth, Bart., Mr. C. W. Macara; *vice-presidents*, *Sir Archibald Geikie*, F.R.S., Sir John Wolfe-Barry, K.C.B., F.R.S.; *chairman of committees*, Sir Norman Lockyer, K.C.B., F.R.S.; *vice-chairmen of committees*, *Sir William Ramsay*, K.C.B., F.R.S., Sir Lauder Brunton, F.R.S., Hon. Sir John Cockburn, K.C.M.G., *Sir Philip Magnus*, M.P.; *hon. secretary*, *Sir Alexander Pedler*, C.I.E., F.R.S.; *members*, Sir Hugh Bell, Bart., Mr. G. T. Beilby, F.R.S., Right Hon. Thomas Burt, M.P., Mr. Dugald Clerk, Captain Creak, C.B., R.N., F.R.S., Dr. Francis Elgar, F.R.S., *Prof. Meldola*, F.R.S., Sir William Mather, Major-General Sir F. Maurice, K.C.B., Prof. J. Perry, F.R.S., *Sir William White*, K.C.B., F.R.S., Mr. Carmichael Thomas, Mr. F. Verney, M.P., Sir Henry Trueman Wood, *Sir Edward Brabrook*, C.B.

The following new vice-presidents were appointed:—Lord Reay, president of the British Academy; President Warren, Vice-Chancellor of the University of Oxford; the Vice-Chancellor of the University of Cambridge; Sir Frederick Pollock, Bart., and Sir David Gill, K.C.B., F.R.S.

AMERICAN FOSSIL CYCADS.[1]

THE wonderful state of preservation of many Palæozoic plants, which has enabled us to gain much valuable information in regard to phylogenetic problems, is in marked contrast to the general absence of petrified fossils afforded by Mesozoic strata. Thanks to the ability and energy of Mr. G. R. Wieland, liberally backed by the Carnegie Institution, a flood of light has been thrown on the morphology of an extinct group of Mesozoic gymnosperms, which it is possible to study with a precision and thoroughness hardly to be surpassed in the case of recent plants. Mr. Wieland's monograph, with its splendid set of large plates, is an addition to botanical literature of exceptional importance. After reading the volume, we couple with a grateful acknowledgment of what has already been done an earnest wish that the results of further investigations may be presented in an equally attractive form in the near future.

Mesozoic plant-bearing rocks in almost all parts of the world are characterised by an abundance of pinnate fronds, recognised by Brongniart and by other pioneers of palæobotany as cycadean on account of their close agreement in external characters with those of modern cycads—a small group of tropical gymnosperms occasionally extending into subtropical regions, which constitute an unobtrusive assemblage of survivals from a remote past. Stems which might reasonably be supposed to have borne these fronds have until recently been met with in a few localities only, and never in great quantity, except, perhaps, in the Purbeck beds of Portland. As Wieland says, it is with the work of the English botanists Carruthers and Williamson (1868) that the exact investigation of fossil cycadean stems "may be said to have fairly begun." The famous species *Bennettites Gibsonianus* of Lower Greensand age, discovered many years ago in Luccomb Chine in the Isle of Wight, first described by Mr. Carruthers and afterwards by Prof. Graf zu Solms-Laubach, has made us familiar with the striking differences between the reproductive shoots of this extinct type and those of existing cycads, differences of surprising magnitude in view of the close resemblances as regards habit and vegetative anatomy. Other European examples of Bennettites have been described by Profs. Cappellini and Solms-Laubach, and an exceptionally well-preserved French Liassic species by Prof. Lignier, of Caen. In 1860 Philip Tyson discovered a few silicified cycadean stems in the Potomac formation of Maryland, but these were not submitted to more than a superficial examination; it was not until the last decade of the nineteenth century that the late Prof. Marsh, of Yale, with an energy worthy of a pupil of Goeppert, secured a collection of more than 700 petrified stems from the Upper Mesozoic rocks of the Black Hills of Dakota and Wyoming. European botanists who have had an opportunity of seeing some of these relics of cycadean groves of the Upper Jurassic and Lower Cretaceous periods in American museums have eagerly waited for the publication of Mr. Wieland's investigations, and the preliminary papers which he contributed to the *American Journal of Science* (1899–1904) served to intensify the impatience with which the more complete descriptions have been awaited.

In chapter i. the author gives an interesting summary of collections of cycadean stems; chapter ii. is devoted to their preservation and external characters. In chapter iii. we read of the difficulty of attacking these enormous flint-like fossils, and of the ingenuity by which the silicified trunks were made accessible to minute examination. Tubular drills were found to afford the best results; photographs of some of the drilled stems remind one of cylindrical cheeses to which the taster's scoop has been freely applied.

Chapter iv. treats of internal structure; many of the facts recorded merely confirm what was previously known, but additional information is given in regard to the anatomy of vegetative organs which makes us wish for further details in regard to many points still left in doubt or incompletely dealt with. We should like to know more about the relative abundance of centrifugal and centripetal wood in the leaf-traces; we are curious to know whether the Bennettites stems usually possessed one cambium-zone or several, and it would be interesting to have more definite statements as to the histological characters of the secondary wood. It is not improbable, as Mr. Wieland suggests, and as the writer suspected from an examination of a silicified cycadean stem from India, that these Mesozoic stems, in some cases at least, differed from modern cycads in the greater compactness and hardness of their wood. No one recognises more fully than Mr. Wieland how much remains to be done, and he promises to do his best to fill up these and other lacunæ. In chapter v. we have an exceedingly interesting account of the vernation and structure of young fronds preserved in buds on the main trunk. It is a curious fact that, despite the extraordinary abundance of stems, detached fronds have not been found in the enclosing strata, a circumstance which enhances the value of the discovery of unexpanded pinnate leaves in organic connection with the stem.

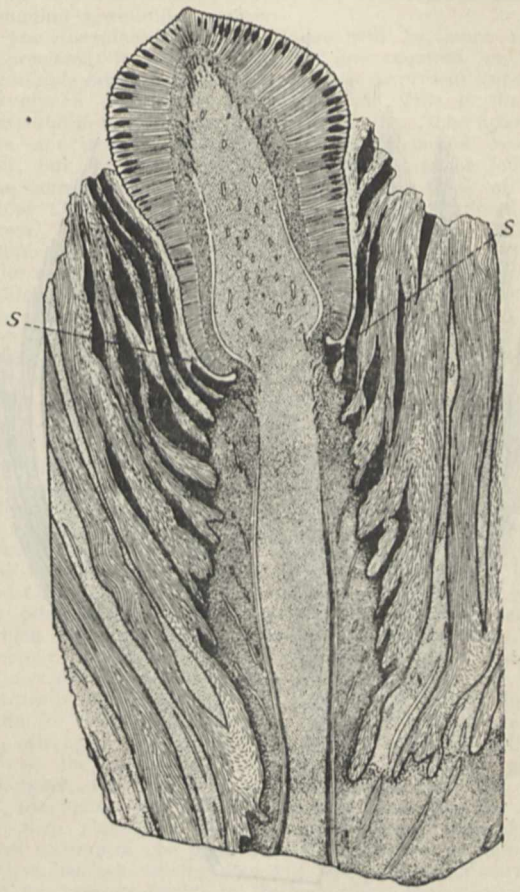


FIG. 1.—*Cycadeoidea Marshiana*. Longitudinal section through ovulate strobilus. *s* = remnant of dehiscent disc of microsporophylls.

It is, however, in chapters vi. and vii. that we find by far the most important part of the author's work. The researches of Carruthers and other authors have shown that Bennettites did not bear terminal, or in some cases apparently terminal, flowers as do the true cycads, but produced axillary branches consisting of a comparatively short axis ending in a terminal receptacle crowded with two sets of appendages, slender stalks terminating in single orthotropous seeds associated with sterile organs, probably homologous with the seed-bearing pedicels, termed interseminal scales, which overtopped the small seeds and almost completely enclosed them in a protecting envelope. These axillary shoots usually occur in profusion on a single stem, and, as Wieland points out, often in approxi-

[1] "American Fossil Cycads." By G. R. Wieland. Pp. viii+284+plates. (Published by the Carnegie Institution of Washington, 1906.)

mately the same stage of development; it may be, as he suggests, that the plant did not fruit until reaching maturity. The seeds of Bennettites are in size like "small grains of rye"; they seem to be exalbuminous, and have little in common with the enormous seeds of recent cycads. With the exception of a single Italian species, in which Solms-Laubach found a few pollen grains associated with a female flower, we were in complete ignorance as to the nature of the male flowers until the publication of Wieland's results. It was usually assumed that in Bennettites, as in true cycads, the flowers were unisexual. Whatever interpretations we put on the morphological value of the interseminal scales and seed-bearing pedicels, it is clear that the female flowers of the fossil genus are characterised by a morphological plan far removed from

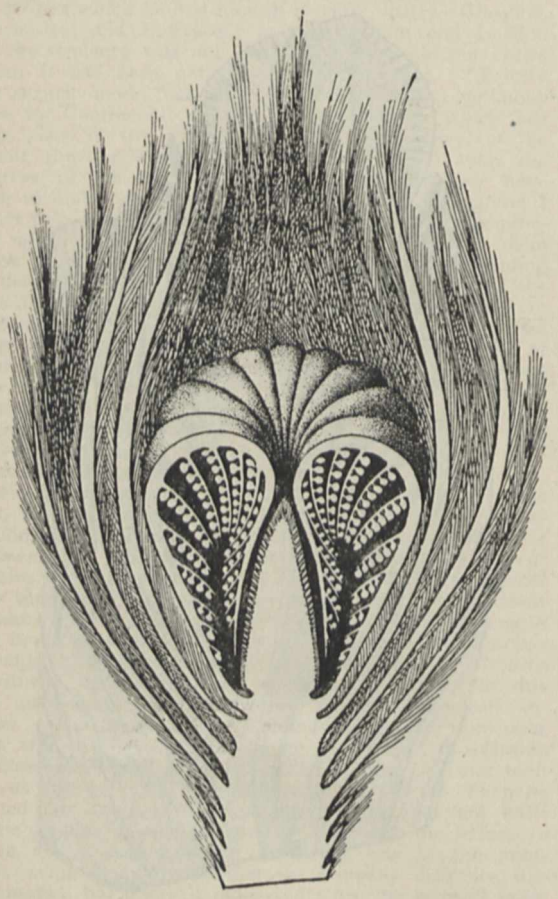


FIG. 2.—Restoration of unexpanded bisporangiate strobilus showing enveloping bracts, folded microsporophylls and conical receptacle bearing short ovuliferous pedicels, &c.

that of the leaf-like carpels of Cycas and from the crowded carpellary scales of other recent genera.

Mr. Wieland has conclusively proved that previous views as to the unisexual character of the Bennettites flowers are incorrect; in most cases, at any rate, the flowers were bisexual. He figures several examples of reproductive shoots terminating in ovulate flowers like those of *Bennettites Gibsonianus*, bearing a basal rim (Fig. 1, s) to which was formerly attached a hypogynous whorl of pinnate microsporophylls with pinnules reduced to an axis producing numerous synangia and microspores. This assumption as to the former association of microsporophylls with a central group of ovuliferous pedicels is justified by the discovery of numerous examples of bisexual flowers, consisting of an axis terminating in a conical receptacle bearing the two sets of organs characteristic of what have previously been styled female flowers, but differing in the smaller size of the seed-stalks and interseminal scales, and presenting the appearance of partially aborted or immature female organs. Surrounding this central receptacle there is a whorl of several pinnate leaves with their upper portions folded inwards between the petioles of the central gynœcium (Fig. 2), and bearing rows of synangia of a type but little removed from those of modern marattiaceous ferns. No specimen has so far been described of a bisexual flower in which both androecium and gynœcium are mature. There appear to be two possible explanations: are these bisexual flowers comparable with the male flowers of Welwitschia (Tumboa), in which the female portion is functionless; or have we a case of dichogamy, in which the male organs matured first, and were subsequently shed? This discovery, first announced in a short paper by Mr. Wieland in 1899, is of the greatest importance as demonstrating the retention in a comparatively little altered form of filicinean synangia and spores of the marattiaceous type side by side with female organs which foreshadow the angiospermous gynœcium. It is impossible in the space at our disposal to attempt to deal with the numerous questions of phylogeny—the probable line of evolution of the Bennettitales and their relationship to modern cycads—but we naturally ask, Is it fitting to speak of plants possessing this type of flower as cycads? The term cycads used by the author is perhaps justifiable if adopted in the widest sense, but the reviewer cannot help feeling in sympathy with a view expressed in a letter recently received by him from Prof. Nathorst, of Stockholm, that the extension of the designation cycads to plants so far removed in the organisation of their essential organs from the cycads as we know them necessarily tends to minimise the importance of fundamental differences.

The generic name Cycadeoidea, proposed by Buckland in 1827, is used by the author in preference to Carruthers's genus Bennettites; it would, we think, be better to retain the latter name for all cycad-like stems possessing the lateral fertile shoots of the type originally described by Mr. Carruthers. There is another very different form of stem which Nathorst discovered in the Rhætic plant beds of Scania bearing fronds long known as a species of Anomozamites, and flowers which probably agreed closely with those of Bennettites. This stem, which Nathorst names *Williamsonia angustifolia*, is important as demonstrating the wide range of vegetative variation within the great group Cycadophyta. The discoveries of Mr. Wieland, Prof. Nathorst and others demonstrate the impossibility of forming any adequate conception of the nature of the Cycadophyta—to use Nathorst's convenient term—if we confine our attention to the meagre remnant of that phylum which has survived the revolutions in the plant kingdom since the beginning of the Cretaceous era.

In the concluding chapters Mr. Wieland deals with questions of phylogeny; while recognising much that is suggestive in the treatment of this difficult subject, we feel that there is a certain vagueness in his conclusions which, though partly due to lack of data, is perhaps to some extent the result of a want of clearness and conciseness of treatment. The initial difficulties have, however, been surmounted, and Mr. Wieland has completed with conspicuous success a very important section of the work; we close the volume with a desire for more, and heartily wish the author further success in a field where the opportunities are unrivalled. A. C. S.

THE RECENT HIGH BAROMETER.

A REGION of exceptionally high barometer readings over western Europe was a feature of especial interest during a great part of January, the mercury in many places attaining to a greater height than any previous record, while elsewhere the readings have scarcely been exceeded. To trace the history of this anticyclonic region and to attempt any explanation requires a series of synchronous and synoptic charts embracing a large part of the northern hemisphere; possibly this may be undertaken by one of our European weather offices when all the facts have been collated. It would seem that vessels traversing the Atlantic have in many cases experienced

barometer readings much in excess of the average during the whole voyage, and for the greater part of the month.

As early as January 4, a region of high barometer, with readings 30·3 inches, spread in over the Bay of Biscay from the Atlantic; this gradually extended eastwards over south-western Europe, and on January 12 the region intensified, readings of 30·7 inches occurring over the Bay of Biscay and western France. The anticyclone maintained its ground, and on January 17 and 18 was distinctly spreading northwards, the isobar of 30·5 inches embracing France, England, Denmark, and the greater part of Norway and Sweden. On January 20 the anticyclonic area was greatly augmented, apparently by an independent region of high barometer spreading down from the extreme north of Europe. The highest readings—30·9 inches—were situated over Lapland and Finland, and on January 21 the highest pressure was in the vicinity of the White Sea, the barometer at Archangel reading 31·39 inches. On January 22 the anticyclone was central over northern Russia, the barometer at Kuopio standing at 31·46 inches. The maximum height of the barometer was attained on January 23, when at Riga the reading was 31·58 inches, and the region of 31 inches and above embraced parts of England, Scotland, and Ireland, the barometer at some of the stations in the British Islands being higher than any previous record. The high barometer area continued to travel southwards, and on January 26 the centre was in the neighbourhood of Constantinople, but the highest reading had then decreased to about 31·1 inches.

The absolutely highest reading of the barometer on record is 31·72 inches, which occurred at Irkutsk on December 20, 1896, and at Semipalatinsk on December 16, 1877. The highest in the British Islands is 31·11 inches, at Aberdeen on January 31, 1902, and 31·10 inches at Fort William on January 9, 1896. The lowest reading on record at the surface of the earth, and reduced to sea-level, is 27·12 inches, at False Point, on the coast of Orissa, on September 22, 1885, and the lowest in the British Islands 27·33 inches, at Ochtertyre on January 26, 1884.

From about January 20 to January 26 the weather was intensely cold over western Europe, and an easterly wind was blowing for the most part. The Weekly Weather Report issued by the British Meteorological Office shows that, for the week ending January 26, the mean temperature was 9° F. below the average in the midland, southern, and south-western districts of England, and the deficiency amounted to 7° F. in several other districts. The minimum temperatures were as low as 5° F. and 10° F. in many parts.

STAR CATALOGUES.[1]

SOME astronomical work is so attractive that it readily finds support and imitation. The preparation of star catalogues scarcely belongs to that category. Such work is dreary and monotonous, and those who devote themselves to it are entitled to the acknowledgment that is invariably granted to those who are willing to sacrifice brilliancy to utility. There is little scope for the exercise of originality. Once the scheme is defined, the stars selected, and the needed accuracy attained, there is nothing to break the wearisome repetition of a purely mechanical process. The work can hardly be said to possess the attractiveness of permanence. The observations give the position of the stars at a certain epoch, and almost before the catalogue is available as a whole, the work of supplementing it has begun. The wayward and lawless proper motions of the stars tend to render the coordinates obsolete, and this cause alone will necessitate the repetition of the work upon which so much labour has been bestowed. Yet no work requires more care and forethought, and this will be painfully evident to those who read the introductions to the several works, the titles of which are quoted below. It will be equally evident to those who recall the names of those who have devoted themselves to this work, and who will thus be reminded that many astronomers, from Flamsteed to Airy, have been content to stake their reputation upon their contributions to the cataloguing of star places. It is the opportunity for the introduction of greater accuracy that affords the necessary compensation. Sir David Gill, than whom few can look back upon the accomplishment of a greater mass of work, probably views the completion of these catalogues with very considerable satisfaction, and regards them as rounding a well-filled career.

The usefulness of a catalogue will be more readily appreciated if the star places are required to make accessible other material to which it is at present impossible to give a final and convenient form. This is the case with the first of the catalogues on our list. The 8560 stars are not isolated points irregularly distributed over the sky, but are generally the brighter stars to be found in the zone allotted for observation to the Cape of Good Hope Observatory by the Astrographic International Congress. These stars form the fiducial points to which the unknown stars of the photographic plates will be referred. The coordinates, determined on one plan, will give great uniformity to the resulting photographic catalogue. All the observations have been made between 1896–9, and, since the plates have been taken approximately within the same years, possible errors arising from proper motion are effectually eliminated. Moreover, the advantages arising from employing stars taken at one epoch and observed on one uniform plan are patent. Apparently, in the use of facilities for reducing photographs, observers in the southern hemisphere were at a disadvantage compared with those in the northern, since the latter could immediately bring into use the admirably arranged catalogues of the Astronomische Gesellschaft; but the pains bestowed by Sir David Gill upon this piece of work have entirely reversed the conditions, and placed the Cape Observatory in the most favoured position, for, to a certain extent, he is able to select those stars for the reduction of his measures which are most suitably arranged upon the plate. The northern observers have to accept such stars as have been observed; but in forming a new catalogue, one would naturally observe those stars which will furnish the best data for subsequent reduction. An ideal scheme would be to select for each plate eight stars distributed uniformly round the circumference of a circle of about 55′ in diameter, the centre of which coincided with the centre of the plate, and, in addition, two stars near the centre of such plate; but owing to overlapping, whereby the four corners of one plate become the centres of four other plates, such a scheme does not work out practically, and on the average twelve or thirteen stars, somewhat irregularly situated, will be available for the reduction of each plate, and this number may rise to seventeen or eighteen stars.

The individual results on which the catalogue places rest have been published in the annual volumes. The details here presented enable one to follow the small corrections that have been introduced to eliminate systematic errors and to secure uniformity throughout. To the ledgers of right ascension three terms have been applied, one to reduce the right ascension to what it would have been if Newcomb's system had been adopted; a second correction, depending on magnitude, is required to reduce the R.A. of a particular star to what the observer would have recorded if the star had been of the fourth magnitude. The necessity of the third correction is not very clear. It has been required because of the small number of clock stars employed in each zone, "and perhaps also because of small outstanding errors in the adopted values of Level, Collimation, and Azimuth."

In order to obtain the greatest possible accuracy in the declinations, a system of small corrections has been applied

[1] "A Catalogue of 8560 Astrographic Standard Stars between Declinations −40° and −52° for the Equinox 1900 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1896–99 under the Direction of Sir David Gill, K.C.B., F.R.S." Pp. lix+403 (London: Printed for H.M. Stationery Office by Eyre and Spottiswoode, 1906.)

"Catalogues of Stars for the Equinox 1900·0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1900–1904 under the Direction of Sir David Gill, K.C.B., F.R.S." Pp. xiii+123. (Edinburgh: Printed for H.M. Stationery Office by Neill and Co., Ltd., 1906.) Price 4s. 6d.

"Astrographic Catalogue 1900·0, Oxford Section, Dec. +24° to +32°. From Photographs taken and measured at the University Observatory, Oxford, under the Direction of Prof. H. H. Turner, F.R.S. Vol. i. Pp. lxvi+223. (Edinburgh: Printed for H.M. Stationery Office by Neill and Co., Ltd., 1906.)

to the values in the annual volumes. These corrections are again three in number:—one required by the Chandler change in latitude; a correction depending, apparently, on some function of zenith distance, and which embraces flexure of the telescope and circle, and removes small uncertainties in the refraction tables. The necessity for the third correction is a little obscure. It is asserted to be necessary on account of small possible errors in the determination of the nadir, or to remove errors arising from abnormal refraction or irregular heating or flexure of the instrument. More details as to the manner in which the last correction has been derived would be welcome. It is contended that the application is justified, since the amount of the probable error of observation is reduced.

A feature of great interest is the comparison between the final places of the catalogue and those given in the earlier Cape catalogues or by other authorities. The main object is, of course, to derive the proper motion, but the real interest centres in the systematic deviations from other catalogues, mainly in the discrepancies shown by those of Cordova. It is impossible within narrow limits to do justice to this discussion, but the points raised are of the highest importance in observational astronomy, and exercise considerable influence on some questions of cosmical interest.

The second work on our list contains four catalogues. Two of these are quite small, and can be dismissed forthwith. One contains nearly a thousand stars culminating south of the zenith of the Cape Observatory. This list includes all stars brighter than 8·5 magnitude which are in the Cape Photographic Durchmusterung, but not in any catalogue of precision; also stars observed with comets or used in survey operations. The main portion, consisting of 3365 stars, culminating north of the Cape zenith, is of more interest and importance. The greater number of the stars is due to the prosecution of a scheme submitted by Sir David Gill to the Comité international des Étoiles fondamentales with the view of forming a zodiacal catalogue sufficiently wide to permit the determination of the moon's place at any observatory and in any part of its orbit by heliometer measures of the distance and position angle of a lunar crater from suitably surrounding stars, or of determining in a similar way the position of any of the larger planets. Of course, it is not possible to determine with the highest accuracy all stars which may be employed for such purposes, but it is hoped that by concentrating the attention of meridian observers on a select number of stars, suitably situated, and by adopting processes likely to eliminate systematic errors, a very considerable improvement in accuracy may result. Several observatories have shown their approval of the scheme by taking part in the observations, and it is hoped that an adequate determination of star places for 1900 will be the outcome, while observations repeated at intervals of twenty-five years would provide all the data required for the most rigorous determination of the places of moon and planets.

The third work is different in its design and more comprehensive in its plan. The star positions for which the means of reduction are supplied number no less than 65,750, and when it is remembered that these stars are situated in a narrow zone, two degrees in width, on the small circle of 31° dec., we are able to learn something of the magnificence of the scheme which proposes to treat the whole sky on a uniform plan. What strikes one with the most force is the fact that a small observatory, the funds of which are necessarily strictly limited by the many demands that are made on the university chest, has been able to carry to a successful issue a scheme of such magnitude: has competed with the resources of great national observatories, and has found itself second to none. Prof. Turner has exhibited qualities of administration of the highest order. He has known how to impart to a comparatively untrained staff the enthusiasm which he himself experienced, and to secure in every part of the work that uniformity of excellence and rigorous accuracy which are essential for the maintenance of its international repute. To him and to the little band which has nobly seconded his efforts we can only offer our heartiest congratulations.

Since Prof. Turner has recalled in the most prominent manner to what extent the scheme has benefited by those who were responsible for the conduct of the observatory in the past, it is not out of place to record here that it was the well-placed generosity of Warren de la Rue that enabled the University of Oxford to play a worthy part in the plan which has been brought to so happy a completion. It is encouraging to remember that the energy of the late Prof. Pritchard was not exhausted, and that, at the age of seventy-nine, he could contemplate embarking upon a new and arduous enterprise. This is the first volume of eight that will appear, and there can be no hesitation in saying that the completion of such a work amply justifies the existence of the University Observatory. Twenty years have passed since de la Rue made his gift, and practically for twenty years the staff of the observatory has been devoted to the completion of this task. Some slight conception of its extent can be inferred from the fact that the titles of the papers immediately connected with this subject fill more than three quarto pages.

At the end of a long article it is impossible to do justice to the many technical points that are necessarily raised in the introduction. It must suffice to illustrate the general policy that Prof. Turner has pursued. This will enable us better to appreciate the exercise of those qualities of administration which have proved so effective. The star images have been measured to the thousandth part of the distance between the *réseau* lines, subtending an angle of 300 seconds in the focal plane of the telescope, or the limit of accuracy has been set at $0''.3$. This may or may not be the greatest accuracy to which it is desirable to aim, but to have attempted another place of decimals would, says Prof. Turner, have delayed the completion of the work, with the limited staff at Oxford, for several years, and perhaps imperilled its completion altogether. This recognition of his limitations has been amply justified. Again, it no doubt required considerable self-restraint to confine the measures to one series of images, since greater accuracy would probably have been obtained if the measures had been distributed over more images rather than confined to repeated bisections of the same; but such a process would involve the additional labour of taking means between quantities which were not similar, and so give additional risk of numerical errors. Prof. Turner is no doubt warranted in asserting that a just relation has been maintained between the labour expended and the accuracy attained.

W. E. P.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In accordance with the regulations for the administration of the Gordon Wigan fund, the special board for physics and chemistry reports that the first award of the prize of 50*l.* from the Gordon Wigan income for physics and chemistry for a research in chemistry has been made to F. E. E. Lamplough, scholar (now fellow) of Trinity College, for his research on the determination of the rate of chemical change by measurement of gases evolved.

Dr. Hobson, of Christ's College, has been appointed chairman for the mathematical tripos, part ii., for the year 1907.

A course of lectures on special zoological subjects is being given at the zoological laboratory during the Lent term. The course includes lectures by the following:—Mr. Forster Cooper, on living and extinct elephants; Mr. Stanley Gardiner, (1) marine rock formations, (2) the distribution of marine animals; Mr. Imms, some recent discoveries in the morphology of insects; Mr. Perrin, trypanosomes and spirochætes; Mr. Potts, parasitism in the Crustacea; Mr. Punnett, (1) metamerism, (2) sex; Mr. Gadow is lecturing on "Environment and Geographical Distribution of Animals" during the Lent and Easter terms.

PROF. GEORG KLEBS, director of the botanical institute of Halle University, has been elected to succeed Prof. Pfitzer at the University of Heidelberg.

DR. REINHARD BRAUNS, ordinary professor and director of the mineralogical institute of Kiel University, has been appointed successor to Prof. H. Laspeyres, who retires from the chair of mineralogy and geology in the University of Bonn.

THE governors of the Borough Polytechnic recently received an offer from Mr. Edric Bayley of 5000*l.* towards the estimated cost of the completion of the premises of the polytechnic. The governors, therefore, asked the London County Council to assist them by making a grant of 7000*l.*, and their request was granted at a meeting of the council on January 23. The cost of the scheme, exclusive of lighting, heating, and equipment, is estimated to be about 11,500*l.*

THE annual meeting of the Mathematical Association was held on January 26 at King's College, London. The association now consists of 419 members. Prof. G. H. Bryan, F.R.S., was elected president in succession to Prof. G. B. Mathews, F.R.S. During the course of an address, Prof. Mathews said he earnestly hoped that the new regulations proposed for the Cambridge tripos would be approved. He thinks it will be very unfortunate if, after adopting the principle of the change as the association has done, these regulations are shelved. He asked all those who are inclined, from sentimental or other reasons, to vote non-placet on this question to consider carefully whether it is right to do so after this matter has been carefully thought out for many months by men who are representative mathematicians and representative mathematical teachers at Cambridge. There is a strong desire at Cambridge to make the mathematical scheme there more living, on the one hand, and to bring it more into connection with the general science of mathematics on the other. After Prof. Mathews's address, papers were read by Prof. W. H. H. Hudson, on diagrams of anemoids; by Prof. A. Lodge, on contracted methods in arithmetic; and by Mr. C. S. Jackson, on the elementary arithmetic of the theory of numbers.

THE current number of *Science Progress* contains an article by Sir Arthur Rücker, F.R.S., on the economics of university education. The essay provides an interesting criticism of Adam Smith's theories of education in the light of modern experience. Sir Arthur Rücker leads up to the general criticism that Smith's arguments appear to be based almost entirely on the view that a university is a place where instruction is bought and sold, not a place where professor and student are linked together as leader and follower in a common search after knowledge. Incidentally, opportunities are found to insist upon many aspects of education likely to be ignored by the public. Thus we read:—"as research is largely concerned with the elucidation of the results of hitherto neglected facts, it is found that for many objects mental dexterity can best be fostered by turning the attention of the abler student from the known to the unknown, from information to investigation." In the same number of the review Prof. H. E. Armstrong, F.R.S., writes on the reform of the medical curriculum, treating it as a problem of technical education. Prof. Armstrong says that, so far as chemistry is concerned, "the reform should take the direction of teaching the subject practically and with direct reference to its applications: as every branch of chemistry in turn must necessarily be laid under contribution, chemists need have no fear that their field of action will be thereby unduly limited."

THE annual prize distribution and conversazione of the Northampton Institute, Clerkenwell, E.C., was held on January 25 and 26. The prizes were distributed by Mr. Evan Spicer, chairman of the London County Council, who in his address to the students made special mention of the importance of the engineering work which was being done at the institute, and of the unique character of the work in technical optics. In regard to the latter, he remarked that it had received the most sincere recognition of our Continental rivals, inasmuch as work of a similar character was being started in France and Austria. The principal, in his report, referred to the present need of additional accommodation, notwithstanding the fact that the institute has this session occupied the buildings of the British Horological Institute for its technical optics work. In the display of instruments made in the various laboratories on both evenings, there were several interesting items. A wireless telephone system was made to work successfully across the courtyard, and some interesting experiments were shown with the electric arc used as a telephone receiver, and with the effect of light on selenium cells. There was also an interesting display by the Postal Telegraph Department of some of the newest developments in telegraphy, both of the ordinary kind and wireless telegraphy, a complete De Forest set of the latter being at work. The 75-ton testing machine and the 50-h.p. experimental engine were on view for the first time in the mechanical laboratories, and there was also a new 25-K.V.A. alternator built in the institute with special modifications for experimental purposes, from which some interesting results may shortly be anticipated.

A SCHEME for the organisation of a central lecture theatre for London, on the model of the Berlin "Urania," is being developed by a representative committee, which includes Sir William Ramsay, Sir W. Huggins, and others. A meeting was held last week, under the presidency of Sir William Ramsay, to hear an explanation of the scheme by Mr. Albert Wollheim. The chairman said he had given two lectures at the Berlin "Urania," and was much struck with the crowds that visited the institution and constantly occupied themselves gaining knowledge of scientific facts. Mr. Wollheim explained that the statutes of the Berlin institution exclude the possibility of the undertaking being exploited commercially; all surplus profits, after the distribution of a 5 per cent. maximum dividend, are devoted to the purchase of apparatus or to building extensions or carried to a reserve fund. The proposed London "Urania" would not clash with the work of the learned societies, but would promote their membership. Illustrated popular lectures would be given on subjects of interest to the public in a building centrally situated and easily accessible. In the summer months the "Urania" would be utilised as a centre for educational visits to museums, gardens of scientific societies, and so on. An educational information bureau, a library, and a publication department would be features of the institution. It is interesting in this connection to recall a similar scheme for a civic museum recently outlined before the Sociological Society by Mr. Huntly Carter. It may be hoped that the promoters of these ideas will join hands and cooperate in providing London with a valuable adjunct to its existing educational facilities.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, December 20, 1906.—Lieut.-Col. Prain F.R.S., vice-president, in the chair.—*Exhibits.*—Two specimens of albino woodlice, *Oniscus asellus*, Linn.: W. M. **Webb.**—Photograph and dried specimens of *Fockea capensis*, Endl., a plant of considerable interest on account of its great rarity and its apparently great longevity: N. E. **Brown.**—*Papers.*—Report on the botanical collections made by Dr. W. A. Cunnington in lakes Nyasa, Tanganyika, and the Victoria Nyanza, 1904–5: Dr. A. B. **Rendle.** Dr. Cunnington spent about three weeks on and about Lake Nyasa, nearly nine months at Lake Tanganyika, and less than a fortnight on the west of the Victoria Nyanza. His object was to make as complete a collection as possible of the plants and animals, especially from Lake Tanganyika, with the view of solving the "Tanganyika problem"—whether the fauna and flora of this lake indicate a former marine connection. The flowering plants, fern allies, and Characeæ, numbering about forty-five species, were, for the most part, well-known and widely-distributed forms, such as *Najas marina*, species of Potamogeton, *Pistia Stratiotes*, *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Jussiaea repens*, *Trapa natans*, and *Chara zeylanica*, with others restricted to tropical or subtropical Africa, such as Ottelia, *Boottia scabra*, and species of Utricularia. In no case was there any suggestion of marine conditions, either past or present, in the representatives of the flora.

The plankton and fresh-water algæ, of which an account was given by Mr. G. S. West, yielded remarkably rich results, due partly, no doubt, to the paucity of our previous knowledge of the microscopic flora of these lakes, especially in the case of Tanganyika. Mr. West's list contains about 400 species, a large proportion of which are new, including one new genus of Palmellaceæ. A few species from Tanganyika showed a striking affinity with marine forms, indicating that at some period the water of this lake had a considerable degree of salinity; but, as Dr. Cunnington explained, this did not involve a previous marine connection, but might be explained by an increase in saline matter in the water due to the damming of the outlet from the lake. This damming was perhaps a periodical occurrence, since Stanley, thirty years ago, described the lake as with no outlet, while a few years later Mr. Hore, visiting the same spot as Stanley, found the water rushing through the present outlet towards the Congo.—A new and abnormal species of Rhipicephalus: W. F. **Cooper** and L. E. **Robinson.**

January 17.—Prof. W. A. Herdman, F.R.S., president, in the chair.—*Platanthera chlorantha*, Custor, var. *tricalcarata*: W. Botting **Hemsley.** The specimen had been found at Pax, Sherborne, Dorset, by Miss D. R. Wilson, who sent it to Kew; the ten flowers on the spike were modified as described, the paired sepals were spurred, and the lip was uppermost, that is, the usual twist of the ovary was absent.—Acanthaceæ of insular Malaya: the late Mr. C. B. **Clarke.** This paper was complementary to a similar one, drawn up for the "Materials for a Flora of the Malay Peninsula," now in course of issue by Sir George King and Mr. Gamble. The paper includes in its area Malaya exclusive of the peninsula itself.—An isopod, *Tachaea spongillicola*, n.sp., of the family Corallanidæ, distinguished from its near ally, the marine *Tachaea crassipes*, Schiödte and Meinert, by having the terminal joint of the maxillipeds, not smaller, but considerably larger than either of the two preceding joints: Rev. T. R. R. **Stebbing.**—A new British terrestrial isopod: A. **Patience.** The species in question, which Mr. Patience has named *Trichoniscus Stebbingi*, n.sp., was first obtained by him in a field near Alexandra Park, Glasgow, in company with *T. pygmaeus*, Sars, and *Trichoniscoides albidus* (Budde-Lund), and subsequently in some numbers in one of the propagating houses of the Glasgow Botanic Gardens.

Society of Chemical Industry, January 7.—Mr. R. J. Friswell in the chair.—The sixth International Congress of Applied Chemistry at Rome: W. F. **Reid** (see NATURE, vol. lxxiv., p. 65, May 17, 1906).—The determination of higher alcohols in spirits, part i., the "ester-iodine" method: C. H. **Bedford** and R. L. **Jenks.** The authors point out the defects of the Allen-Marquardt process for the estimation of higher alcohols in potable spirits. Dunstan and Dymond (*Pharm. Journ.*, 3, xix., 741) have shown how to determine organic nitrites by allowing them to act on an acid solution of potassium iodide in a flask void of oxygen, and then titrating the liberated iodine with thiosulphate. This serves as the basis of the authors' method. Details are given for the extraction and esterification of the total higher alcohols, and the subsequent decomposition of the esters by iodine. Beckmann's method of esterification (one part of sodium nitrite and two parts of acid potassium sulphate powdered together) is employed. Results are given showing the accuracy of the method. An analysis can easily be carried out in a day.—The determination of indigotin in commercial indigo: C. **Bergtheil** and R. V. **Briggs.** The authors criticise Bloxam's method for the determination of indigotin (Journ. Soc. Chem. Ind., 1906, xxv., 735), and point out that low results are obtained. The error is due to the factor on which the calculation is based, and the loss of indigotin which invariably occurs in salting out and filtering the sulphonic acid salt. A series of determinations was carried out by the authors' method (Journ. Soc. Chem. Ind., 1906, xxv., 729) and by Bloxam's method (*loc. cit.*), and they are of opinion that the latter does not appear to be trustworthy either in application to pure indigotin or to commercial indigo. The method is cumbersome, and inapplicable to work in the indigo districts of India owing to the low temperature at which it is necessary to work, and the large amount of ice required for this purpose.

Geological Society, January 9.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The Cretaceous formation of Bahia (Brazil) and the vertebrate fossils contained therein: J. **Mawson** and Dr. A. S. **Woodward.** This paper relates to a series of estuarine and fresh-water deposits originally described to the Geological Society by the late Samuel Allport in 1859. The results of thirty years' collecting of fossils are summarised, and the distribution of the formation, so far as determined, is marked on a map. The strata are disturbed by numerous dislocations and discordant dips, and no regular succession of zones or horizons can be discovered. All the more important vertebrate fossils collected are now in the British Museum (Natural History). From these a few remains of new species are selected for special description. A mandibular symphysis of a very large crocodile, with a long garial-like snout, belongs to one of the Goniopholidæ. Some dinosaurian vertebræ seem to belong to the iguanodont group. A large fish-skull represents a new genus allied to Macropoma, and indicates a species five or six times as large as any cœlacanth previously discovered. The discussion of a complete list of the fossil Vertebrata proves that the formation is of Cretaceous age, and suggests that it may be Lower Cretaceous, as supposed by Hartt.—A new dinosaurian reptile from the Trias of Lossiemouth, Elgin: Dr. A. S. **Woodward.** Mr. William Taylor, of Elgin, recently discovered two skeletons of a small new reptile in the Triassic sandstone of Lossiemouth. Two imperfect skeletons of the same species are also shown on a slab of the same sandstone in the British Museum (Natural History). The head and trunk measure only 4 inches in length, but there is a very long and slender tail. The head is relatively large, and resembles that of Ornithosuchus in many respects, but the fossils do not exhibit any teeth. The author concludes that this must have been a running or leaping reptile, and that it represents a new genus of Dinosauria related to the American Triassic Hallopus.

Faraday Society. January 15.—Sir Joseph Swan, F.R.S., past-president, in the chair.—The application of the electron theory to electrolysis: E. E. **Fournier d'Albe.** The electron theory, by postulating the existence of material carriers of all electric charges, is practically an extension of the ionic theory to solids and gases, and it thus brings into line the processes of metallic and electrolytic conduction. The author directed attention to the importance of making further studies of mobility and quantitative determinations of the hydration of ions as a preliminary for determining the sizes of the ions and of their actual constitutions based on kinetic principles.

Royal Meteorological Society, January 16.—Annual general meeting.—Presidential address, weather in war time: R. **Bentley.** The address showed how, on more than three hundred occasions, the course of history was greatly influenced by weather conditions.

EDINBURGH.

Royal Society, December 17, 1906.—Prof. Gray, vice-president, in the chair.—The hæmo-renal salt index as a test of the functional efficiency of the kidney: Dr. Dawson **Turner.** The hæmo-renal salt index is defined to be the ratio of the electrical resistance of the blood to the electrical resistance of the urine. In health this ratio should be 4 or 5. When the index increases it indicates that the blood contains fewer salts or is richer in corpuscles, or that the urine contains more salts, or that all these changes exist together. With low resistance of the urine the functional activity of the kidneys is increased. Several medical cases were referred to, and it was pointed out that the method would probably prove to be of great value in surgery. With the apparatus which had been devised the measurements could be rapidly made on very small quantities of both blood and urine. The method was another example of the application of precise scientific measurement to clinical medicine and surgery, and showed the importance of a medical student being trained in medical experimental physics.—Relation between magnetisation and electric conductivity in nickel at high temperatures: Dr.

C. G. **Knott.** The point of special interest was the manner in which the increase of conductance due to the application of a field transverse to the direction in which the conductivity was being measured first diminished steadily with rise of temperature until it reached a minimum at about 280° C., then rose abruptly to a maximum at 310° C., and finally fell off to zero at 350° C.—The relation between normal take-up or contraction and yarn-number for the same degree of twist in twisted threads: T. **Oliver.** In a former paper the relation between the take-up in the second twisting of a two-ply yarn and the amounts of first and second twistings was studied experimentally and analytically. The present paper considered the relation when, with the same twistings, different sizes of thread were used. This at once brings in the "yarn number," which cannot be taken in the same way as wires are gauged, but must depend on the relation of length to weight. Experimental results were obtained for two distinct sets of cases, according as the component threads were of the same diameter or of different diameters. Formulæ were established with which the experimental results were compared, and considering the complexities of the problem the comparison was sufficiently satisfactory. —The superposition of mechanical vibrations (electric oscillations) upon the magnetisation, and conversely, in iron, steel, and nickel, part ii.: J. **Russell.** In this continuation of a difficult piece of work the author discussed the discrepancy between his former results and those obtained by Dr. Eccles, and expressed his opinion that the latter investigator had not taken sufficient precaution in reducing the metal to exactly the same magnetic state before each experiment. It is only by means of a succession of gradually diminishing reversals that we can be certain that the magnetised substance is brought back to a definite condition time after time.

January 7.—Prof. Crum Brown, vice-president, in the chair.—Notes on aboriginals of the northern territory of South Australia: Dr. W. Ramsay **Smith.** The paper contained a detailed discussion of several of the peculiar rites and customs of the Australian aborigines, such as the scars on shoulder, breast, arms, and abdomen. Evidence was adduced that these scars had definite signification, implying, perhaps, the number of children borne, the number still alive, the death of a near relative, or the widowhood of the individual bearing the scars. Other points taken up were the character of the dentition, the grasping power of the great toe, the rite of sub-incision, and the interpretation of the carved message-sticks.—Exhibition of the skeletons of monkeys showing effects produced by improper feeding: Prof. D. J. **Cunningham.** The skeletons and skulls in the university anatomical museum frequently showed abnormalities, such as excessive bending or softening or a certain roughness on the surface. Many of the specimens had been purchased from travelling menageries, and there seemed to be little doubt that the effects were due to improper feeding and bad ventilation. —The partition of heat energy in the molecules of gases: Dr. P. **Ehrenfest.**—Vibrating systems which are not subject to the Maxwell-Boltmann law. Second paper: Dr. Wm. **Peddie.** These two papers were sequels to Dr. Peddie's first paper, certain results in which were criticised and to some extent modified. Dr. Peddie also gave a purely mathematical discussion of the problem in distribution devised by Lord Kelvin as a test-case for the proof or disproof of the Boltzmann-Maxwell doctrine. This was the problem of the motion of a particle within a circular region the rim of which consisted of a series of semi-circular corrugations. Although in the long run the time integral of the kinetic energy of the component motion parallel to any fixed direction would in this case be the same for all directions, the time integrals of the two components, radial and transversal, according to polar coordinates, would not be the same, thus disproving the Boltzmann-Maxwell law.—Note on cases of contour zones of molecular arrangement from surface disturbance: Dr. James **Hunter.** When a piece of fine-grained stone which has been used for polishing splits, an inspection of the new surfaces shows a distinct zone running approximately parallel to the cylindrical surface of the stone disc. Outward towards the circumference, the texture of the stone is radial, suggesting radial arrangements of the molecules, while inside there is no trace of this arrangement. Similar contours appear in other cases, such as when glass is cut by a diamond or by the cutting-wheel. It was interesting to observe how different the patterns of the markings were in these two instances.

PARIS.

Academy of Sciences, January 21.—M. Henri Becquerel in the chair.—A proposed system of classification for the bibliography of subjects bearing on seismology: G. **Bigourdan.**—An expedition of Commandant Chaves in Africa: **Prince Albert I. of Monaco.** An outline of the magnetic work done on this expedition, and an account of the comparison of the instruments used with those at Cape Town.—The resistance and elastic equilibrium of tubes round which an elastic wire is wound: A. **Jacob.** —Communications were received from M. Milan Stefanik and M. Janssen stating that observations of the solar eclipse of January 14 had been prevented by clouds.—The approximation of functions by limited trigonometrical series: Maurice **Fréchet.**—Helices of propulsion: P. **Tsoucalas** and J. **Vlahavas.**—Propulsive helices: F. **Ferrier.**—Measurements of the Zeeman effect on the blue lines of zinc: P. **Weiss** and A. **Cotton.** The lines studied were the three 4810·71, 4722·26, and 4680·33, in a magnetic field the strength of which varied between 25,500 and 36,000 Gauss. Contrary to the results of Reese and Kent, the distance between the two magnetic components was found to be proportional to the intensity of the field, the results being in complete accord with the simple relations which Runge and Paschen have discovered.—The modifications which the absorption bands of tysonite undergo in a magnetic field: Jean **Becquerel.**—The preparation of pure helium by filtration of gases from cleveite through a wall of silica: Adrien **Jaquerod** and F. Louis **Perrot.** In a previous paper the authors have shown that the helium thermometer with a fused quartz bulb was useless on account of the readiness with which the gas penetrated the walls at a high temperature. On the other hand, it was found that silica is quite impermeable to all other gases at about 1000° C., with the exception of hydrogen and possibly carbon monoxide. In the present paper application is made of these facts to the preparation of pure helium from cleveite. Using a bulb of 42 c.c. capacity, the method described gives a yield of about 1 c.c. of pure helium per hour. The gas obtained in this way was found by spectroscopic examination to be free from nitrogen, the only gas present besides helium being a minute trace of hydrogen, possibly derived from the electrodes of the tube.—The absence of nutrition in the formation of the artificial plants of Leduc: MM. **Charrin** and **Goupil.** Experiments are described showing that the word nutrition is misapplied when used in connection with these phenomena.—The mechanism of the synthesis of some quinoline derivatives: L. J. **Simon.**—The conditions of stability of the carbamines: H. **Guillemard.**—The synthesis of derivatives of cyclohexane: 3 : 3-dimethyl- and 3 : 3 : 6-trimethyl-cyclohexanones: G. **Blanc.** The author has described in an earlier paper the synthetical preparation of ββ-dimethyl- and ββε-trimethyl-pimelic acids. These acids are converted into the corresponding anhydrides by treatment with acetic anhydride, and these, slowly distilled under ordinary atmospheric pressure, split up quantitatively into carbon dioxide and the cyclohexanone.—The synthesis of natural erythrite: M. **Lespieau.** The preparation of an inactive erythrolactone has been described in an earlier paper; this lactone treated with brucine, and the product submitted to fractional crystallisation, has yielded a lævorotatory lactone and natural erythrite.—The symbiosis of the fig and blastophage: Leclerc **du Sablon.**—The presence of formaldehyde in green plants: G. **Kimpflin.** As a reagent for detecting formaldehyde, the author uses methylpara-amidometacresol, and shows that the reaction is distinctive. This reagent has the advantage that it does not destroy vegetable tissue.—The active substances of *Tephrosia Vogelii*: M. **Hanriot.** By methods given in detail, the author has isolated a volatile liquid, tephrosal, of the composition $C_{10}H_{16}O$, and a crystalline substance, tephrosine, of the formula $C_{31}H_{26}O_{10}$.—The formation and distribution of an

essential oil in a living plant: Eug. **Charabot** and G. **Laloue.** An examination of the plant *Artemisia absynthium.*—The pharmacodynamical action of a new alkaloid contained in the root of fresh valerian: J. **Chevalier.**—The formation of the skeleton in some of the hexacorals: Armand **Krempf.**—The part belonging to the anastomotic branch of the spinal in the physiological properties of the pneumo-gastric or pneumo-spinal nerve: F. X. **Lesbre** and F. **Maignon.**—Some new experiments concerning the pathology of pulmonary anthracosis: G. **Kuss** and E. **Lobstein.** Further experiments bearing on the criticisms of MM. Calmette, Grysez, and Vansteenberghe. The conclusions drawn from this work are that ordinary pulmonary anthracosis, as arising in ordinary life, is produced by inhalation and not by deglutition.—The evolution of the Cerithidæ in the Middle and Upper Eocene of the Paris basin: Jean **Boussac.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts iii. and iv. for 1906, contains the following memoirs communicated to the society:—

May 12.—The motion of an electron under the influence of a longitudinally directed force: Paul **Hertz.**

March 31.—Physics without apparatus; attraction and repulsion of unelectrified bodies. Electrical experiments with a polished table surface: W. **Holtz.**

May 5.—The imaginary zeros of the hypergeometric function: A. **Hurwitz.**

June 16.—Calorimetric studies, i., specific heats of pure alcohol, and of mixtures of alcohol and water: E. **Bose.**

July 28.—Calorimetric studies, ii., thermal anomalies in alcoholic mixtures; iii., relations between the foregoing results (i. and ii.): E. **Bose.**—Seismic records in Göttingen during 1905: G. **Angenheister.**

May 19.—A characteristic property of the *Klassenkörper* (Abelian functions): Ph. **Furtwängler.**

October 27.—Statistical review of the local and remote earth tremors recorded at the Samoa Observatory during 1905: F. **Linke.**

July 28.—Principles of a general theory of linear integral equations: D. **Hilbert.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 31.

ROYAL SOCIETY, at 4.30.—On the Two Spectra of the Elements as Evidence of the Composite Nature of the Atoms: Prof. W. N. Hartley, F.R.S.—On the Explosion of Pure Electrolytic Gas: Prof. H. B. Dixon, F.R.S., and L. Bradshaw.—The Firing of Gaseous Mixtures by Compression: L. Bradshaw.—A Recording Calorimeter for Explosions: Prof. B. Hopkinson.—On the Discharge of Negative Electricity from Hot Calcium: Dr. F. Horton.

ROYAL INSTITUTION, at 3.—Standards of Weights and Measures: Major Percy A. Macmahon, F.R.S.

FRIDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 9.—The Methods of Combating the Bacteria of Disease in the Interior of the Organism: Sir Almroth E. Wright, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—President's Address: On the Constitution and Management of Scientific Societies.

MONDAY, FEBRUARY 4.

LONDON INSTITUTION, at 5.—Through Savage Europe: Harry de Windt.

SOCIETY OF ARTS, at 8.—Gold Mining and Gold Production: Lode Mining: Prof. J. W. Gregory, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—(1) The Chemical Composition of some Motor Tyre Rubbers; (2) On the Composition of some New Crude Rubbers: Dr. P. Schidrowitz and F. Kaye.

VICTORIA INSTITUTE, at 4.30.—The Bible Pedigree of the Nations: M. L. Rouse.

TUESDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 3.—Survivals from the Past in the Plant World: Prof. A. C. Seward, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Modern Motor Vehicles: Col R. E. B. Crompton, C.B.

ZOOLOGICAL SOCIETY, at 8.30.—On the Fœtus of the Giraffe: Prof. E. Ray Lankester, F.R.S.—On New or Rare Cumacea from the Collection of the Copenhagen Museum. Part i.: Dr. W. T. Calman.—Description of a New Amazonian Tree-Frog with Peculiar Breeding Habits: Dr. E. A. Goeldi.

WEDNESDAY, FEBRUARY 6.

SOCITY OF PUBLIC ANALYSTS, at 8.15.—Annual General Meeting. Presidential Address.—(1) Mineral Acids in Vinegar; (2) The Composition of English Fermentation Vinegar: F. D. Ratcliff.—The Detection of Cane Sugar in Milk: W. H. Anderson.

SOCIETY OF ARTS, at 8.—The Principles and Practice of Insurance, and their Modern Developments: T. E. Young.

GEOLOGICAL SOCIETY, at 8.—Note on the Cervical Vertebra of a Zeuglodon from the Barton Clay of Barton Cliff (Hampshire): Dr. C. W. Andrews, F.R.S.—On the Origin and Age of the Plateaus around Torquay (South Devon): A. J. Jukes-Browne.

ENTOMOLOGICAL SOCIETY, at 8.—Notes on the Indo-Australian Papilionidæ: Percy I. Lathy.

THURSDAY, FEBRUARY 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Influence of Increased Barometric Pressure on Man, No. 3, The Possibility of Oxygen Bubbles being set free in the Body: Leonard Hill, F.R.S., and M. Greenwood, jun.—On the Combining Properties of the Opsonin of an Immune Serum: Prof. R. Muir and W. B. M. Martin.—Experiments made to determine the Condition under which "Specific" Bacteria derived from Sewage may be present in the Air of Ventilating Pipes, Drains, Inspection Chambers, and Sewers: Major W. H. Horrocks, R.A.M.C.—Observations on the Life-History of Leucocytes, Part ii., On the Origin of the Granules: C. E. Walker.

ROYAL INSTITUTION, at 3.—Standards of Weights and Measures: Major P. A. Macmahon, F.R.S.

LINNEAN SOCIETY, at 8.—*Papers:* New Plants from Malaya: Dr. Otto Stapf.—Tertiary Foraminifera of Victoria: the Balcombian Deposits of Port Phillip: F. Chapman.—*Exhibitions:* Specimens of *Chara ornithopoda*: H. and J. Groves.—Some Observations of Climbing Plants (with lantern-slides): Rev. John Gerard.—Herbarium formed by A. Ruperti, 1698-1700: W. Rose Smith.

CHEMICAL SOCIETY, at 8.30.—On the Rapid Electroanalytical Deposition and Separation of Metals, Part i., The Metals of the Silver and Copper Groups and Zinc: H. J. S. Sand.—The Alkaloids of Ergot: G. Barger and F. H. Carr.—Influence of Substitution on the Formation of Diazo-amines and Amine-azo-compounds, Part vi., the Partially Methylated 4:6-Diamino-*m*-xylenes: G. T. Morgan and F. M. G. Micklethwait.—(1) The Reduction of Hydroxylaminodihydroumbellulone Oxime; (2) The Constitution of Umbellulone, Part ii., the Reduction of Umbellulonic Acid: F. Tutin.—Studies on Optically Active Carbimides, Part v., The Aryl Esters and the Amides of 1-Menthylcarbamic Acid: R. H. Pickard and W. Oswald.—Some Constituents of Natural Indigo, Part i.: A. G. Perkin and W. P. Bloxam.—The Occurrence of Isatin in some Samples of Java Indigo: A. G. Perkin.—(1) On the Absorption Spectra of Benzoic Acid, the Benzoates and Benzamide; (2) The Absorption Spectra of Phthalic, *iso*Phthalic and Terephthalic Acids: Phthalic Anhydride and Phthalimide: W. N. Hartley and E. P. Hedley.—$\alpha\alpha\gamma$-Trimethyl- and $\alpha\alpha\gamma\gamma$-Tetramethyl-tricarballylic Acids and $\alpha\Delta$-Dimethylbutane $\alpha\beta\Delta$-Tricarboxylic Acid: H. Henstock and C. H. G. Sprankling.—A Reaction of Certain Colouring Matters of the Oxazine Series: J. F. Thorpe.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Investigations on Light Standards and the Present Condition of the High-Voltage Glow Lamp: C. C. Paterson (Conclusion of Discussion).—Comparative Life Tests on Carbon, Nernst, and Tantalum Incandescent Lamps using Alternating Currents: H. F. Haworth, T. H. Matthewman, and D. H. Ogley.

CONTENTS.

PAGE

The Plant as Machine. By Dr. F. F. Blackman, F.R.S. 313
The Norsemen in the Orkneys. By J. W. Cursiter . 315
Organic Chemistry for Students. By G. Y. . . . 316
Some Opinions on Teaching Mechanics. By G. H. B. 317
Our Book Shelf:—
Joseph: "What are We?" 318
Hough and Sedgwick: "The Human Mechanism, its Physiology and Hygiene and the Sanitation of its Surroundings" 318
Arnoux: "Arithmétique graphique. Introduction à l'Étude des Fonctions arithmétiques" 319
Boulger: "Familiar Trees" 319
Letters to the Editor:—
Radium and Geology.—Prof. W. J. Sollas, F.R.S. 319
The Mathematical Tripos.—Dr. Edward J. Routh, F.R.S. 320
Fertilisation of Flowers by Insects.—E. W. Swanton; Dr. Alfred R. Wallace, F.R.S. 320
The Immortality of the Protozoa.—J. Shawcross . 320
Perception of Relief by Monocular Vision.—A. E. Smith 321
The Ruwenzori Boundary Dispute 321
The Art of the Lapidary. (*Illustrated.*) By J. W. J. 321
Notes. (*Illustrated.*) 323
Our Astronomical Column:—
The Recent Total Eclipse of the Sun 326
The Solar Radiation. 326
Photographs of Giacobini's Comet (1905*c*) 326
The Red Spot on Jupiter, 1905-6 327
A Peculiar Short-period Variable (155.1906 Cassiopeiæ) 327
The British Science Guild 327
American Fossil Cycads. (*Illustrated.*) By A. C. S. 329
The Recent High Barometer. 330
Star Catalogues. By W. E. P. 331
University and Educational Intelligence 332
Societies and Academies 333
Diary of Societies 336