THURSDAY, NOVEMBER 19, 1908.

GEOLOGY OF CHINA.

Research in China. Vol. ii. Systematic Geology. By Bailey Willis. Pp. v+133+v. (Washington: Carnegie Institution, 1907.)

IT is difficult to be quite sure for what class of reader this work is intended. The main facts of interest have already appeared in the previous volume, but in this they are discussed from "the point of view of systematic continental history." In the present state of knowledge this might seem rather a hopeless undertaking, and the result does not dispel our misgivings; much of the explanatory matter is elementary, and much is merely speculative.

The reader's confidence in the author is somewhat rudely shaken at an early stage, as, for instance, at the close of chapter ii., where, on p. 34, it is first stated that "there is room to question what features existed in Central Asia during the Sinian period"; six lines further on, owing to the fact that the Sinian strata consist of limestone, this becomes "it is a fair inference that practically all Asia draining to the Cambro-Ordovician Sea was low and featureless." The next paragraph, however, begins, "The fact that Asia at the opening of the Paleozoic era was a featureless continent has important bearings." After this bold identification of fact with inference, it becomes necessary to inquire into the credentials of other so-called facts. One of the most interesting results recorded is the discovery of a glacial till in ancient rocks, said to be Cambrian. Convincing proof is given of the glacial character of this deposit; its age does not seem to be so clearly established. In the present volume we read,

"The tillite (*sic*) passes into a greenish shale . . . including characteristic pebbles. . . . This shale conglomerate . . . grades into the overlying limestone, the basal layer of a great thickness of Sinian."

But if we turn to vol. i., Blackwelder informs us that

"The Nan-t'ou formation [of which the till is the uppermost member] is limited above by an uneven surface, upon which lies a sheet of conglomerate. The matrix of the conglomerate is a greenish argillaceous limestone and the pebbles are like those in the underlying tillite. The two formations are therefore related by a basal conglomerate, which the till was well calculated to furnish. . . ."

This statement is sufficiently clear, and is accentuated by the two diagrams representing the succession of strata given on pp. 264 and 268, in each of which an undulating line is drawn between the conglomerate and the till. What, then, is in fact the relation of the till to the conglomerate? Do they pass into each other (Willis), or are they separated by an uneven line (Blackwelder)? But, again, is even the asserted age of the conglomerate a fact, or is it an inference? Turning once more to vol. i., we find on p. 269 that the till

"lies at the base of the Cambro-Ordovician limestone, from which we obtained Lower and Middle Cambrian fossils within less than 100 miles . . . of Nan-t'ou. Hence it is highly probable that these glacial beds on the Yang-tzi are of early Cambrian age."

Though the fossils were found only a hundred miles away, we should still have been glad of additional evidence to show that the beds at Nan-t'ou were on one or other of the horizons they indicate.

It is of interest to note in passing that since the Sinian formation is equivalent to the Cambrian and Ordovician, it almost precisely corresponds to the Cambrian as defined by Sedgwick.

The summit of this formation is said to be on the horizon of the Trenton or Middle Ordovician; above this "it passes by transition into shales which are probably of Silurian or Devonian age." The suggested *passage by transition* of Middle Ordovician into either Silurian or Devonian shales leads to the suspicion that the author uses this term in some esoteric sense.

The treatment of the Angara and Gondwána beds is one of the most unsatisfactory chapters in the volume; both series are included under the head of Permo-Triassic strata, while so far as existing observations go, the Gondwána beds begin with the Lower or Middle Carboniferous,[1] while the most trustworthy evidence we possess points to a Jurassic age for the Angara. There is an inexactitude also in defining the limits of the Angara beds; they are not confined to the northern region indicated by the author, but extend to Afghanistan and through Turkestan, as Musketow has already pointed out.

Students of the geology of India will be surprised to learn that "no distinctly sedimentary pre-Cambrian rocks are known there," *i.e.* in the peninsula (p. 23), and those who have given attention to ripple marks will scarcely admit that they are to be taken offhand as evidence of "waves" in the common sense of this term (p. 38).

The structural trend-lines of Asia seem to be drawn for the most part after the maps of von Richthofen, Suess, Neumayr, and Futterer; it is pleasing to find that the generalisations of these great masters have been almost entirely confirmed by recent investigators. But we see no evidence for the postulated "Isle of Tibet." A region of which the geology is almost unknown naturally offers great temptations to the theorist.

There is some internal evidence of hasty writing, such as inaccuracies in translation conveying a rather different sense from that of the original; as an example we may cite the last sentence of the first paragraph (p. 69) from Suess:—

"The great height of the ranges is accompanied, however, by a relatively even more striking altitude of the valleys, a circumstance which diminishes the differences of level in the interior of the mountainous regions, but the observer is even thus below the limit of eternal snow."

This is rendered from the French, which runs:—

"L'altitude plus forte des chaînes a pour contre-partie une hauteur plus grande des fonds de vallées, ce qui atténue les différences de niveau à l'intérieur

[1] Neumayr and Waagen concluded in favour of an Upper Carboniferous age long ago, and Hayden has since shown that they must lie even lower.

de la région montagneuse, mais l'observeur ne s'en trouve que plus rapproché de la limite des neiges éternelles."

The French is a correct translation of the German.

The pith of this volume might have been summed up in a single chapter without losing any important contribution to science, and the space so saved might have been devoted to a much-needed bibliography of the subject. The author would not then have completely overlooked the work of the French explorers in Yün-nan. The artistic excellence of the numerous maps by which the volume is illustrated deserves unqualified praise.

FLOWERS AND WHAT THEY TEACH.

Types of Floral Mechanism. A Selection of Diagrams and Descriptions of Common Flowers. Arranged as an Introduction to the Study of Angiosperms. By Dr. A. H. Church, Part i., Types i.–xii. (January to April). Pp. vii+211; with 52 full-page plates (39 coloured) of floral structure, and 79 text-figures. (Oxford: Clarendon Press, 1908.) Price 21*s.* net.

THE title conveys a very imperfect idea of the nature of this work, which stands apart from all others that have been issued as introductions to the study of botany. The method of teaching botany by a careful investigation of selected types is, indeed, well known and much employed; but it has never been carried out, in English works at least, with any approach to the thoroughness of study of the types in themselves and in their relations to their environment and to their allies that we find here.

The author in a preface informs us that the admirable illustrations were originally prepared for class purposes, limited to a hundred types, of which twelve "Early Spring Types" are included in the present volume, and the arrangement and general scheme are designed to represent the working method applicable to the subject.

"No methods are indicated, nor have any been employed in making preparations which are beyond the reach of the 'elementary student'; and at the same time a general 'elementary' acquaintance with the subject on the part of the reader has been assumed. Since it is necessary to draw the line somewhere . . . and the present work is admittedly of only a general and elementary character, histological details are omitted."

The twelve types treated of are, successively, *Helleborus niger, Galanthus nivalis, Jasminum nudiflorum, Crocus vernus, Richardia africana, Daphne Mezereum, Viola odorata, Narcissus Pseudo-narcissus, Erica carnea, Ribes sanguineum, Cydonia japonica,* and *Vinca major.*

In the study of such a series, it is evident that there can be no close connection traced by an "elementary student" between so different types. Thus each becomes the subject of a separate monograph. That on *Viola odorata* may be taken as an example. A brief general notice of its appearance, habitats, tendency to vary, and production of cleistogamic flowers is accompanied by footnotes with references to descriptions and figures by Dioscorides, Brunfels, Gerarde, and other early botanists, and to its names and cultivation in England. Then follow a detailed description of the inflorescence and flower, and a brief notice of the effects of cultivation on the flower. The floral diagram and phyllotaxis are fully discussed and illustrated, as are also the development of the floral members and the "special mechanism" of the flower for securing the reproduction of the species, including the relations with various bees. The cleistogamic flowers and the possible origin of this type of flower are then treated of.

The various floral "monstrosities" are enumerated, and are "referred to failures in the adjustment of certain features of the floral construction or mechanism." The development and structure of the capsules, their mode of opening, and the structure of the seeds conclude the discussion under *V. odorata.* Then follows a "Comparison of Allied Forms," under which six and a half pages are devoted to *Viola tricolor,* chiefly var. *arvensis,* and five pages to *V. altaica,* or "the garden pansy." For each of these a detailed comparison of the structure and mechanism of the several parts brings into view their resemblances and differences, and their relations with their environment. Although reference is made to the "very variable" *V. tricolor,* there is little stress laid on the extent of the tendency to vary, and the opinion is expressed, even with regard to the relations between *V. tricolor, V. lutea,* and allied alpine forms, that "no sharp line of demarcation either exists or need be drawn between 'specific forms' which only exist as useful conventions." While there is a risk of attaching too high a value to the many forms that have been distinguished and named by critical botanists in the genus Viola, as in a good many other genera, it may be questioned whether the author might not have usefully directed the attention of students to the nature and degrees of constancy of the forms so freely met with in the Linnean *V. tricolor.*

The study of the types selected is employed by Dr. Church as a basis for certain "Theoretical Conclusions" with regard to the origin and development of the genus Viola. The hypothesis is expressed that *V. odorata* is a "highly specialised representative of a shrubby, or even arboreal, plant-phylum," with "panicles of regular flowers, which had already passed from an asymmetrical vegetative type of construction to a symmetrical pentamerous condition." From this a later evolution led to structural eccentricity of two phases, and to adaptations of the floral mechanism for visits of certain insects. These conclusions find support from a study of the genera associated in the family Violaceæ, Viola standing out "as the crowning genus of the entire group; the type, that is to say, in which the various modifications of the original construction are present in the greatest number, and combined to make a most efficient form of floral mechanism." The relations of the forms included under the family to types in other families are discussed, and the steps are summarised that led to the definition of the Violaceæ as a family.

The other eleven types are treated with almost similar fulness, and numerous interesting problems are brought into notice. The arrangements of the floral members (phyllotaxis) in each type receive especial attention, as might be expected from an adept in this subject.

Dr. Church has produced a valuable contribution to botanical literature, excellent alike in the text and in the illustrations, and the execution is worthy of the Clarendon Press. If the remaining eighty-eight types are worked out in the same manner as their forerunners, the whole will form one of the most valuable introductions to the study of angiosperms in any language, but there is reason to doubt whether its necessary size and cost, and the thoroughness of the treatment, may not put it out of reach of most "elementary" students of botany. Its value will be more appreciated by teachers and by advanced students; few botanists can fail to benefit from its pages, and no botanical school can afford to neglect so valuable and suggestive a storehouse of information. There is the more reason to regret that it is on the heavy, highly glazed paper so trying to many eyes and of very doubtful durability.

COTTON WEAVING.

The Cotton Weaver's Handbook. By H. B. Heylin. Pp. x+326. (London: Charles Griffin and Co., Ltd., 1908.) Price 6*s.* net.

DURING the last twenty-five years many excellent books dealing with textile subjects have been published in Germany, America, and England, but in none of them has cotton weaving been treated as Mr. Heylin treats it. His book contains 462 pages, of which 112 are blank paper, 12 sheets are blank design paper, and 326 pages are of printed matter, the latter being divided as follows:—8 pages are allotted to the index, 30 to a reprint of cotton-weaving examination questions set by the City and Guilds of London Institute, and 36 pages to pictures of textile machinery. On the remaining 252 pages there are upwards of 350 figures, but with the exception of those relating to designs, drafts, and lifting plans, the illustrations are poor. Most of them consist of pictures of machinery and appliances which are of small value to the student, and when, as in this case, they are mainly without reference letters, and inadequately described, they do little more than add to the size of the book. The following may be taken as examples of the majority of these illustrations. Fig. 350 is a picture of a smallware loom, and the descriptive matter consists of "There is a separate shuttle for each tape woven." Fig. 357 has letters added to special mechanism, but these are not referred to. Figs. 273, 274, and 275 are perspective, edge, and plan views of ladder tape, and the only description given is that "ladder tape used for Venetian blinds is a good example of what may be done by the four-ply system of weaving."

In the text there is ample evidence of haste. Statements are repeated again and again, as on pp. 30, 32, and 34, where we are told that the scope for producing a variety of weave effects is in proportion to the number of threads in the repeat of a design. Again, on pp. 16, 18, and 33, similar repetitions are found concerning broken drafts. That mistakes are very numerous will be seen from the following, which are selected, almost at random, from a long list. On p. 84 it is stated that the ordinary picking motion is "put out of action whilst the wire is inserted to form the warp pile." In these looms the shuttle and the wire are passed through the warp together. The twist tester figured on p. 190 is said to "take out the twist at both ends of the thread simultaneously," whereas it can only untwist from one end. On p. 124, Fig. 294 should read Fig. 296. On the last line of p. 170, /120 should read 4/120, and on p. 225 "the slacker will be the top speed" should read "the slacker will be the top shed." On p. 214 the calculation for determining the point of connection between the back heald cords and the tappet treadle is wrong, and resolves itself into a calculation to determine the required lift of a tappet for operating the back heald shaft. On p. 221 a swing pinion is said to be compounded with a wheel *D*, and also to gear with the wheel *D*. Three calculations are given on p. 245; one is without answer, and both the others lack some of the cancelled figures.

The chapter on weaves is the best in the book, but since this branch of the subject has been more exhaustively treated by German, American, and British writers than any other, it would perhaps be unreasonable to expect Mr. Heylin to say much that is new concerning them. With regard to the heading of this chapter, it is stated on p. 6 that the term "weave is sometimes miscalled design"; nevertheless, the latter term is used throughout the book. The chapters on the power loom and its accessories, and on preparing yarn for the loom, are quite inadequate. Frequent reference is made for details to the frontispiece, which is an unlettered picture of a power loom, and, therefore, affords no means of identifying the parts. To a reader who is familiar with the loom such descriptions as are given are useless, and to others they will be unintelligible. The "Costing of Cloth" precedes the "Systems of Naming Yarns," and prices are given in shillings, pence and farthings, instead of in pence and decimals of pence; also, where yarns are weighed, pennyweights and grains are used instead of grains only. Several pages are occupied with rules and examples for determining the counts of folded yarns, but in no case is the basis of a rule given; further, the problems do not amount to more than the addition, or the subtraction, of fractions, as, $\frac{1}{20}+\frac{1}{30}+\frac{1}{60}=\frac{1}{10}$, and $\frac{1}{12}-\frac{1}{20}=\frac{1}{30}$. An undated market report with official quotations for cotton and yarn occupies five pages.

By a thorough revision, and by filling in the blank pages and deleting the examination questions, the subjects named in the contents might be adequately dealt with, but in its present form this book contains so little that is new, and so much that is inexact or untrue, that it is difficult to say for whom it is suited.

ELECTRICAL TESTING.

Laboratory and Factory Tests in Electrical Engineering. By George F. Sever and Fitzhugh Townsend. Second edition, revised and enlarged. Pp. xii+269. (London: A. Constable and Co., Ltd.; New York: D. van Nostrand Co., 1908.) Price 10*s*. 6*d*. net.

IT is almost unavoidable that a book on laboratory practice, written by men whose duty it is to plan and superintend the work done by students, must savour somewhat of the instruction sheets which at universities are supplied to the laboratory classes. It is equally unavoidable that such instruction cannot be given in perfectly general terms, but must be adapted more or less to the syllabus in use at each particular university, and to the plant provided for the laboratory. Thus a work on laboratory tests may be exceedingly useful to students working at the particular laboratory to which it refers, but whether students at other institutions will be able to derive much benefit from it is doubtful. The advanced student and the scientific engineer, who is already in practice, will probably also be able to derive some advantage from the book under review, but he would reap the same advantage with less mental labour from any elementary text-book on electrical engineering. The words "factory tests" in the title must be taken to mean that the tests used in a particular laboratory may more or less also be used in a factory. This is, of course, true of all work carried out in a modern well-equipped laboratory, and, therefore, not a distinctive feature of the methods described in the present work.

It is certainly difficult to compress into 260 pages the whole subject of electrical testing, and want of space may be the reason why the authors have treated certain subjects in a very brief—one is almost tempted to say sketchy—manner, but I think they have not been judicious in the matter of curtailment, inasmuch as they have shortened or omitted altogether the exposition of general principles. On the other hand, they have unduly expanded the mere routine of testing. As an example of sketchy treatment of fundamental matters, take the Heyland diagram on p. 172 of the induction motor, which is given on the assumption that the motor has neither ohmic nor iron losses, and the various vectors are indiscriminately referred to as representing magnetomotive forces, currents, flux, or electromotive forces, without a word of explanation. That such treatment of a difficult subject must have seemed to the authors themselves somewhat unsatisfactory may be gathered from the following sentence, which occurs on p. 173:—

"This diagram has been so fully discussed in the literature of the induction motor that it is not thought necessary to reproduce the proof of it here."

Just so. The authors assume that the fundamental principles are known, and content themselves with giving mere rules for testing.

The book is divided into three parts. The first deals with preliminary measurements and with tests of continuous-current machines. In the second part we come to alternating-current machines and transformers, and then follows the third part, which bears the title "Electrical Measurements." This title is rather misleading, for here we find such subjects as the determination of the leakage coefficient of a dynamo, the Hopkinson method of testing for permeability, Ewing's hysteresis tester, Ewing's magnetic bridge, the plotting of the hysteretic loop—all subjects which one would rather call magnetic, not electrical, tests. However, a title which only fits part of the contents is not a serious matter, but that some electrical tests are treated in a very superficial manner is a decided drawback. Thus the Wheatstone bridge, which logically ought to have found a place in the first part, is dismissed in two pages of letterpress and a very imperfect diagram, whilst no mention is made of Varley's bridge or Thomson's double bridge. The potentiometer fares even worse. The diagram on p. 250 is crude and incomplete, and it is no help to the reader to be told on p. 251 that "for commercial use the potentiometer is usually arranged in some compact and convenient form." It is precisely the instrument as practically used with all its refinements that the reader expects to find in a book on laboratory and factory testing.

The third part also deals with tests on batteries and photometric work. Since both these subjects together occupy barely nine pages, it is clear that the treatment can only be very superficial. One feature of the book which strikes the reader as peculiar is that the authors omit in most cases to mention the origin of the methods they describe. Thus, Scott's name is not mentioned in connection with the change from three- to two-phase circuits, nor is Heyland's name mentioned when describing his diagram. Quite apart from the consideration that it is only fair to give credit where it is due, the suppression of such references is inconvenient to the reader. Certain discoveries, inventions, methods, or tests are known under the names of the men who first published them, and are usually identified in this manner. By omitting such means of identification, the young student loses touch with the subject he is supposed to acquire.

GISBERT KAPP.

SCHOOL ALGEBRAS.

(1) *Elementary Algebra—A School Course.* By W. D. Eggar. Pp. viii+324+28. (London: E. Arnold, n.d.) Price 3*s*. 6*d*.

(2) *A New Algebra.* By S. Barnard and J. M. Child. Vol. i., containing Parts i., ii., and iii., with Answers. Pp. x+371. (London: Macmillan and Co., Ltd., 1908.) Price 2*s*. 6*d*.

(3) *Algebra for Secondary Schools.* By Dr. Charles Davison. Pp. viii+623. (Cambridge: University Press, 1908.) Price 6*s*.

(4) *The Eton Algebra.* Part i. By P. Scoones and L. Todd. Pp. xxv+184. (London: Macmillan and Co., Ltd., 1908.) Price 2*s*. 6*d*.

(1) THIS book covers most of the ground required for boys who are not specialising in mathematics, with exercises in logarithms and a short chapter on trigonometric ratios. There are tables of

these functions and of square roots at the end of the book. There is an excellent collection of examples, many of which are of a practical type, and, therefore, in themselves more interesting than the old-fashioned academic questions. The proofs of formulæ and methods are in some cases somewhat concise, and would need amplification by the teacher. In particular, the proof of the binomial theorem and the explanation of the method of finding square roots are of this character. In some cases the author adopts the heuristic method, and requires the student to derive formulæ for himself, as, for instance, in finding the factors of $x^3 \pm y^3$ and $x^3+y^3+z^3-3xyz$, and in finding the meaning of fractional indices and the values of logarithms.

We should like to see less formal methods of finding the H.C.F. of two algebraic expressions, based on the fact that $R = aA - bB$ contains the common factors of A and B, as in many cases R can be factorised and the common factors detected with much less trouble and with a more direct appeal to common sense than by the formal method. The chapter on factors is very fully and carefully done, and this method would be a natural sequel.

The use of graphs is well exemplified and illustrated by a good number of examples. The chapters on ratio, proportion, and variation are good, especially in the selection of interesting practical examples.

(2) Messrs. Barnard and Child have made a brave attempt to give a logical development of algebra in a form suitable for school work. They explain the meaning of the laws of association, commutation, and distribution as applied to addition, subtraction, multiplication and division, and lead up to the solution of what are to a beginner quite difficult problems.

Negative numbers are not considered until part ii. (p. 149), and are there explained by extending the scale of natural numbers backwards. In this part some of the difficulties would seem to be too delicate for the comprehension of a beginner, as, for example, the distinction between $2+(-3)$ and $(-3)+2$. Every teacher must, of course, use his judgment as to how far to press such niceties. The explanations are carefully given throughout, and the collection of examples is excellent. The method of factors is applied to finding the H.C.F. and L.C.M. of a set of expressions; in fact, one special and excellent feature of the book is its early introduction to factorisation. As soon as a boy can factorise with facility, the expressions have a form and interest to him which they did not possess before. Fractions are introduced in part iii., and theorems on equal fractions (the authors avoid the use of the term "ratio") are given in chapter xx. Graphs are introduced in chapter xxiii., and illustrated by useful examples. The book ends with quadratic equations and problems leading to them, followed by a useful series of test papers. We look forward with interest to the appearance of the second volume.

(3) This is a book on the model of Todhunter, with the re-adjustments and improvements in methods of proof which modern requirements demand. Proofs of index laws and of the binomial and exponential theorems are given for all commensurable numbers, and are assumed, perhaps, however, somewhat too silently, to hold for incommensurables also, the author evidently considering it wise to postpone a rigorous treatment of incommensurables. Indeterminate equations of the first degree are introduced early, and clearly illustrated by well-drawn graphs. There are good chapters on permutations and combinations, and on the simpler tests of convergency and divergency of series, and the chapter on miscellaneous graphs forms a useful introduction to curve-tracing. Continued fractions and probability are not treated. The book is excellently printed, and there are a good number of examples attached to the various chapters, but rather a scanty supply of miscellaneous examples (100) at the end of the book. This could be remedied in a subsequent edition.

(4) This consists of a collection of examples up to quadratic equations, prefaced by a set of specimen examples worked out, to secure uniformity of method, and concluding with miscellaneous examples arranged in short sets, and graduated in difficulty, so as to test a boy's knowledge at various stages of progress. There is an extensive collection of graphs, each of which is accompanied by useful instructions as to scale. No bookwork is given, as it is considered that, in the early stages of algebra, all explanation must be left to the teacher.

OUR BOOK SHELF.

Agriculture for Southern Schools. By J. F. Duggar. Pp. xi+362. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 4*s.* 6*d.*

THIS little book has been written, the author tells us, as an elementary text-book on agriculture that shall differ from others in having a definite and limited field—the southern States of the United States. While the principles underlying the subject are universal, their applications vary much in different localities, and by confining attention to a particular area it becomes possible to present the subject in the concrete way essential for beginners. The crops, soil conditions, and general facts of cultivation are all within the experience of the scholar or his farmer friends, and he is not likely to be troubled with that *bête noir* of the agricultural teacher—the principle that is perfectly sound in itself, but not economical, and therefore not applicable, in the particular district.

A perusal of the book shows that the author has succeeded in his somewhat difficult task. The essential principles are well brought out, and the illustrations are to the point. The opening chapters deal with the structure of the flower and seed-formation: peach, cotton, tobacco, and others being chosen as examples. The conditions necessary for germination and plant growth are then discussed, and the author next passes on to the highly important problem of adapting the crop to the soil. So much money has been lost in the past through planting crops unsuited to the soil that the author does well to direct attention to this matter; he points out, for instance, that sandy soils are best cropped with early vegetables, peaches, cotton, pea-nuts, water-melons, &c., while clay soils are better for hay crops, apples, &c. A few chapters are then devoted to manures, and

afterwards the special crops of the south are described. Succeeding chapters deal with plant diseases and insects; these, however, are written by specialists, as one man could not hope to write a useful book which would cover the whole range of the subject. Altogether the book appears to be admirably suited to the purpose for which it is intended, and it can be cordially recommended as a clear statement of the principles of the subject. E. J. R.

Vitality, Fasting, and Nutrition. By Hereward Carrington. With an introduction by Dr. A. Rabagliati. Pp. xl+648. (London: Rebman, Ltd., n.d.) Price 21*s.* net.

THE use of food of different kinds in disease, and the need of prohibition of food either in part or *in toto*, is a necessary part of the knowledge of every medical practitioner. The author of the above work seeks to magnify the importance of fasting over prolonged periods as the sole means of curing all the ills of human flesh. Some years ago another American writer wrote a book entitled the "No Breakfast Cure," in which the omission of this very pleasant meal was lauded as the universal panacea for all illness. Mr. Carrington has, however, "gone one better," and advises the discontinuance of all meals. His book is a strange medley, and hardly merits serious consideration in a scientific journal. Among its many assertions which are unsupported throughout by any experimental evidence are the following:—All medical science is wrong *ab initio*; diseases are nature's mode of cure; the taking of the impurities called foods is the source of all evil; the germ theory of disease is a myth; the law of conservation of energy is a fiction; food is not a source of energy or strength, but of weakness; the energy of the body is derived from an internal source, a kind of vital spirit in one's interior which can only be cleansed and rendered pure by the agency of starvation.

Happily for the sake of the too easily gulled public, he relates some cases illustrative of his method of cure. The perusal of these will be quite sufficient to prevent his therapeutic methods from obtaining a wide vogue. Some of these describe the ordinary symptoms of starvation somewhat graphically, but death when it occurred as the inevitable result is attributed to something else. Photographs are given of one patient reduced to the condition of a skeleton, but purified from the dross of food with the vital flame burning without hindrance. As a proof of this patient's vigour after a fast of forty-one days, the author naïvely remarks:—"I helped him to undress and dress, though he could easily have done this himself."

The book is only remarkable as an instance of the lengths to which a fad can be carried.

W. D. H.

Die Cestoden der Vögel. By Dr. O. Fuhrmann. Zool. Jahrb., Suppl. 10, part i. Pp. 1–232. (Jena: Gustav Fischer, 1908.)

IN no group of vertebrates are cestode worms so numerous and of such varied types as among birds, and as these have hitherto been but little studied, Dr. Fuhrmann has for the last eleven years devoted a large portion of his time to their investigation, directing special attention to the tæniid, or tapeworm, group. The result is the present memoir, which bears full witness to the arduous nature of the author's labours. No fewer than sixty-four distinct generic types (many of them with numerous species) of these parasites are recognised as infesting birds, and the author has taken special pains to ascertain so far as possible the particular groups of birds to which these various genera respectively devote their attentions. This renders the work of value and interest to the ornithologist as well as to the students of parasitology, since the results have a distinct bearing on the mutual relations of different bird-groups. He shows, for instance, that the plover group (Limicolæ) has no parasites common to the gulls (Gaviæ), which may tend to show that these groups are less intimately related than is generally considered to be the case, although, before coming to a definite conclusion, the difference in their habitats must be borne in mind. Similarly, it is found that the parasitic worms of the diurnal birds of prey (Accipitres) are totally distinct from those of the owls (Striges), despite the fact that the food of many members of the two groups is identical. In this case we have confirmation of the modern view as to the wide sundering of the Accipitres and the Striges. To follow the author further is, within the limitations of our space, impossible, and we may therefore conclude by commending his work to the best attention of both ornithologists and helminthologists. R. L.

Thoughts on Natural Philosophy, with a New Reading of Newton's First Law. By A. Biddlecombe. Pp. 24. (London: Whittaker and Co., n.d.)

MANY and various are the subjects that may be included under the term "natural philosophy." The author, in a brochure of the modest length of twenty-four pages, refers to all the recent physical discoveries, over which he is enthusiastic. Radium and the theory of atomic disintegration, he says, "enabled him to jump to the apprehension of the speed theory of material combination which has formed the germ from which this sketch of a true natural philosophy has developed."

His main point seems to be that energy (or natural motion)—and the æther is considered to be material—is the original thing, and that rest is a secondary effect. He thus arrives—by "natural philosophy," shall we say?—at a point not very distant from the modern doctrine of energy, although he himself appears to consider that this point of view is unorthodox. The "speed theory" is best described in the author's own words:—

"This is the great truth, and appears to be the key to the Riddle of the Universe—viz., that the speed[1] and weight of granules, corpuscles, atoms, and molecules, and the peculiarities of movement resulting from that speed and weight, give to substances their distinguishing characteristics, and account for all natural phenomena."

With this as a possible point of view, none, probably, will be disposed to quarrel. Though it may be new to the philosopher, it will sound not altogether unfamiliar to the man of science.

The Ruskin Nature Reader. Being a Collection of Literary Extracts to Accompany a Course of Nature Study. Selected and edited by G. R. Bennett. Pp. ix+236. (London: J. M. Dent and Co., n.d.) Price 1*s.* 9*d.*

THE judicious selection of literary extracts which Mr. Bennett has made shows convincingly what a strong appeal to our great writers natural objects and phenomena have always made. Though called after him, the reading-book is by no means confined to excerpts from Ruskin's work; indeed, there are only five such extracts among forty-four. Gilbert White, Tyndall, Izaak Walton, Darwin, and Richard Jefferies are among the writers drawn upon. If the book sends boys and girls out to observe for themselves, as Mr. Bennett hopes it will, it will have served a really useful purpose.

[1] Speed and movement may take many forms.

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.

An Electromagnetic Problem.

IN the application of general principles to special cases it is sometimes found that the result is a seeming paradox, which is not always easy to remove. Such problems, although involving no new principle, are nevertheless of considerable interest, and after attaining their satisfactory solution we often realise that we did not before appreciate the full import of the general law.

The following question has been discussed with considerable interest among some of the writer's friends, and therefore it seemed not improbable that other physicists might be interested.

If two spheres of positive electricity are near together and are suddenly released, it is clear that their potential energy decreases as they separate and goes over into kinetic energy of motion. This kinetic energy is, of course, the energy of the magnetic field which results from the motion of the charges.

It seems possible, however, to arrange a system so that this magnetic field shall vanish because of symmetry, and the question then presents itself, Where is the energy? Suppose we have a sphere of positive electrification placed as the water is in a soap bubble, and capable of expanding under the mutual repulsion of its parts. The potential energy of the electricity certainly decreases as the sphere expands, and *if the electricity be considered continuous* there is certainly no chance for a magnetic field, as is easily seen from consideration of symmetry. If the sphere be allowed to expand, where does the energy go? The obvious answer is that the electricity is not continuous, but exists as discrete particles, *i.e.* as electrons; but if we try to escape the difficulty in this way, it is equivalent to admitting that the electrical laws, together with the conservation of energy, *require in themselves* the discrete structure of electricity. If, on the other hand, we say that the electricity is associated with matter, *i.e.* with ponderable mass, and the energy appears as ordinary mechanical energy of motion, then we are admitting that the electrical and energy laws *require the association of electricity with matter.*

There seem to be no other solutions to the problem than those above given, and if we admit either of them we reach a conclusion which certainly is striking when we consider that we have only used the general laws of electricity and energy.

The writer does not state the above as a fundamental paradox, but only as an interesting problem.

D. F. COMSTOCK.

Institute of Technology, Boston, Mass., November 3.

The Progress of Aviation.

I HAVE read with great interest the article on the above subject by Prof. Bryan in NATURE of October 29.

May I be permitted to direct especial attention to the necessity for finding the displacement of the centre of pressure on all kinds of surfaces and at all angles therein referred to? The paper by Prof. Bryan and Mr. Williams on the subject of longitudinal stability, and Captain Ferber's article in the *Revue d'Artillerie* (November, 1905), both assume the truth of Joëssel's law. There is, however, every reason to suppose that there is a certain critical angle below which Joëssel's law ceases to be true, the displacement decreasing with the angle instead of increasing.[1]

Consequently, the numerical conclusions arrived at from the stability formulæ of Captain Ferber and Prof. Bryan may be very wide of the mark.

I hope to experiment in this direction myself, but my time is very limited. There can be no doubt whatever that a thorough investigation as to the centre of pressure would be of the greatest practical use.

HERBERT CHATLEY.

32 Britannia Road, Southsea, October 31.

[1] Spratt-Moedebeck's "Pocket-book of Aëronautics" (1901); Wilbur Wright, Smithsonian Report, 1902, pp. 133–148 (*Journal of Western Society of Engineers*, December, 1901); Turnbull, *Physical Review*, vol. xxiv., No. 3, 1907.

I AGREE strongly with all that Mr. Chatley has said. It cannot be too emphatically pointed out that the object of our stability investigations was to show that the subject is capable of being treated mathematically, and that, *given the requisite experimental data*, the conditions of stability of any system of planes or surfaces can be calculated out in the form of numerical results. The cases in which this was done were intended merely as *examples* illustrative of the general method, and for this purpose Joëssel's law furnished the simplest assumption available at the time. It will be noticed, too, that arbitrary values were assumed for the moments of inertia of the systems. To draw inferences from the results of examples worked out with this object would be an unfortunate mistake.

It is to be regretted that want of time has prevented my attempting to work out any examples based on the Turnbull results, though the idea suggested itself when I saw the paper in the *Physical Review*. The theory of stability has thus been somewhat at a standstill. Those who, like Mr. Chatley and myself, would like to see that theory advanced are prevented from doing this by pressure of other duties, while those who have the necessary time and money have been mainly occupied of late in breaking records. Mr. Lanchester's theory of stability starts from so different a standpoint that it must be discussed at a future time.

G. H. BRYAN.

Potato Black Scab.

THE discovery this autumn of black scab in the potato crop in two localities in co. Down was the means, through the Irish Department of Agriculture, of supplying me with excellent material of diseased tubers for examination. I have kept the resting "spores" of the chytridian fungus *Chrysophlyctis endobiotica*, Schilb., causing the disease, under varied conditions of temperature, nourishment, moisture, and light, and have succeeded in causing the "spores" to germinate, especially by cultivation in potato juice. Each "spore" proves to be a zoosporangium, full of zoospores or zoogonidia, seen in active swarming motion before rupture of the sporangium. The zoospores, 1·5–2 μ in diameter, escape through a slit-like opening in the wall of the sporangium 30–60 μ in diameter, and have the usual characters of a chytridian zoospore.

Since the publication of Schilbersky's short preliminary account in 1896 in the *Berichte der deutscher botanischen Gesellschaft*, and Potter's account of his discovery of the pest in Cheshire in 1902, we have learnt nothing of the life-history of this injurious fungus.

T. JOHNSON.

Royal College of Science, Dublin, November 17.

The Nature of γ Rays.

EXPERIMENTS by Prof. Bragg and myself upon the secondary kathode radiation which proceeds from matter through which γ rays are allowed to pass, taken in conjunction with the similar result announced by Mr. Cooksey in NATURE of April 2 (vol. lxxvii., p. 509) for X-rays, support the theory of the material nature of X and of γ rays originally advanced by Prof. Bragg.

The modification of the ether-pulse theory recently advanced by Prof. Thomson may possibly furnish a partial explanation of these effects, but in the light of some experiments which I have lately carried out upon the secondary γ rays, even this modification seems quite insufficient. A brief summary of these results is appended.

(1) The γ rays of Ra, and probably of Th, appear to consist of two distinct homogeneous bundles, the value of λ/Δ (where λ is the absorption coefficient and Δ the

density of the material) for the soft set being approximately four times that for the hard.

(2) For each set of rays the value of λ/Δ is constant, and practically independent of the nature of the absorbing material with which λ is measured, provided that in the case of the soft rays secondary effects be excluded.

(3) Secondary γ radiation appears on both sides of a plate which is penetrated by a stream of γ rays. There exists a marked lack of symmetry between the amount of secondary radiation which proceeds from the two sides.

(4) A lack of symmetry exists in the case of some substances between the quality of the radiation on the two sides.

(5) The last results seem very difficult to reconcile with a pulse theory. On the "material" theory propounded by Prof. Bragg no such difficulty arises.

(6) The secondary γ radiation appears to be derived from the primary by a process of scattering, this process generally involving a reduction in the subsequent penetrating power of the ray affected.

(7) There appears to be reason to believe that the distribution of the scattered radiation depends to some extent upon the hardness of the radiation which is scattered, also upon the nature of the material in which the scattering is produced. The softer radiation appears to be turned back to a somewhat greater extent than the hard. Materials of high atomic weight seem to be able to produce more complete scattering than those of lower atomic weight.

(8) The absorption of γ radiation which has already passed through a thickness of one substance by screens of a different substance may not in all cases give a true measure of the absorption of the original radiation which has been effected by the first screens.

J. P. V. MADSEN.

University of Adelaide, October 1.

[As there are few opportunities in Australia for an investigator to place his views quickly before a scientific public, we print the above letter, but with it the correspondence must cease. The subject is more suitable for discussion in special journals devoted to physics than in our columns.—ED. NATURE.]

The Origin of Spectra.

THE very interesting observation of the anomalous dispersion of luminous hydrogen in the neighbourhood of the Hα line recorded by Messrs. R. Ladenburg and Stanislaw Loria in NATURE of November 5 (p. 7), and the known absence of the phenomena in ordinary hydrogen, show conclusively that *the spectrum lines of a substance are not free periods of the atoms in their normal state, but only of those systems produced somehow by the agency which gives rise to the spectra.*

The figure 1/50,000 as the number of electrons per atom of course means that in the gas under experiment only one atom in 50,000 was emitting the Hα line at any one time. The very important remark is made that the anomalous dispersion in the neighbourhood of the other lines of the hydrogen series "is expected to be much smaller than that at the Hα line." If this be so, it will show that at any given time different numbers of atoms are producing the different lines, that is to say, that the spectrum is not produced *in toto* by each atom. Each atom (or rather the system emitting the lines) may, for instance, only be emitting one line at a time. These results are the same as those I have deduced from Prof. R. W. Wood's work on the anomalous dispersion of sodium vapour. Sodium vapour shows anomalous dispersion in the neighbourhood of all the lines of the principal series, which "is very strong at D, feeble at the first pair of ultra-violet lines λ 3303, and almost imperceptible at λ 2852." It is also, Wood states, stronger at D_2 than at D_1. This shows that the number of atoms emitting D_2 at any time is greater than the number emitting D_1, and both these are much greater than the numbers emitting the higher members of the series. We note that there is no anomalous dispersion in the neighbourhood of the lines of the subordinate series of the sodium spectrum showing that heat alone does not produce those systems which vibrate with the periods of the subordinate series, which agrees with the facts that these series do not appear in the absorption spectrum of sodium vapour or in the Bunsen flame spectrum of sodium.

It thus seems probable that different series of lines in a spectrum are produced by entirely different vibrating systems, while any system possibly only emits one line at a time of its own particular series, depending upon the manner in which it has been struck. It is evident that the different vibrating systems obtained, and their relative proportions, may be expected to vary with the nature of the electrical discharge producing the spectra, and hence the variation of the spectra under different conditions. This may, perhaps, on the modern views, be regarded as the same idea put forth many years ago by Sir Norman Lockyer in his dissociation hypothesis.

I make these observations in order that those working on the subject from the theoretical side may the better see the phenomena to be explained, which are quite different from ordinary dynamical vibrating systems.

In conclusion, I should like to direct attention to the importance of extending Messrs. Ladenburg and Loria's work. By examining every line in the spectrum of an element we could, for instance, say whether a line was faint because very few systems were emitting it, or whether its faintness must be attributed to the fact that the vibrations producing this line have only a very small amplitude.

ALBERT EAGLE.

Imperial College of Science and Technology, London, November 9.

A Gall-producing Dragon-fly.

WHEN looking through Dr. C. Houard's new work on galls ("Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée," tome i.), I was surprised to find on p. 249 an entry:—"Minime borselette *Q. ped. Lestes viridis*, Van der Lind."

A gall-producing dragon-fly was quite new to me, but on looking up the subject I found a series of very important observations on the oviposition and larva of the species in question by the Abbé Pierre and M. de Roequigny-Adanson, in the *Revue scientifique du Bourbonnais et du Centre de la France*, xv. and xvi. (1902–3), and the *Annales et Bulletin de la Société entomologique de France* for 1904. As these seem to have been entirely overlooked in England, I think it may be useful to epitomise them as briefly as possible.

The eggs of *Lestes viridis* are laid on the branches of a great variety of deciduous trees and shrubs, but always close to, or overhanging, water, and therefore probably most often on alders or willows. These result in the production of small galls, which are sometimes extremely abundant, and which are thus described by Pierre:—

"Un bourrelet mesure de 1 mm. ½ à 2 mm. de longueur, sur ½ ou 1 mm. de largeur. Deux bourrelets sont associés en chevron et forment un angle d'à peu près 90°, ouvert vers le bas du rameau. Le sommet de l'angle présente une pellicule corticale plus ou moins arrondie, formant clapet au dessus de l'ouverture par laquelle de 1 à 4 œufs ont été insérés sur chaque bourrelet. Enfin les chevrons distants de 2 mm., sont associés en série longitudinale, de telle façon qu'une même génératrice du rameau soit sensiblement bissectrice de tous les angles."

The emergence from the eggs and the structure of the larva are equally curious. The new-born larva, or "pro-larve," as Pierre calls it (*Ann. Soc. Ent. de France*, 1904, pp. 477–84, pl. iv.), resembles a coleopterous pupa, being enclosed in an outer membrane which leaves it only the power of leaping. If these young larvæ do not fall into the water on emerging from the egg, they leap about, sometimes for several hours, until they succeed in reaching it. After reaching the water the pro-larva rests on its back for two hours, and then casts the skin, a process occupying from three to thirteen minutes. The larval development of *Lestes viridis* has been compared by M. Giard to that of the crickets. A similar structure of the newly emerged larva has also been noticed in *Epithera bimarulata*, another dragon-fly.

I may remark that *Lestes viridis*, though common on the Continent, is an insect of great rarity with us, and not firmly established in the list of British species.

W. F. KIRBY.

THE GEOLOGY OF THE GRAMPIANS.[1]

THERE are few parts of the British Isles which can rival the southern Highlands of Scotland for beauty and variety of scenery. Over much of this district the genius of Scott has thrown the glamour of romance, and year after year crowds of tourists visit the scenes which he has rendered famous. The flat vales which lie to the south of the mountains (the plain of Strathmore) afford an excellent contrast to the bolder hill country behind them. Even the most stolid traveller who enters this region may be expected to feel some curiosity regarding the origin of the scenery and the history of the rocks which meet his eyes. Not a little has been written on this subject, but much of it is contained in scientific memoirs and periodicals which are beyond the grasp of the untrained geologist. The country, especially the Highland portion of it, is of great complexity, and its structure has given rise to discussions, many of which are far from settled at the present time. The task which the author of this work has essayed is one of considerable difficulty. He aims at giving an account of the geology and physiographical development of this intricate region which shall be intelligible to the unscientific and at the same time thoroughly abreast of the most recent researches. He has achieved a large measure of success even in the most difficult part, while some of his chapters, such as those on glaciation and scenery, are excellent. The result is a book which is at once interesting to the layman and useful to the professed geologist.

The great boundary fault which runs across Scotland from Stonehaven to the Firth of Clyde separates the Highlands from the valley of Strathmore, two districts which are as different in their geology as in their scenery and economic development. To the north lie metamorphic schists and gneisses of unknown age; to the south are fossiliferous Old Red Sandstone and Carboniferous rocks. One volume is assigned to each of these subdivisions. Much of the southern Highlands has been mapped by the Geological Survey, which has published maps (and in some cases memoirs also. Mr. Macnair is well known for his investigations on the metamorphic rocks of Perthshire, and is familiar with a large part of the area he undertakes to describe. His researches have led him to conclusions not essentially different from those of the Survey officers, whose opinions and observations he frequently quotes. He accepts the current theories that as we proceed northwards from the Highland border we pass over a succession of slates, grits, gneisses, mica schists, and limestones, which are not only apparently but actually in ascending order. They vary in lithological character and in degree of metamorphism, but are essentially an unbroken and continuous succession, the quartzite of Schiehallion and Ben-y-gloe being the highest, while the grits and slates of Leny and Aberfoyle are the lowest rocks of the district. Two series of igneous rocks are found among the sedimentary schists, one older and another later than the period of folding and metamorphism. The former comprises the hornblendic schists, which are especially common around Loch Tay, and the acid gneisses of Ben Vuroch; among the latter may be placed the granitic bosses of Garabal Hill, Glen Lednock, &c. Mr. Macnair describes what, in his opinion, is the structure of the country, and gives sections showing a series of complex fans and synclinoria the axes of which have a north-east trend. Although these hypotheses are accepted by probably the majority of the geologists who are working in this district at the present time, they cannot by any means be regarded as established on any firm basis of proof. The apparent upward succession is quite possibly misleading. Many strong reasons may be advanced against it, and the structure is not more clear than the sequence. Apart from this, Mr. Macnair's account of the geology of the Grampians is clear and judicious, and may be recommended to those who wish to get a general idea of the subject without too much detail.

The second volume begins with a description of the Old Red Sandstone (Upper and Lower) of Strathmore. This vast sedimentary formation has always had a strong attraction for Scottish geologists. The author has given much time to its study; he discusses it with enthusiasm, and attempts to prove that, contrary to the usual opinion, the deposits are of marine origin, and at one time completely buried the Highland mountains. The arguments he brings forward are not new to geologists, and, we must confess, are, in our opinion, far from convincing; the old theories of Godwin Austen, Ramsay, and Sir A. Geikie are not yet disposed of and out of date. These chapters contain, however, many observations which are little known and well worth placing on record. The Carboniferous rocks occupy only a very small area, and are not otherwise important.

As might be expected in a region of such varied topography, the glacial and alluvial deposits are of considerable importance. The chapters devoted to them and to their effect on the scenery of this part of Scotland are the most readable in the book, and should prove interesting to anyone who cares for geology

Photo. by W. L. Howie.

FIG. 1.—The Killin Hills, from the Dochart. From "Geology and Scenery of the Grampians."

[1] "The Geology and Scenery of the Grampians and the Valley of Strathmore." By Peter Macnair. 2 Vols. Vol. i., pp. xiv+195; vol. ii., pp. xii+199. (Glasgow: James MacLehose and Sons, 1908.) Price, 2 vols., 21s. net.

or physiography. They are also free from the controversial matter which is rather obtrusive in the chapters on Highland schists and Old Red Sandstone. We must congratulate the author also on the excellence of the illustrations, most of which are from photographs. Many of them are very beautiful and appropriate, and should be of great help to those who are not specially versed in geological literature. An exception may be made in the case of some of the photomicrographs of rock sections, which are not up to the general high standard of the book. A really good geological map of the area described is also a desideratum which should be supplied if the book reaches a second edition, as we hope it will.

J. S. F.

Photo. by W. L. Howie

FIG. 2.—View from the summit of Ben Lawers looking north-east along th great axial line of folding. From "The Geology and Scenery of the Grampians."

THE LICK OBSERVATORY-CROCKER ECLIPSE EXPEDITION, JANUARY, 1908.

BY the courtesy of Prof. Campbell in furnishing advance proofs of Lick Observatory Bulletins Nos. 131 and 132, and from preliminary reports published by himself[1] and Dr. Albrecht,[2] we are able to form an idea of the perfect organisation of, and the results obtained by, the expedition from Lick Observatory which went to Flint Island to observe the total eclipse of the sun of January 3.

The whole of the expenses of the Lick expedition was defrayed by Mr. W. H. Crocker, this making the ninth occasion on which his generosity has rendered such an expedition feasible. The party was conveyed from Tahiti to Flint Island by the U.S. gunboat *Annapolis*, and arrived at the latter place, which is in latitude 11° S., and is 450 miles N.W. of Tahiti, on December 9, thus leaving twenty-four clear days for the erection and adjustment of the instruments. In addition to the Lick party, consisting of Prof. Campbell, Messrs. Perrine, Aitken and Albrecht, and Mrs. Campbell, the expedition included Prof. Lewis, of Berkeley, and Prof. Boss, and was accompanied by an expedition dispatched by the Smithsonian Institution; the latter consisted of Prof. Abbot and his assistant, Mr. A. F. Moore, who were charged with the task of making bolometric observations of the coronal radiations. Readers of NATURE will remember that this island was also selected by Mr. F. K. McClean as the *locale* of the expedition which he fitted up and carried through at his own expense, and Prof. Campbell remarks that they (the McClean party) were found to be "helpful and congenial companions."

The programme of the Lick observers comprised the determination of the contact times, the photography of the corona, on large and small scales, and of the coronal and chromospheric spectra, and a photographic search for any possible intra-mercurial planet. As Mr. McClean has already reported, the weather on the morning of the eclipse was extremely sensational, rain falling in torrents between five minutes before and two or three seconds after the commencement of totality, but happily the clouds dispersed, and the remainder of the eclipse was observed in a comparatively clear sky. That results were obtained which are likely to provide valuable additions to our knowledge of solar physics may be inferred from the following brief *résumé* of the preliminary reports of the observers.

The observations of the contacts showed that mid-eclipse took place some 27 seconds earlier, whilst totality lasted some 9 seconds less, than the predicted times.

In the intra-mercurial planet research two quadruple sets of cameras were employed, each set so arranged as to include an area 9° broad and 28° long in the direction of the sun's equator. Three hundred star images, going down to the ninth magnitude, were recorded, and all have been identified with known stars by Prof. Perrine. It now seems certain that no planet brighter than the seventh magnitude exists nearer the sun than Mercury, and, as it would need a large number of seventh-magnitude planets to account for the outstanding anomalies in the motion of Mercury, Dr. Albrecht considers that the observational side of this research should now be considered as closed. The *raison d'être* of the Mercury anomalies must be sought elsewhere; possibly, as suggested by Prof. Seeliger, the material responsible for the Zodiacal Light may be sufficient to account for them.

With the Floyd camera, having a Clark lens of 5 inches aperture and 67 inches focal length, fed by a 12-inch cœlostat, eight exposures, varying from "instantaneous" to 16 seconds, produced excellent

[1] Publications of the Astronomical Society of the Pacific, No. 119, April, 1908.

[2] The Journal of the Royal Astronomical Society of Canada, vol. ii., No. 3, p. 115.

negatives showing streamers two solar diameters in length. These long streamers are rather evenly distributed around the sun, but the strong inner corona is much more intense on the east and west than at the poles.

Prof. Campbell and Dr. Albrecht speak very highly of the simplicity and the performance of the 40-feet "tower camera" of 5 inches aperture, designed by Prof. Schaeberle for the 1893 eclipse. Fig. 1 is reproduced from an illustration accompanying the former's report in the Publications of the Astronomical Society of the Pacific, and shows the instrument, in position, at Flint Island. Many advantages are claimed for this form of "direct" instrument; among them the removal of the lens and a greater part of the tube from the ground region of intense atmospheric tremor, and the elimination of the possible distortion of a cœlostat mirror are not the least. Six exposures, varying from 2 to 64 seconds, were made, and the negatives show a wealth of coronal details. The chromospheric stratum is shown on the first and last photographs, and there is a large eruptive prominence in position-angle 214°. About fifteen streamers extending to 1½ lunar diameters and a similar number extending to 1 lunar diameter are shown on the longer exposures. An unusually straight and slender streamer starts near the south point and extends, not radially, but in the direction of 190°, for about 1½ diameters; during the last seven-ninths of its length this streamer is accompanied by a fainter branch which makes an angle of 4° with its axis. Comparisons of the photographic brightness of the corona, effected by impressing standard squares on some of the plates, show that almost all the effective photographic light came from the inner corona situated within 1′ or 2′ of the moon's edge.

A plate exposed, in a spectrograph with the plate continuously moving, for fifteen seconds on either side of the end of totality, shows a spectrum in excellent focus from λ 3800 to λ 5100 the linear scale being such that from λ 3700 to λ 5300 is 13 inches. Hundreds of bright lines, showing the depths and locations of the corresponding vapours, are recorded, and should furnish a wealth of information as to the sun's higher atmosphere.

A spectrograph fitted with quartz lenses, and prisms, of 9·2 cm. aperture and 1 metre focal length, was employed by Prof. Lewis to obtain photographs of the spectra of the corona and the "flash." A sliding diaphragm in front of the slit permitted comparison solar spectra to be obtained on the same plate, and an exposure of 3¼ minutes on the corona, with the slit tangential to the east limb, and a shorter exposure on the chromosphere were made immediately before, and at, third contact. The unexpected curtailment of totality caused the latter to be over-exposed, but some eighty chromospheric lines are seen projecting beyond the solar spectrum; the resulting spectra are some 14 cm. long from λ 3000 to D. Both the continuous and the line radiations of the corona are shown, and both apparently emanated from the inner corona within a region of less than a quarter of a radius from the photosphere. Fifteen certain, and ten doubtful, lines are recorded, and of the former those at λλ 5304, 3602·3 and 3390·7 are the strongest, the respective intensities being 10, 15 and 30. That neither Huff, in 1900, nor Dyson, in 1900, 1901 and 1905, recorded the strong line at λ 3602·3, and that the latter obtained lines not shown on his own spectra, is taken by Prof. Lewis as evidence supporting the idea of a variable corona.

In discussing the relative temperature of the corona, Prof. Lewis employs the principle enunciated by Stokes in 1876, and used by Lockyer in his researches on stellar temperatures. This principle depends upon a comparison of the relative amounts of the ultra-violet and the red radiations in the light-sources examined, predominance of the former denoting higher, and of the latter lower temperature. In Lockyer's stellar work it was found that by the assumption of this law the previous results depending upon the chemical classification of the stars were plenarily confirmed, and Prof. Lewis's conclusions are no less regular. Comparing the coronal with the solar spectrum, he finds that the latter is, relatively, much richer in violet light, and says, "hence it may be inferred that the corona is considerably colder than the sun." Subsequent comparative tests with a standard candle, allowing for the atmospheric absorption of the ultra-violet radiations, fix the lower limit of coronal temperature at considerably more than 2000° absolute.

FIG. 1.—The 40-ft. Coronagraph.

Some eighty-two chromospheric lines, between λλ 3199·8 and 4863·0, with identifications from Rowland's tables and Dyson's eclipse paper, are given, but, with only the tips of the lines projecting from the dense, over-exposed spectrum, the wave-lengths are, naturally, only approximate.

For the examination of polarisation effects in the corona, four exposures, varying from two to six seconds each, were made with each of the four cameras arranged for this purpose. Each photograph shows marked polarisation in all parts of the corona, and a comparative study of the series should, incidentally, produce valuable information concerning the effect of clouds on such photographs, for during one exposure a cloud passed over the southern half of the corona, leaving the northern half cloud-free.

With two single-prism spectrographs, specially designed by Prof. Campbell, three photographs of the coronal spectrum were obtained, the slits being placed east and west across the centre of the solar image. With the first, a good spectrum of the extreme inner corona, extending from λ 3550 to λ 5390, was obtained during an exposure of 3m. 40s. Both the line at λ 5303 and an apparently new line at λ 3601·3, also obtained by Prof. Lewis, are recorded strongly, each extending to 3′ from the west, and 2′ from the east, limb; the line at λ 3987·0 is faintly, and that at λ 4231·5 is easily, visible, whilst another apparently new, and faint, line shows at λ 3625·5. The absorption lines are seen most readily in the regions lying between 10′ and 20′ from the limb, but are quite faint in the outer, and apparently absent from the inner, corona. A comparison of the continuous spectrum with solar spectra taken with the same instrument at Mount Hamilton indicates, again, a lower temperature for the former, although, in the absence of further details as to the similar treatment of the photographs considered, this evidence is not so conclusive as that educed by Prof. Lewis.

With the second single-prism spectrograph, Cramer isochromatic plates were used and good spectra, extending from λ 3600 to λ 6000, obtained, the general features being the same as in the preceding spectrum. Measures of the green line give its wave-length as 5301·4 ± 0·5.

Owing to the inter-diffusion of the bright-line, the continuous, and the absorption spectra, these coronal spectrograms are rather difficult to interpret, but it appears certain that the radiations of the outer corona, of, say, more than 20′ from the moon, are either not recorded at all or are masked by the diffused spectrum of the brighter inner corona. The proportion of the light radiated by the coronal particles at this eclipse appears to have been relatively great as compared with the amount of sunlight diffused by them, but whether this is due to variability in the corona or to the interference of light clouds at the previous eclipses is a question which Prof. Campbell and Dr. Albrecht leave for future consideration. To those observers who had had previous eclipse experience, the outer corona on this occasion appeared disappointingly faint.

It is unnecessary here to enter into the numerous details given by Prof. Abbot concerning his bolometric apparatus, but several important modifications of that previously employed had been made for this eclipse, chiefly with the object of restricting the operative radiations during each observation to that definite, small area of the corona that was under actual observation. Preliminary observations of the relative brightness of the sun, of the sky at different distances from the sun, and of the moon were made before eclipse day, and the results are shown below. Tests were also made of the quality of the light from each of these sources, the criterion being the proportional transmissibility of the various rays by an ashphaltum screen. For sun, sky and moon the proportions of light transmitted were 0·29 to 0·37, 0·25 and 0·50 respectively, the difference sky–moon being due, presumably, to the size and nature of the reflecting particles. These results lead to the inference that if the brightness of the corona be due merely to reflected ordinary sun rays, the transmissibility of the rays will be greater if the reflecting particles be of the grossness of those composing the lunar surface, and less if they are minute like the molecules of gases.

During the eclipse, observations were made with the sun in six different positions in regard to the cross-wires of the finder, the latter being crossed to form angles of 75° and 105°. In positions i. and ii. the moon's image was tangent in one of the obtuse angles, and in iii. in one of the acute angles; this meant that in i. and ii. the bolometer was central on points 4′ of arc beyond the extremities of a lunar diameter inclined 52°·5 to the E. and W. diameter; whilst in iii. the distance of the moon's limb was about 12′ of arc. In positions iv. and v. the wires were 1′·5 of arc beyond the extremities of the moon's diameter, east and west respectively, and in vi. they intersected at the centre of the dark moon. The observations showed that the transmissibility of the inner coronal radiations, which passed through a screen transmitting light of less wave-length than 3 μ, was 0·364; on the same day the mean transmissibility of the solar radiations was found to be 0·332. The whole of the reduced results are collected in the following table, taking the sun's brightness as 10,000,000 :—

	Brightness
Sun, near zenith (Flint Island)	10,000,000
Sky, 20° from sun ,, ...	140
,, distant from sun ,, ...	31
,, average ,, ...	62
,, ,, previously measured at Mount Wilson	15
Corona, positions iv. and v.	13
,, ,, i. ,, ii.	4
Moon, about zenith distance 50° (Flint Island)...	12 (?)

In positions iii. and vi. the galvanometer showed no deflection.

Several significant facts appear from these figures, of which two call for special mention. The first is that at sea-level (Flint Island) the sky is some four times as bright as observed at an altitude of 1800 metres (Mount Wilson), thus showing the profound importance of establishing our observatories in the higher altitudes. Secondly, the brightness of the sky at 20° from the sun is to that of the corona as 140 : 13; nearer the sun the ratio would be enormously increased, and it therefore appears that to obtain photographs of the corona without waiting for an eclipse is unpromising, to say the least.

Summing up the evidence now available, Prof. Abbot believes that the best explanation of the character of the coronal radiation is that it is, in the main, due to reflected sunlight. The apparent absence of polarisation need not weaken this supposition, for, owing to the fact that they receive light from the solid angle of a whole hemisphere of the sun, the particles of the inner corona would be partially polarised in many directions, and therefore exhibit no definite polarisation in any one. The observed modification of the reflected solar spectrum may be due to the fact that the bright emissions from the heated particles close to the sun are sufficient to obliterate the absorption lines; further out the particles would be cooler—perhaps mainly solid and liquid—and the emission spectrum would then diminish, the absorption spectrum, as a consequence, appearing gradually. But as the light is still reflected sunlight only its intensity would diminish and its character and transmissibility would remain the same, as the observations show that they do.

Whilst recognising fully the difficulty of accounting rigidly for all the observed phenomena, Prof. Abbot concludes that in all probability the brightness of the corona is mainly due to reflected ordinary sunlight, diluted to some extent by the emissions from incandescent particles, and possibly, also, by some small amount of "luminescence" such as produces the aurora.

WILLIAM E. ROLSTON.

THE PRESERVATION OF THE NATIVE FAUNA AND FLORA IN AUSTRALASIA.

WE are glad to see that the New Zealand Government is actively continuing the work of preserving the natural scenery of the dominion to which we directed attention last year. Some interesting particulars are given in the Report on Scenery Preservation for the year 1907–8 lately issued by the Department of Lands, from which it is evident that the authorities fully appreciate the value of the remarkable natural attractions for which the Dominion is so justly famous. During the year under review an addition of more than 8000 acres was made to the area reserved under the Scenery Preservation and Public Works Acts. This area now reaches a total of about 34,000 acres, exclusive of 100,000 acres of Crown land similarly reserved under the Land Act.

The public of New Zealand appears to be as much interested in the good work as the Government, considerable sums having been raised by subscription for the purchase of special areas in the neighbourhood of some of the large towns. Let us hope that they will not forget to reserve a sufficient belt along the coast-line, so that future generations may be protected from attempts on the part of grasping landlords to prevent the public from making full use of the seashore, such as have lately given rise to so much dissatisfaction in our own country.

The proper care of the areas reserved appears to be a matter of no little trouble and expense. Where they are covered with forest there is the constantly recurring danger of bush-fires and damage by stock. As the inspector of scenic reserves remarks in his report, swaggers and Maoris appear to set fire to the country as if they were inspired by a spirit of destruction, and settlers, in clearing their own lands, are indifferent to the damage their fires may cause by spreading on to the lands of the Crown.

One of the most beneficial results of the reservation of these large areas of native bush is seen in the preservation from destruction of the native birds. We quote again from the subsidiary report of Mr. E. Phillips Turner, the inspector of scenic reserves :—

"In the Canterbury reserves I found that the native birds (with the exception of the tui, which in Akaroa is still fairly plentiful) are getting very scarce. In Otago the larger size of the reserves has served as a more effectual sanctuary, and tuis, bell-birds, and tomtits were fairly plentiful, whilst fantails, robins, wrens, parrakeets, kakas, and pigeons were also seen."

The author of the main report is, we think, rather unnecessarily severe upon the New Zealand botanists. After very properly directing attention to "the interesting and valuable report on a botanical survey of the Tongariro National Park, by Dr. Cockayne," he observes :—

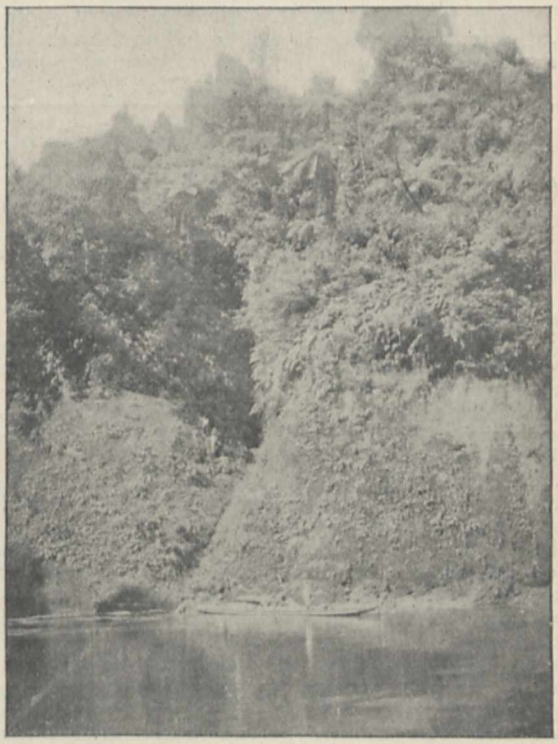
"Nowhere in the world are such beautiful and rare plants and trees to be found as in New Zealand, and the time is not far distant when this will be widely recognised, and visitors from abroad will undertake what our own students have overlooked."

It is only a few months since we had occasion to notice an extremely interesting and beautifully illustrated work on the New Zealand flora by two local botanists,[1] and it seems to us that a surprising amount of good work of this kind has been done by New Zealand students; witness the valuable publications of the New Zealand Institute during the past thirty or forty years. There are not many people in New Zealand who can afford to devote their lives to such work gratuitously, but we have little doubt that if the New Zealand Government extended to local naturalists sufficient encouragement, there would be no lack of competent investigators eager to enter the field. If the "visitors from abroad" are able to undertake the work, it is largely on account of the generous assistance and encouragement which they receive both from the authorities in their own country and those in New Zealand.

[1] Laing and Blackwell, "Plants of New Zealand."

The report is again copiously illustrated by photographs of some of the more remarkable scenery, one of which, taken on the Wanganui River, we reproduce. This river is said to have "no equal in the world as regards its botanical and scenic attractions," and the photographs certainly go a long way to support the claim.

Two reports by Dr. Cockayne, lately published by the New Zealand Department of Lands, have also reached us, the one referred to above as a botanical survey of the Tongariro National Park, and the other as a botanical survey of the Waiporra Kauri Forest. These are also copiously illustrated by excellent photographs, and should prove of great interest to botanists all over the world. The report on the Tongariro National Park contains an extremely interesting chapter on the geology of this remarkable volcanic district, by Mr. R. Speight. The photograph of the summit of Mount Ruapehu, showing a hot and sometimes boiling lake surrounded by ice-cliffs, is particularly striking.



Wanganui River Scenery—Mangaro, sixty-six miles from Wanganui.

We further observe with much satisfaction that the various societies interested in natural history in the Commonwealth of Australia are making a vigorous and combined effort to arouse the Federal Government to a full sense of its responsibilities with regard to the preservation of the native fauna. The movement which has lately taken place in England in relation to the protection of birds, and which culminated in Lord Avebury's Bill, appears to be largely responsible for the renewed interest which is being

taken in these matters in Australia. The Royal Societies of South Australia and New South Wales, the advisory committee *re* Fisheries and Game Acts in Victoria, and the Linnean, Zoological, and Animals' Protection Societies of New South Wales are all taking an active part in furthering the good cause. An influential deputation, headed by Prof. W. Baldwin Spencer, F.R.S., has already waited upon the Prime Minister of the Commonwealth, on August 4, in regard to the prohibition of the exportation of the skins and plumes of Australian birds, and was most favourably received. It must not be supposed, of course, that nothing has already been done to secure the preservation of the native fauna of Australia; this is by no means the case. Some of the most interesting animals, such as the platypus and the lyre bird, have, we believe, been more or less protected for a long time, but it is felt, and rightly, that existing legislation is not sufficient, and that if the native fauna is not to disappear in the near future, much more vigorous action must be taken. We wish the new movement in this direction every success, and cannot doubt that it will be followed by excellent results.

ARTHUR DENDY.

PROF. WILLIAM EDWARD AYRTON, F.R.S.

ON Sunday, November 8, Prof. Ayrton died at the age of sixty-one. During the last four years he was in danger on account of excessive blood-pressure. The immediate cause of death was influenza, followed by bronchitis and heart failure.

He was the son of an able barrister and the nephew of the Rt. Hon. Acton Ayrton, a Minister in Gladstone's Government from 1869 to 1874. I have before me the history of the Ayrton family for the last three hundred years, a family of able lawyers, musicians, surgeons, clergymen, university dons, and schoolmasters. He went to University College School, London, where he gained numerous prizes; at University College he gained the Andrews exhibition in 1865 and the Andrews scholarship in 1866. He passed the first B.A. examination with honours, and then became a pupil of Lord Kelvin in preparation for the Indian Telegraph Service. His eulogistic account of how Lord Kelvin dealt with his students, published in the *Times* about the beginning of this year, was greatly praised in NATURE a short time ago. In style and force it will compare favourably with anything written in the English language. He was not only a fine writer, he was also a brilliant speaker. He seldom needed notes in speaking. Twenty years ago, at the Paris Exhibition, he gave a long lecture in French, using no notes, and French critics described it as being nearly perfect in style and enunciation. In India he did good work with the late Mr. Schwendler, and became electrical superintendent of the Telegraph Department. In 1872–3 he was on special duty in England, and acted also for Lord Kelvin and Prof. Jenkin, the engineers of the Great Western Telegraph Cable. From 1873 to 1878 he was professor of natural philosophy and instructor in telegraphy in the Imperial College of Engineering, Tokio, Japan.

I gave a short account of Ayrton's Japanese laboratory in a paper read before the Society of Arts in January, 1880. I venture to think that nobody interested in the history of scientific education can afford to neglect that paper. It describes the educational ideas which had gradually been developed in Japan. At Glasgow and Cambridge and Berlin there were three great personalities, but, except for these, the laboratories of Kelvin, of Maxwell, and of Helmholtz were not to be mentioned in comparison with that of Ayrton. When I went to Japan in 1875, what I found were fine buildings, splendid apparatus, carefully chosen and often designed by himself, and earnest, diligent students; I found also a never-resting, energetic, keen-eyed chief of great originality and individuality. It is no wonder that Maxwell jestingly said that the electrical centre of gravity had shifted towards Japan. It must be remembered that at that time there were not half-a-dozen people in Great Britain who had experimented in electricity.

Before 1875 he had published papers on telegraphy; after 1875 his investigations were mainly on electrical phenomena, sometimes without, but oftener with, a practical bearing on engineering.

From 1879 to 1884 Ayrton was professor of applied physics at the City and Guilds Technical College, Finsbury. It may already be forgotten that the system of instruction created there was radically different from anything which previously existed. It is now to be found in every technical college of this country. Students learnt by actually doing things in the laboratories and workshops. The most important thing leading to success was that there were no outside examiners. Hitherto professors had merely shown experiments at the lecture table. In one or two mechanical laboratories a few students looked on whilst the professor broke specimens with a 200-ton testing-machine or made tests on a steam engine. Only a few volunteer students had a chance of making experiments in physics anywhere. Ayrton gave interesting work to all students, and induced them to think things out for themselves. The motors and dynamos and other contrivances which were tested were not so small as to be toys, and they were not so large but that they could be left in charge of the average student without fear of disaster. The preliminary work was particularly Ayrton's invention, and as to this his book on Practical Electricity ought to be consulted. He said:—in the study of mechanics and other parts of science we deal with weight, inertia, stress, colour, &c., and a boy's senses have made such things tangible. But in electricity we deal with something almost abstract, and there must be a regular training which will make the things which we call current and voltage and resistance and magnetic induction just as tangible to the student as weight is.

Again, Ayrton never tried to create the perfect engineer. He aimed at creating a learner, a person with developed common sense, a man who would learn engineering when he had the chance of practice, a man whose education would go on until he died, a man who could use books, a man fond of reading. It is difficult now to say how much of his system is due to colleagues like Armstrong and myself. We had the same ideas, we never quarrelled, we never seemed to differ in opinion; on any given question we seemed always to come to the same conclusions. No mere chemist taught chemistry, no mere mathematician taught mathematics, no mere physicist taught physics, no mere specialist taught anything at that college. Practical and descriptive geometry and graphics were taught, and almost no deductive geometry or geometrical conics. Ninety per cent. of the usual work in algebra and trigonometry was put aside as unnecessary trickery. Analytical conic sections gave place to the calculus study of curves in general. Before 1879 squared paper was expensive; in 1879 Ayrton arranged that it could be bought at sixpence a quire. Every subject was taught through the other subjects. I am afraid that the average student would have failed to pass any outside examination in any of the subjects, but he had a wonderful power of using on any new

problem his very thorough acquaintance with a few fundamental principles.

No marks were ever given for lecture notes, but rough laboratory notes and finished accounts of laboratory work in good English, with elaborate sketches and squared-paper curves, were thought most important. When a hundred students pass through laboratories of no large dimensions in one week, some system must be adopted, and the education cannot be ideally perfect, especially when the number of instructors is limited. But great encouragement was given to any student who adventured and discovered things of which he had not been told anything. Advanced students had fine opportunities for original research.

From 1884 until he died Ayrton was professor of electrical engineering at the City and Guilds Central College, South Kensington. The laboratory here became a sort of developed combination of that at Finsbury and the one in Japan. In my opinion, there is no electrical laboratory in the world that can compare with the Kensington laboratory, whether we look at it from the educational or from the research point of view. He always said that much of its success was due to the helpfulness of Mr. Mather.

In dealing with students, that earnestness and enthusiasm and inspiration, that training in scientific method, that sympathy and helpfulness for others which he received from Lord Kelvin, he handed on to many thousands of pupils, and they in turn are handing them on to new generations.

"The Electricians' Directory" speaks of about 150 papers published, usually in collaboration with myself, Mather, and others, in the Proceedings and Transactions of the Royal Society, Physical Society, Institution of Electrical Engineers, and other societies, giving the titles of the most important, and it gives the names of some of the numerous inventions with which Ayrton alone or with others has benefited the world. The time from 1879 to 1884 was a particularly happy one. There are now hundreds of schools where men may learn electrical science; in most of them his pupils are teaching. There are now thousands of electrical engineers in whose employment a man can obtain experience. But at that time there was only one school, there was almost only one office in which and there was almost only one engineer in whose service, education and experience could be found. Every young man of promise, every engineer with ambition, was attracted from Germany, America, and elsewhere to the place where new discoveries and new inventions were the order of the day. It was a glorious time, that pioneering time when everything planted was fruitful, when everything tried was successful. Those discoveries are now such common knowledge, those inventions are such usual parts of all electrical machinery, that nobody dreams of mentioning their author's name in connection with them.

I remember once, in 1886, sitting at a meeting of the Institution of Electrical Engineers beside Prof. Ayrton, and, looking over the large audience, I was able to say that nearly three-quarters of the people present were Ayrton's old students.

He loved the Institution of Electrical Engineers, and it was no wonder, for it was the mirror of his life. It gave a setting and a value to all his life's work and all he cared for. It gave a scope for that energy, that earnestness, that untiring industry, that hatred of inaction which was his most intense characteristic. He was a member of it almost from the beginning; his speeches during discussions form some of the best reading in its proceedings; he was a diligent attender at general meetings, at council meetings, and at meetings of the numerous committees. His love for it was that of a nurse or mother for the boy whom she has seen grow up to splendid manhood.

Since 1879, when he lectured on electrical transmission of power at Sheffield, Prof. Ayrton delivered many popular lectures, and each of them may be said to have been epoch-making. He acted on many juries and congresses. He was president of Section A of the British Association in 1898, president of the Physical Society in 1890, president of the Institution of Electrical Engineers in 1892. He became a Fellow of the Royal Society in 1881, and in 1901 he was awarded a Royal medal by the Royal Society for his scientific work.

His first wife was his cousin, Matilda Chaplin, one of the famous pioneering Edinburgh medical students; their daughter Edith, now Mrs. Israel Zangwill, was born in Japan. His second wife is well known as the only woman member of the Institution of Electrical Engineers; she was awarded the Hughes medal of the Royal Society for her scientific work in 1906; their daughter Barbara has already published a physiological investigation.

When I first knew him in Japan the motto printed on his notepaper was "Energy." It was his motto through life, or rather his motto was "Earnestness."

He had a keen sense of justice and a high regard for truth. His mere presence often caused the tone of conversation to be raised. The ideals towards which he worked incessantly were noble ideals. In his own lifetime great progress had been made towards their realisation, but occasionally he was despondent, particularly towards the end, when his ailing body could not respond to his vehement spirit. He could not see that all the noble things for which he had worked were being worked for now by numerous energetic young men, most of whom had been inspired by himself. It was sad to watch him towards the end, the active mind warring with the weak body. I felt often that I wanted to say with Kent in the old play, "O, let him pass! He hates him that would upon the rack of this rough world stretch him out longer."

JOHN PERRY.

NOTES.

SIR WILLIAM RAMSAY, K.C.B., F.R.S., and Dr. G. W. Hill have been elected corresponding members of the Bavarian Academy of Sciences.

M. LOUIS-FÉLIX HENNEGUY, professor of comparative embryogeny in the Collège de France, has been elected a member of the Paris Academy of Sciences.

MR. JAMES SWINBURNE, F.R.S., has been elected president of the Junior Institution of Engineers, in succession to the late M. Gustave Canet.

WE learn from *Science* that the Nichols medal of the American Chemical Society has been awarded to Prof. W. A. Noyes, of the University of Illinois, and Dr. H. C. P. Weber, for their researches on the atomic weight of chlorine.

THE Royal Statistical Society offers the "Howard medal" (bronze) and a grant of 20*l*. for the best essay on a statistical study of infantile mortality in Great Britain and Ireland and of its causes. The competition is open, and is not limited to Fellows of the Statistical Society. Essays must be sent in before June 20, 1909.

THE eighty-third Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. William Stirling, his subject being "The Wheel of Life." The

course, which will be fully illustrated, will commence on Tuesday, December 29, and will be continued on December 31, 1908, January 2, 5, 7, and 9, 1909.

THE fiftieth anniversary of the foundation of the British Ornithologists' Union will be celebrated by a special meeting in the rooms of the Zoological Society on Wednesday, December 9, at 3 p.m. Only four of the original members still survive—Dr. F. Ducane Godman, F.R.S., Mr. Percy S. Godman, Mr. W. H. Hudleston, F.R.S., and Dr. P. L. Sclater, F.R.S.—and at the close of the meeting commemorative gold medals will be presented to them.

AT the annual general meeting of the London Mathematical Society, held on November 12, the following were elected to be the council and officers of the society for the session 1908–9:—*President*, Sir William Niven; *vice-presidents*, Mr. A. Berry, Prof. W. Burnside, Prof. H. M. Macdonald; *treasurer*, Prof. J. Larmor; *secretaries*, Prof. A. E. H. Love, Mr. J. H. Grace; *other members of the council*, Dr. H. F. Baker, Mr. G. T. Bennett, Mr. A. L. Dixon, Prof. E. B. Elliott, Dr. L. N. G. Filon, Dr. E. W. Hobson, Major P. A. MacMahon, Mr. H. W. Richmond, Mr. A. E. Western.

A FEW weeks ago Sir J. H. Carruthers directed attention to the fact that there is no monument in London to commemorate the life-work of Captain Cook. Admiral Lord Charles Scott and other representatives of the Royal Navy have expressed cordial approval of the proposal to erect such a monument to the great navigator. "A large number of us have had reason," they add, "when following our vocation, to feel personally grateful to him for the care with which he carried out his explorations and the accuracy of his hydrographical surveys." It is hoped that the proposal to establish some public memorial of Captain Cook will receive generous support from the British public.

THE death of M. Alfred Ditte, professor of inorganic chemistry at the Sorbonne, adds yet another to the long list of losses sustained by the Academy of Sciences during the past year. This distinguished chemist, although not prominently identified with any epoch-making discovery, made numerous important contributions to inorganic chemistry. The pupil of Deville, Ditte's earlier papers furnished experimental material confirming the theory of dissociation. In this connection may be mentioned his work on the formation and decomposition of the hydrogen compounds of selenium and tellurium, and the same idea of the equilibrium of chemical reactions led to his researches on the action of water on antimony chloride, mercuric sulphate, and bismuth nitrate. The conditions governing the artificial production of crystallised minerals were also thoroughly worked out by him, and gave rise to a long series of memoirs. Ditte published no joint papers, his work being entirely personal, and the same individuality was exercised in his professorial work, especially in his laboratory instruction. He was elected a member of the Academy of Sciences in 1897, in succession to Schutzenberger.

THE Government of Madras has approved, we learn from the *Pioneer Mail*, the recommendation of the recent industrial conference that there should be a special department under a special officer to deal with industrial questions. This officer will be styled Director of Industries. In carrying out industrial development the Government considers immediate action is possible as regards the establishment of an industrial museum, the preparation of a list of manufactures in the Presidency of sufficient importance to justify the establishment of special industrial schools in relation to them, and in other directions. The director is to submit proposals for giving effect to the recommendations of the conference in regard to the establishment of six weaving institutions on the lines of the Manchester or Bradford textile schools at six centres in the Presidency, each under an Indian expert; the employment of a dyeing expert to report on the state of that industry in the Presidency; the establishment of a leather-trade school with a small tannery attached; the offer of a reward for the design of a suitable oil-extracting plant and the introduction of improved oil presses, &c.; and the extension of well-boring operations.

FROM the *Times* of November 14 we gather the following remarks, contributed by a correspondent, upon the work of Dr. James Fletcher, the Dominion entomologist, whose death was announced last week:—So long ago as 1879 Dr. Fletcher was vice-president of the Entomological Society of Ontario and part editor of their annual reports, to which he had contributed a paper on Canadian beetles in the previous year; and from this time until his death he worked hard at Canadian entomology and botany, and published numerous papers and reports, chiefly on economic entomology and on the habits and transformations of insects, in various Canadian journals, especially in the *Canadian Entomologist*, of which he became assistant editor in 1887, about the time that he was appointed Dominion entomologist and botanist to the exeprimental farms at Ottawa. Here he set himself energetically to combat insect pests, which are far more destructive in the American continent than in Europe, and his exertions were so much appreciated that he was called "the farmers' friend" throughout Canada. Nor did he neglect botany, for he published a "Flora Ottawaensis" in the Transactions of the Ottawa Field Club, vols. i.–v. (1880–4), and again in the *Ottawa Naturalist*, vols. ii.–vii. (from 1888 onwards).

THE first general meeting of the Institute of Metals, formed in June last, was held in Birmingham on November 11 and 12 under the presidency of Sir William White, K.C.B. The institute already has a membership of about 350, and a considerable number of members from all parts of the country attended, and were cordially welcomed by the Lord Mayor of Birmingham (Mr. G. H. Kenrick). The president's address, which dealt with the aims of the institute and the part which manufacturers, users, and scientific investigators may be expected to play in its development, aroused the keenest interest. An excellent list of papers for reading and discussion was forthcoming, the most notable being those by Mr. J. T. Milton and Mr. A. Phillip on the practical side, and by Mr. C. Desch and Mr. W. Rosenhain on the scientific study of non-ferrous alloys. In the majority of cases the papers were adjourned for further discussion at the London meeting on January 19 and 20. It is a matter of congratulation that the Birmingham metal works have interested themselves so keenly in the formation of the institute, and that a strong local committee was formed the invitation of which to hold the first meeting in this important centre of the metal industry was gladly accepted by the council of the institute. Excellent arrangements were made for the reception of members and visitors. Visits to some of the chief metal works were carried through, a reception was held by Sir Oliver Lodge at the new university buildings, followed by an inspection of various departments, and special mention must be made of an exhibit at the

conversazione of upwards of 100 "diseased" metals and alloys which had been collected at the instigation of Mr. Boeddicker, the chairman of the local committee. It is to be hoped that this display of metals and alloys which have failed from obscure causes will lead to much valuable research work being set in hand. Certain it is that in the corrosion of metals the institute has a magnificent field of investigation. The meetings were a pronounced success; the institute has justified its establishment, and now takes its place among the technical institutions of this country.

THE first number of the Bulletin of the Sleeping Sickness Bureau has been published by the Royal Society, bearing date October, 1908, and is edited by the director, Dr. A. G. Bagshawe. It deals with the chemotherapy of trypanosomiasis, and contains a clearly written summary and review of the results hitherto obtained in the treatment with drugs of diseases caused by trypanosomes, with references to 197 memoirs. The subject is dealt with under the headings "Treatment of Trypanosomiasis in Man," "Biological Accommodation of Trypanosomes to Chemotherapeutic Agents," and "Treatment of Experimental Animals," after which the editor draws some conclusions and lays down some principles which, in his opinion, have been established by this vast accumulation of experimental research. The publication is a most valuable one, and will undoubtedly be of great use to those engaged in research or practice in this field by putting clearly before them what has been achieved, and suggesting lines of investigation to be followed.

POLYCHÆTOUS annelids collected off the Pacific coast of North America by the U.S. steamer *Albatross* in 1903 form the subject of a paper by Mr. J. P. Moore in the Proceedings of the Academy of Natural Sciences of Philadelphia for June last. Out of 107 species collected, forty-seven are considered to be new.

AMONG the contents of vol. iii., part i., of the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne is a paper by Mr. A. Randell Jackson on rare arachnids captured in Britain during 1907. Three of these are new to the British fauna, two being new species, of which one appears to be indigenous, while the second is introduced; the third is a continental species of the attid or jumping group. Of three other species only one sex had hitherto been recorded in our islands.

SPIDERS likewise form the subject of an article in the *Bulletin international de l'Académie des Sciences de Cracovie* for June, Mr. Vl. Kulczyński treating therein of the Javan and Sumatran representatives of the groups Mygalomorphæ and Cribellatæ. Some of the specimens described were collected at Palembaug, in Sumatra, others in the islands of the Batu, Krakatau, and Babo groups, and yet others in Java itself, more especially in the mountains. A considerable number of new species and races is named and described.

STUDENTS of variation should be interested in an elaborate paper by Dr. A. Brožek, of Prague, on the variability and local forms of the decapod crustacean *Palaemonetes varians* from four different localities, published in the *Sitzungsberichte der k. Böhm. Gesellschaft der Wissenschaften* for 1907. Two of the four localities are so far apart as Plymouth and Montenegro, and the variations—in the number and form of the "teeth" of the rostrum—are expressed in figures. It is noteworthy that the variability displays a marked tendency to asymmetry, and the author divides this asymmetrical variation into a "positive" southern and a "negative" northern type.

THE damage caused to cotton in India by the caterpillars of the cotton leaf-roller moth (*Sylepta derogata*, or *multilinearis*) is discussed by Mr. H. Maxwell-Lefroy in Entomological Bulletin, vol. ii., No. 6, of Memoirs of the Department of Agriculture in India. While this common pest does not, as a rule, inflict much harm on native Indian cotton, it is extremely injurious to introduced American and Egyptian strains, destroying in some instances almost the entire crop. Whether these foreign cottons will eventually become more immune to attack remains to be seen.

THE intra-uterine development of the hedgehog appears to have received but little attention at the hands of embryologists, despite the fact that the group is one of the most ancient of all mammals, and therefore likely to yield interesting results in this respect. As regards the age of the group, it may be mentioned that both the extinct Necrogymnurus and the existing Erinaceus are represented in the Oligocene phosphorites of central France, the persistence of the second genus being attributed to the defensive coat of spines with which its members are furnished. Recently Mr. H. Jacobfeuerborn has investigated the development of the hedgehog, with especial reference to the time of the acquisition of the external form during intra-uterine life, which he finds to be unusually early. The results of the investigation are published in the *Zeitschrift für wissenschaftliche Zoologie*, vol. xci., part i.

THE relations of the fauna of Central Europe to the Glacial period form the subject of a long and interesting paper by Prof. F. Zschokke, of Basle, published in the *Verhandlungen der deutschen Zoologischen Gesellschaft* for 1908. The paper is illustrated by two of Geinitz's maps, showing the maximum glaciation of North and Central Europe. Although at first bringing death and destruction in its train, the Ice-age should be regarded, in the author's opinion, as a great vivifying factor, exciting the fauna to active and passive migrations, and thus extending the distribution of the various species both on land and in water. The author has much to say regarding the spread in Central Europe of Nehring's "steppe-fauna" from the direction of the Ostsee, and adds that subsequently to this there must have been a great northern post-Glacial migration of southern animals and plants. The article is of such interest as to be well worthy of translation into English.

To the October number (vol. xliii., part i.) of the *Journal of Anatomy and Physiology* Prof. O. C Bradley contributes an important paper on the morphology and development of the mammalian liver. Basing his conclusions largely on development, the author is of opinion that the liver is primarily an organ of more simple structure than was supposed to be the case by the late Sir W. H. Flower, consisting of three, in place of six, main lobes. The difference between the two views will be rendered most easily apparent by the following table:—

Bradley		Flower.
Central lobe.	Right lobule	Right central lobe
	Left lobule	Left central lobe
Right lateral lobe	Main part	Right lateral lobe
	Processus caudatus	Caudate lobe
	Processus omentalis or papillaris	
Left lateral lobe		Left lateral lobe

The division of the central lobe into two is dependent on the presence of an "umbilical fissure," and is therefore not primary. The three fundamental lobes make their appearance independently, and develop in connection with different embryonic veins, the central lobe being produced

about the umbilical veins, while the right and left lobes grow along the course of the corresponding omphalomesenteric veins. The origin of the hepatic fissures cannot yet be satisfactorily explained.

A PHYTOGEOGRAPHICAL study of the Bonin Islands is contributed by Dr. A. Hattori to the Journal (vol. xxiii., art. 10) of the Royal College of Science, Tokyo. Although the average monthly temperature seldom exceeds 27° C., the vegetation is tropical in character, and shows close affinities with the flora of Formosa. A considerable proportion of Indian and Ceylonese plants, consisting largely of coastal plants, suggests the importance of sea transportation. A single endemic genus, Boninia (Rutaceæ), is recorded, and thirty endemic species, or about 14 per cent. of the total. The screw-pine, *Pandanus boninensis*, an endemic species, thrives generally, and in one locality forms a pure forest; the palms *Livistona chinensis* and *Ptycosperma elegans* are prominent, also the fern trees *Alsophila Bongardiana* and *Cyathea spinulosa*.

AN impressive volume, copiously supplied with illustrations, has been compiled by Dr. D. T. Macdougal, of the Desert Botanical Laboratory connected with the Carnegie Institution at Washington; he discusses therein the botanical features of the North American deserts. The volume contains the essence of previously published reports on deserts in Texas, Mexico, and California, and concludes with some general remarks on deserts and desert plants. On the subject of temperatures it is noted that in the soil around the roots of plants temperatures were measured up to 43° C., and the readings obtained by inserting the bulbs of thermometers into Opuntia stems ranged from 27° C. to 43° C. Again, it was observed that on occasions a difference of 20° C. existed between the temperature of the air and soil surrounding the stem and root of the same plant. These facts, it will be seen, do not harmonise with generally accepted ideas.

WE have received early numbers of the new periodical *Archiv für Zellforschung*, edited by Dr. R. Goldschmidt, intended, as the title implies, for the publication of original communications on cytology. The first part, issued in February, was inaugurated with a paper by Dr. R. Hertwig on modern problems of cell-science, in which he discusses the function of the nucleus and the nature of its influence. He elaborates his theory of a relation existing between the nucleus and the protoplasm, whereby the phenomena of division and other changes in the cell are regarded as a release of the tension set up by a departure from the normal proportion. An important contribution to the same subject is made by Dr. M. Popoff, wherein he details his experiments with Infusoria to obtain data for working out the proportion mentioned. The tabulated curves are of great interest, also the reasoning as to a chemico-physical ultimate cause. Dr. G. Tischler communicates the results of cytological investigations with sterile plant hybrids, but is unable to offer any explanation of the determining influence. Other contributions relate to the chromosomes, the formation of sperms in the Myxinoideæ, and Dr. Goldschmidt traces the chromatin changes in the egg of *Distomum lanceolatum*.

MESSRS. GUSTAV FISCHER, of Jena, have published a very useful and interesting booklet, by Dr. P. Schatiloff, explanatory of Ehrlich's "side-chain theory," and illustrated with several diagrams ("Die ehrlichsche Seitenkettentheorie," pp. 56, price 2 marks).

IN the *Journal of Comparative Neurology and Psychology* for October (xviii., No. 4) Mr. Judson Herrick discusses the morphological subdivision of the brain, and suggests a scheme of subdivision of the vertebrate nervous system which he thinks might be tentatively adopted as a terminology available for all vertebrates.

THE *Journal of Hygiene* for September (viii., No. 4) contains several important papers; among others, Mr. Currie discusses abnormal reactions to horse serum in the serum treatment of cerebro-spinal fever, Dr. Green discusses immunity against vaccinia in animals and the influence of temperature on calf vaccine, and Mr. Watson publishes a note on the variation of the rate of disinfection with change in the concentration of the disinfectant.

THE *Bio-Chemical Journal* for October (iii., No. 9) contains a paper by Dr. Owen Williams on the microchemical changes occurring in appendicitis. It would appear that in the course of the changes in the intestinal wall an abnormal condition with the formation of calcium soaps is induced. The calcium soaps are absorbed with difficulty, and tend to act as foreign bodies in the wall, and at times as a concretion in the lumen, of the appendix.

RATS and their parasites have assumed considerable importance in the dissemination of plague, also in trichinosis, and Mr. A. E. Shipley, F.R.S., in the *Journal of Economic Biology* (iii., No. 3, October) gives a long list of the ecto- and endo-parasites which infest these animals.

IN 1807 Dr. Francis Buchanan, author of the well-known "Journey through Mysore," was appointed to make a comprehensive survey of Bengal. After about 20,000*l.* had been expended on the work it was discontinued, and a portion of the MSS., now in the India Office Library, was published by Mr. M. Martin in 1838 under the title of "Eastern India." Even admitting its obvious shortcomings, the book has been of much value to later writers. Mr. H. MacPherson, Director of Land Records, Bengal, has now issued a pamphlet entitled "The Aboriginal Races of the Sonthal Parganas: a Plea for the Reprint of the Buchanan Manuscripts," in which he shows the value of the collection. If the Government of Bengal finds itself unable to re-print the collection *in extenso*, it may be hoped that it will at least publish the portions which Mr. Martin either abbreviated or omitted from his book.

ONE of the most primitive methods of chartography is that employed by the inhabitants of the Marshall Islands. Mr. T. A. Joyce, in the October number of *Man*, describes a chart of this class from the British Museum collection. It consists of a framework of sticks, those which are horizontal and vertical being intended as supports to the map, while the diagonal and curved rods represent the swells raised by the prevailing winds. At the intersections of the rods shells are fixed to denote the islands of the group. Comparison with a modern chart shows that the position of each island with reference to its neighbours is indicated with considerable accuracy. The distances from island to island are not so correctly defined; but this is a matter of minor importance, because the winds in these latitudes being constant at certain seasons the boat can be steered by the swells alone, and its position with reference to the islands can be determined by indications which the practised eye draws from cross-swells and the like. From the fact that the Ralic Archipelago is most accurately charted, it would appear that the maker of this map was a resident in one of the islands of this part of the group.

IN the October number of the *Reliquary* Mr. E. H. Goddard discusses the objects of the Bronze age which have been found in Wiltshire. It is remarkable that a

district which at the earlier period of the Bronze age was densely peopled should possess so few examples of the later period, when men no longer buried their weapons with the dead. The writer suggests as an explanation of this that Wiltshire possesses neither large rivers, like the Thames, nor turbaries and bogs, such as those of Somerset, Devon, and the north of England, situations where such relics are most abundantly found. The chalk downs of Wiltshire offered few opportunities for the loss of such things or for their preservation so late as our time. Even granting this, the absence of founders' hoards, except one from Donham, now in the Farnham Museum, remains unexplained. Socketed celts and palstaves are fairly numerous, but swords, except one doubtful example in the Devizes Museum, are conspicuously absent. One dagger found at Winterbourne Basset resembles those found in the Swiss lake-dwellings. The socketed sickle from Winterbourne Monkton is an unusual form of the implement, rare in any form in Great Britain, and almost unknown on the Continent, where sickles without sockets are the rule. In Ireland, however, they are more common. A socketed gouge, again, is an example of a type uncommon in England. It seems obvious that the conditions of the Wiltshire Bronze-age people differed in some respects from that of the race in other parts of this country, and the abnormal types to which Mr. Goddard directs attention may have been the result of some foreign influence or may have been imported. His article supplies good illustrations of these abnormal local implements.

THE present month has experienced very exceptional changes of temperature, although for the most part the weather has remained mild for the time of year. During the first week the thermometer stood high over the whole country, and in many parts of England the days were more like spring than late autumn. A decided change of temperature occurred about November 7, and for the two or three subsequent days the thermometer fell to an abnormally low reading. At Greenwich the first frost of the season was registered by the sheltered thermometer on November 10, and the thermometer fell to 22°, which is lower than any previous reading during the first half of November since 1841, whilst on the grass the exposed thermometer registered 9°. The weather report issued by the Meteorological Office for the week ending November 14 shows that similarly low readings occurred in other parts of the kingdom between November 8 and 11, the sheltered thermometer registering 16° in the east of Scotland, 17° in the Midland counties, and 18° in the east, south-east, and south-west of England. On the grass the lowest readings were 7° at Llangammarch Wells, 9° at Greenwich, 12° at West Linton, 13° at Birmingham, 14° at Newton Rigg and Kew, and 15° at Canterbury, Oxford, Buxton, and Dumfries. There was a rapid rise of temperature between the mornings of November 10 and 11, amounting to 30° at Oxford, 25° at Nottingham, and 23° at Bath. The subsequent weather has been very mild for the time of year.

THE monthly meteorological charts of the North Atlantic and Indian Oceans issued by the Meteorological Office, and the chart for the North Atlantic issued by the Deutsche Seewarte, for November, 1908, have been received. The charts issued by both countries contain practically similar useful information, and show on their face the normal values of the principal meteorological elements, the best routes for sailing vessels and steamships, the average limits of trade winds for the month in question, together with the latest reports of ice in the Atlantic and of the south-west monsoon in the Indian Ocean. On the backs of the charts are given average statistics of fog in the Atlantic, of ice in the Southern Ocean, and other information of importance to seamen. The charts are published during the month prior to that to which the data refer; they are compiled from all available sources at the disposal of the various meteorological and hydrographic offices, and deal with some thousands of observations. The labour involved is very onerous, but the value of the work, brought up to current time, cannot be over-stated.

AMONG several useful articles contained in the *U.S. Monthly Weather Review* for June last, recently received, we find a note by Prof. Cleveland Abbe suggesting the importance of establishing a graduate school of meteorology on the principle of that established by the Association of American Agricultural Colleges, in which lectures and experiments by specialists bring home to interested audiences the present state of agricultural knowledge. The third session of this school was held at Ithaca in July last; the "seminar" forms a predominating part of the work, in which the instructor undertakes to show students how important items of knowledge have been obtained, and replies to questions that may be put. Referring to meteorology, Prof. Abbe says:—"At present we rely too much on books and letters; we shall do better to get together, ask questions, try experiments, and compare notes." In this country a great step in this direction is made by the director of the Meteorological Office by continuing during the present winter season the series of meetings commenced in 1905 for the informal discussion of important contributions to meteorological literature, particularly those by colonial and foreign meteorologists. To these meetings contributors of observations to the office, and, so far as space permits, others known to be interested in meteorology, receive invitations to be present, and to take part in the discussions. We also note that in a recently published report of a departmental committee appointed by the Board of Agriculture the opinion is expressed that in agricultural institutions provision might well be made for instruction respecting the relations between meteorology and the crops.

THE October issue of the Journal of the Institution of Electrical Engineers contains a communication, made to the institution in May by Mr. G. F. Mansbridge of the Post Office, on the manufacture of electrical condensers. Although other forms of condensers are mentioned, the chief interest of the communication centres round the rolled paper condenser, in the development of which Mr. Mansbridge has played so active a part. To it we owe the possibility of purchasing condensers for as many shillings to-day as we paid pounds a few years ago. They are made of paper, one side of which is coated with tin mud, which is then dried and burnished. Two sheets of this coated paper are rolled up together, with or without intervening layers of plain paper, and the roll impregnated with hot paraffin wax. A microfarad condenser constructed in this way, and tested by the direct deflection method, the voltage being applied one minute, shows an insulation resistance of 1700 megohms at 100 volts, 1500 at 500 volts, and 200 megohms at 1000 volts.

THE foundations of trigonometry form the subject of a paper by Dr. Arthur C. Lunn in the *Annals of Mathematics* (October). The author points out that in the existing literature of real analysis, the purely logical introduction of circular functions, apart from any appeal to geometrical setting to supply features of the proofs, is mainly accomplished in two ways, one by defining the sine and cosine in terms of their expansions in infinite series, the other by basing the definition on the differentiation formulæ

for the sine and cosine with the special conditions that $\sin 0 = 0$ and $\cos 0 = 1$. Dr. Lunn considers that a more elementary treatment can be obtained by starting from the following postulates, viz. the addition formula for the sines of numbers of the straight-angle set, the continuity of the sine and cosine, the assumptions that $\cos 90° = 0$ $\sin 90° = 1$, $\cos 180° = 1$, that $\cos x$ is not negative between 0 and 90°, and that if $\sin x/x$ has a limit when x vanishes that limit is unity. The last assumption is required to determine the unit of angular measurement.

In a paper communicated to the *Rivista marittima* for March last, and reprinted by the Officina poligrafica italiana of Rome (1908), Dr. Filippo Eredia discusses the prevailing winds in the Straits of Messina, and gives statistics of the observations made at various semaphore stations along the Italian and Sicilian coasts.

It was announced in last week's NATURE that on November 28 Mr. Thayer would give a demonstration at the Zoological Gardens of the obliterative effects of the costumes of animals. By an error, which we regret, the date was wrongly printed; it should have been November 18, and not November 28.

Messrs. Isenthal and Co., 85 Mortimer Street, London, W., have issued a list of precision instruments based on the resonance principle, containing information concerning the frequency and speed meters, as well as other instruments, constructed by them.

We have received from Prof. W. A. Herdman, F.R.S., a volume containing copies of four addresses delivered by him, in his capacity of president of the Linnean Society, at the anniversary meetings of the society in May of the years 1905–8. The subjects of the addresses were, in the successive years, Linnæus and artificial pearl formation, natural pearl formation, some fundamentals of sea-fisheries' research, and plankton studies in the Irish Sea.

OUR ASTRONOMICAL COLUMN.

Comet Morehouse, 1908*c*.—The remarkable changes which have been shown to have taken place in the extent and form of comet 1908*c* are well illustrated by a series of photographs taken by M. Quénisset at the Juvisy Observatory, and reproduced in the November number of the *Bulletin de la Société astronomique de France*.

Two photographs taken on September 30 with equal exposures showed changes in intensity, but were quite eclipsed by one taken the next night, October 1, between 10h. 48m. and 12h. 55m. The trail of a bright star interferes somewhat with the image of the comet's tail, but, despite this, it is seen that the tail has a large, bright condensation at some distance from the head. From the coma of the comet several narrow, straight streamers emerge, and then suddenly expand into a bright, nebulous mass which continues for some distance with a much greater breadth and diffuseness than the preceding part of the tail. It almost appears as though a tremendous activity of the head had emitted all this matter and had then subsided, leaving only the normal emission of material to form the straight, narrow streamers. This apparently fluctuating activity may easily be explained by assuming that, during its journey through space, the comet encounters meteor swarms of various densities.

These changes may be held to account for M. Bigourdan's widely published statement that, at about the time they were photographed, the comet lost its tail. The visual radiations certainly did decrease in intensity, but the photographic rays were not much fainter; M. Bigourdan's observations were visual.

Some of the photographs show a tail 17° long, that is, actually about twenty-seven million miles (43,000,000 km.), whilst the diameter of the nucleus is 10′ of arc, or actually about 290,000 miles (460,000 km.).

Numerous photographs, showing changes similar to those described above, have also been obtained at the Greenwich and Stonyhurst observatories.

Particulars of the more recent spectrum of the comet are published by MM. Deslandres and Bernard in No. 18 of the *Comptes rendus* (p. 774, November 2). The spectra were obtained with a specially designed spectrograph of 10 cm. aperture and 31 cm. focal length, fitted with an ultra-violet glass objective. A prism of the same glass, having an angle of 22°, was placed in front of the objective, and was, at times, supplemented by another of ordinary flint having an angle of 61°.

The spectra obtained differ on many points from those obtained earlier by Comte de la Baume Pluvinel and described in these columns. The present workers find that the ratio of ultra-violet to visual rays is abnormal, and that the continuous spectrum is very persistent both in the images of the head and of the tail. The hydrocarbon bands, usually a prominent feature of cometary spectra, especially in the green region, are apparently absent, whilst of the numerous cyanogen bands reported by de la Baume Pluvinel only the two first heads of the ultra-violet group, at λ 388, were photographed. The three strongest bands appear at about λ 456·1, λ 426·7, and λ 401·3, and are due to some unknown light-source. Many of the bands are double, and MM. Deslandres and Bernard suggest the possibility of this being due to the Zeeman or the Doppler effect, or, maybe, to some new phenomenon special to comets.

A New Spectroscopic Laboratory at Pasadena.—Owing to the difficulty of obtaining large supplies of electricity at the Mount Wilson Observatory, Prof. Hale has recently installed a new spectroscopic laboratory at Pasadena, where the laboratory researches necessary for the elucidation of present-day solar problems may be carried out. An illustrated description of the new laboratory appears in No. 3, vol. xxviii., of the *Astrophysical Journal* (p. 244, October).

The main instrument is a 30-feet spectrograph sunk in a waterproof well, 8 feet in diameter, in the concrete floor of the laboratory. The numerous pieces of apparatus for producing radiations are arranged around the well-head, the light being reflected on to the spectrograph slit by a plane mirror. Among the apparatus briefly described in the present note there is an electric furnace capable of withstanding pressures up to 200 atmospheres, and of giving temperatures up to 3000° C.; this is to be employed for studying the spectra of such refractory metals as vanadium and titanium at widely different temperatures. A transformer capable of producing voltages from 1000 to 64,000 has also been installed, whilst a complete outfit for the study of the Zeeman effect in various spectra is intended for the laboratory researches which will naturally follow Prof. Hale's recent and remarkable discoveries in the sun-spot spectrum.

A Large Group of Sun-spots.—Another large group of sun-spots, made up of a great number of smaller spots, has recently been seen on the solar disc. This group was first observed at South Kensington on November 6, and was for several days quite easily visible with the naked eye. Another extensive group was first seen, near the limb, on November 12, and was visible to the naked eye on November 17.

Biographical Memoir of Asaph Hall.—In April of this year Mr. G. W. Hill read before the National Academy of Sciences, Washington, a biographical memoir of the late Prof. Asaph Hall giving an account of his life and work. This memoir now appears in vol. vi. of the Biographical Memoirs of the society (pp. 241–309), and is accompanied by a valuable bibliography of Prof. Hall's writings, published between 1858 and 1906, to the number of four hundred and eighty-six.

A Research on the Movement of Comet Wolf.—The results obtained from the first part of a research into the movement of comet Wolf, undertaken by M. Kamensky, of the Pulkowa Observatory, appear in No. 13 of the *Bulletin de l'Académie impériale des Sciences de St. Pétersbourg* (October, p. 1041). The present results consist of tables for the calculation of the eccentric anomaly, and they may be used in calculating the perturbations of Faye's and Tempel's comets also.

THE MANUFACTURE OF ARTIFICIAL GRAPHITE.

WITH the advance of electrochemistry it was found that electrodes of carbon were not so satisfactory as could be desired, because they disintegrated badly when employed in a great many of the electrochemical processes for which they were found to be practically the only substitute for the expensive platinum. Many attempts were therefore made to convert ordinary carbon into the more suitable modification—graphite—which possesses high conductivity and resistivity.

No very satisfactory method was devised, however, until Mr. Acheson succeeded in obtaining a very pure form accidentally when engaged in experiments upon the formation of silicon carbide, now known commercially as carborundum. Silicon carbide can be prepared by heating in the electric resistance furnace a mixture of silica and carbon, when the following reaction takes place :—

$$SiC_2+3C=SiC+2CO.$$

On one occasion, by the overheating of the furnace, he found that a large quantity of silicon carbide had been decomposed into carbon and silicon as follows :—

$$SiC=C+Si.$$

The silicon had actually been volatilised, and carbon in the form of graphite remained behind.

Silicon carbide is a magnificently crystalline product showing a splendid iridescence, and the graphite which was left behind had all the crystalline shape which the carbide originally had, but it no longer possessed iridescence, and in place of being next only in hardness to the diamond, was soft and friable, and had the familiar black appearance of graphite. Analysis showed it to be almost pure carbon, containing no more than 0·05 per cent. of impurities.

It might naturally be supposed that the purity of the final product would be directly affected by the purity of the starting material. This certainly would be so if it were simply a case of the high temperature of the furnace changing ordinary carbon into graphite; but as the reaction depends upon the formation of a carbide, which then at the great heat to which it is subjected loses one constituent by volatilisation, the other constituent remaining behind, and, furthermore, as at the temperature at which this reaction takes place all other metals are volatilised, or first converted into carbides and then volatilised, leaving the carbon, this is not so. In the preparation of graphite it is not necessary that sand in the proportions

$$SiO_2+3C=SiC+2CO$$

should be employed, because if the lower layers are converted into carbide volatilisation takes place. The vapourised silicon then passes through the next layer, and is converted into carbide; further volatilisation ensues, and the silicon passes through another layer, and so on progressively, until, finally, it passes out of the furnace as vapour.

The furnace is a long, oblong brick channel with electrodes at each end, which are connected together by means of a core made of granulated carbon. This core is surrounded by the mixture of sand and carbon, such as coke, from which the graphite is to be prepared. The furnace core is made of such dimensions that when the current is passed the temperature will be raised sufficiently high to convert the mixture surrounding it into carborundum, and then volatilise the silicon, leaving behind the graphite.

The carbon electrodes consist of twenty-five carbon rods, every rod being 86 cm. long and 10 cm. square. The internal part of the furnace is lined with silicon carbide, which protects the fire-bricks from the enormous operating heat. Generally, coal is employed as a raw material, being first broken to the size of peas; but as anthracite does not convey the current well, a conducting core of carbon rods is run through the centre of the furnace. When the furnace has been built up it is covered in with a mixture of sand and coke to prevent access of air. It is usually about 9 metres long, and the anthracite layer is 50 cm. by 35 cm. square. Such a furnace requires about 800 kilowatts to work it.

At the commencement of the operation the resistance is very high, therefore a high electrical pressure is required at the terminal electrodes. As the temperature rises and the core becomes graphitised, the resistance becomes less; consequently the voltage of the external circuit must be cut down. A pressure of about 200 volts is required at the commencement, but towards the end this is lowered to 75 volts. Shortly after the current is switched on, the volatile portions of the coal are driven off and burn with a characteristic yellow flame, which after a time becomes less, and its place is taken by the blue-coloured flame of carbon monoxide, because at this point the carbide commences to form. As the process continues the flame again becomes yellow, the carbide at this stage being decomposed. When the reduction is completed the flame is chiefly made up of burning volatilised metal, and shows a very fine absorption spectra. If a cold body is introduced into the flame it becomes covered with a felt-like coating of silicon dioxide.

The length of time required depends upon the purity of the graphite required. For most technical purposes it may contain up to 10 per cent. of ash. Further heating lowers the ash content, but, of course, as more energy is required, it increases the cost of the finished product.

Owing to the fact already mentioned, that much less than the theoretical amount of carbide-forming material need be added, Acheson finds that anthracite coal, which in its natural condition contains disseminated throughout its mass certain impurities, such as Fe_2O_3, SiO_2, Al_2O_3, &c., is particularly well adapted to produce graphite. That which contains 5·78 per cent. of impurities is especially suited for this purpose, and the graphite obtained from it contains only about 0·033 per cent. of ash. Other carbonaceous materials, such as brown coal, may be used, but, as a rule, the results are not so satisfactory.

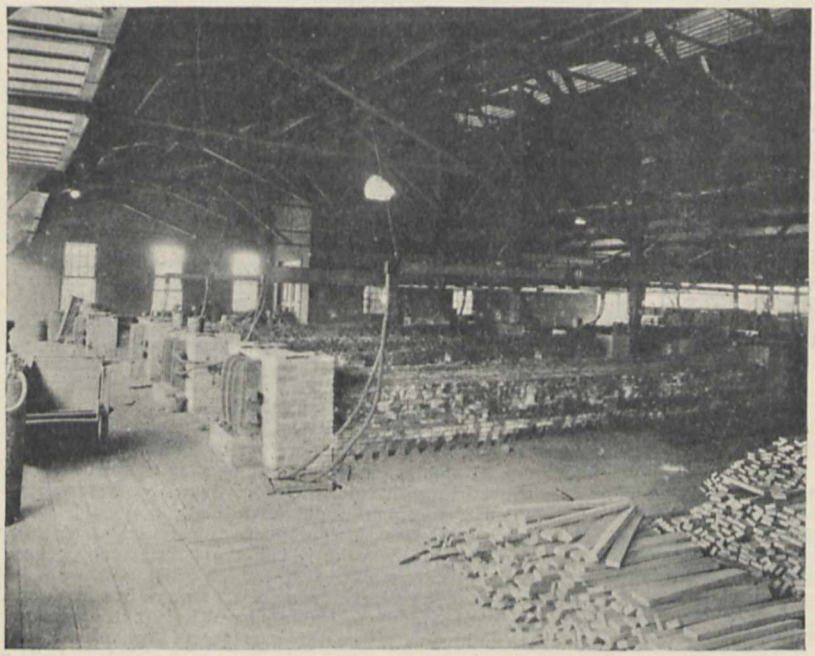
It is not necessary that the carbide should be silicon carbide; other carbides, such as iron, appear to be of equal value in the formation of graphite. A spectrographic study of the flames produced in the operation always shows the presence of volatilised metals.

A particularly fine quality of graphite can be obtained from the coke left at the bottom of the stills used for cracking petroleum. This coke, known as petroleum coke, is honeycombed with small holes produced by the escaping gases, and the graphite obtained has exactly the same appearance as the original product, except that in place of the dull black of the coke it has the polished appearance characteristic of graphite.

For making electrodes, crucibles, motor brushes, and other articles of any particular shape, it is not necessary, as is the case with natural graphite, to grind up and then shape the articles with some suitable binding material; but by the Acheson process the articles are first made from some form of amorphous carbon, and afterwards converted directly into graphite. For example, lamp-black, powdered wood charcoal, or coke is mixed with a metal, its oxide or salt, which is capable of forming a carbide; the mixture is then moistened with water containing a little sugar—molasses or other binding material—made into a paste, and formed into any desired shape. It is then placed in the electric furnace, embedded in broken carbon, and covered over with amorphous carborundum to prevent loss of heat. The dimensions of the furnace are so arranged that when the current is passed the temperature is raised sufficiently high to graphitise a portion of the carbon; the furnace then becomes more conducting, and the pressure at the terminals can be lowered. As an example of the proportions of carbon and oxide used, the following has been found satisfactory for the formation of motor brushes :—ninety-seven parts finely powdered wood charcoal and three parts of iron oxide mixed into a paste and formed into the desired shape. If the electrodes are separated about 5 metres, the space between being filled with the articles to be graphitised and packed with carbon, an initial E.M.F. of 150 volts causes a current of 300 amperes. As the carbon and articles become graphitised the E.M.F. drops, until with a pressure of 100 volts a current of 7000 amperes is passing.

Acheson finds that it is not always desirable to convert the whole of the articles into graphite, but that if the operation is stopped when a portion is still ungraphitised they are stronger and less liable to fracture than when they consist of pure graphite.

It has already been mentioned that graphite of any desired purity can be obtained by this process, it simply being a question of how long the product is heated in the furnace. When it is to be ground and used as a lubricant it is necessary to make it of a higher degree of purity than when required for many other purposes; but, however pure the graphite, there are certain difficulties in employing it as a lubricant mixed with oil or water, owing to its precipitating out very shortly after being mixed with them. Although many attempts have been made to get over this difficulty, it is only quite recently that Acheson has been successful in doing so. In 1901, when experimenting upon the manufacture of crucibles, he found some difficulty in obtaining clay which had good binding qualities. He therefore commenced the study of clays which are used in the manufacture of crucibles. It



International Acheson Graphite Co., Niagara Falls, N.Y., U.S.A.

was noticed that American crucible makers imported the clay from Germany, because, although the clay has practically the same chemical constitution as the American product, it has a greater tensile strength and is more plastic. Acheson then noticed that clays found at or near to the place at which the felspar rocks are decomposed are not so plastic or strong as when obtained at a distance from their source of origin. It occurred to him that this might be due to their containing vegetable or organic extract matter.

Experiments were therefore undertaken upon the action of vegetable extract matter, such as tannin and plant extracts, upon various clays. Remarkable results were obtained, it being found that a weak and only moderately plastic clay, after treatment with a dilute solution of tannic acid or extract of straw, increased in plasticity and became much stronger. In some cases the increased strength was as much as 300 per cent., and only 60 per cent. as much water was required to produce a given degree of fluidity. It remained suspended in water, and would pass through a filter paper. Clay thus treated Acheson called "Egyptianised," because the "Children of Israel" used straw in making bricks.

Now as clay so treated would remain suspended in water, it occurred to Acheson that perhaps the fine, unctuous graphite which he succeeded in directly manufacturing in the electric furnace in 1906 would also remain suspended in water if thus treated.

When disintegrated, graphite is treated with water containing tannin, the weight of which was from 3 per cent. to 6 per cent. of the graphite employed. The graphite remains suspended in the water indefinitely, and passes through a fine filter paper; it is therefore in a semi-colloidal condition. Graphite so treated Acheson calls "*deflocculated.*" To cause complete deflocculation and the suspension of the whole of the graphite requires prolonged mastication in the form of a paste with water and tannin, and after this mastication it is improved by diluting with considerable water and allowing to remain some weeks, with occasional stirring. The addition of a very small quantity of hydrochloric acid causes flocculation and precipitation.

The graphite, even after it has been flocculated, is in so fine a state of division that when dried by evaporation *en masse* it forms a hard cake. It is self-binding, like clay, and when dried in the sun is like a black clod of clay.

This deflocculated graphite is a splendid lubricator, and may be used in place of oil. It was tested on a shaft measuring 25/16 inches in diameter, and running at 3000 revolutions per minute in a bearing 10 inches long. On the same shaft a similar bearing was lubricated with oil, and this ran much the warmer of the two. If water alone is used for lubricating, rusting ensues; no rusting takes place with deflocculated graphite. Deflocculated graphite can also be suspended in the dehydrated state in oil. The two products come on the market as "aquadag" and "oildag" (d-a-g = deflocculated Acheson graphite).

Aquadag has been found very satisfactory as a cutting compound in screw-cutting. It will be readily understood that, while preventing rust, the high specific heat of the water permits high speed of the machinery, and therefore increased output. One disadvantage of aquadag is the rapid evaporation of the water; consequently, for general lubricating purposes, oildag is of more value. For automobile lubrication, for example, oildag is stated to have proved much more efficient than oil without graphite. F. M. P.

THE FAUNA OF THE MAGELLAN REGION.[1]

IN 1892–3 Dr. W. Michaelsen conducted a zoological collecting expedition to the south end of South America, and was remarkably successful as regards booty. Descriptions of his collections began to appear in 1896, and they are now gathered together in three substantial volumes, each of several hundred pages. Dr. Michaelsen gives a lively account of his journeyings, and Prof. Dr. G. Pfeffer, of Hamburg, who persuaded some of his enlightened fellow-citizens to subsidise the expedition, refers briefly to the general bearing of the various contributions. It seems to us a matter for regret that there is no adequate summation of the results of the expedition, though we do not know what more Dr. Pfeffer could have done within the limits allotted to him. It is certainly

[1] "Ergebnisse der Hamburger Magalhaensischen Sammelreise 1802–93. Herausgegeben vom Naturhistorischen Museum zu Hamburg. Bd. i., Allgemeines, Chordonier, Echinodermen, und Cœlenteraten. Bd. ii., Arthropoden. Bd. iii., Bryozoen und Würmer. Not continuously paged; numerous plates (Hamburg: L. Friederichsen and Co., 1896–1907.)

very difficult to deal with a huge bundle of memoirs, by about forty different authorities, and bearing diverse dates from 1896 to 1907. We cannot do more than give a general indication of the contents of these volumes.

Dr. Paul Matschie reports on eight species of mammals, including a new mouse (*Acodon michaelseni*, n.sp.), and refers to a number of remarkable facts, such as the occurrence in the sub-Antarctic region of a cat (*Felis pajeros*) which closely resembles the Manul-cat of Central Asia. G. H. Martens discusses the birds, of which forty-two species were collected. He notes that 299 species (in 176 genera) are known to occur in the Antarctic and notial regions (south of a line between 42° and 43° S.), that of these 192 are confined to the western hemisphere and fifty-six to the eastern, while forty-eight are circumpolar. It is pointed out that about a third of the families of birds are represented in the southern polar region. We may direct attention to the statement that the Arctic tern is found as far south as 66°. Dr. Franz Werner describes two new iguanids from Chili—species of the genus Liolæmus—and a new batrachian, *Leptodactylus kreffti*, also Chilian. Prof. Einar Lönnberg deals with forty-six species of fishes, including *Etmopterus paessleri*, a new dog-fish. Prof. Michaelsen reports on the tunicates, describing some new forms, discussing the classification of Polyzoidæ, and showing that Paramolgula, Agnesia, Boltenia, and Synoicum are good instances of bipolar genera. The typical form of the pelagic *Fritillaria borealis* is found in the two polar regions, while other forms (*sargassi* and *intermedia*) are found in the tropics.

Prof. H. Ludwig makes an interesting comparison of Arctic and Antarctic holothurians. No Antarctic species occurs in the Arctic fauna; ten genera are represented at both poles; nine genera represented in the south are absent from the north; six genera represented in the north are absent from the south; of the ten genera represented at both poles, none is exclusively polar; two genera—Pseudopsolus and Theelia—are exclusively Antarctic; four genera—Eupyrgus, Trochoderma, Myriotrochus, and Acanthotrochus—are exclusively Arctic. It comes to this, that there is no special resemblance between Antarctic and Arctic holothurians; on the contrary, there is *great dissimilarity*. It is pointed out that ten forms showing "parental care" are now known, that six of these are peculiar to the Antarctic, and that each of the six has solved the problem in a fashion of its own. There is hermaphroditism in *Cucumaria crocea* and *Pseudopsolus macquariensis*, while in two synaptids (*Chiridota pisanii* and *Ch. contorta*) the sexes are separate. Dr. M. Meissner describes a new echinus from Gough Island, and takes a survey of the southern forms. He notes some illusory suggestions of bipolarity which he corrects later on; the fact is that there is little in common between north and south. Only one species of Antedon (*A. rhomboidea*) was obtained from the Magellan region, but Prof. Ludwig takes a survey of the known southern forms. He finds that the species of Antedon are in a general way like the northern species, but there is no bipolar species, and there are no northern counterparts of *Thaumatocrinus renovatus*, *Promachocrinus kerguelensis*, and *P. abyssorum*. In his report on the ophiuroids, Prof. Ludwig notes that although six genera occur in both polar regions, there is no bipolar species. Meissner discusses the asteroids, and notes that although fifteen genera are represented in both polar regions, there is no bipolar species. Dr. Walther May discusses the twenty-two species of alcyonarians from the Magellan region, including the three new species *Alcyonium paessleri*, *Metalcyonium patagonicum*, and *Virgularia kophameli*. Dr. Carlgren reports on the Zoantharia, describing many new species and establishing a number of new genera, Condylanthus among Antheadæ, Isotealia, a Bunodid, Parantheoides, one of the Paractidæ. There is no clear case of bipolarity of species. An interesting fresh discovery is that of numerous brood-pouches (ectodermic invaginations of the body-wall) in *Condylactis georgiana*, the first case recorded among Antarctic Actiniaria.

The reports on Arthropoda make up a thick volume. In his account of the Hemiptera, G. Breddin establishes a new family to receive a somewhat isolated type, Peloridium; H. Schouteden describes two new aphids; Prof. A. Forel discusses three new ants, which are the most southerly representatives of their race as yet recorded; E. H. Rübsaamen reports on a remarkable new Pteromalid (*Aditrochus fagicolus*, n.g. et sp.), peculiar in structure and unique in making Cynipid-like galls on the leaves of the Antarctic beech, whereas all other gall-making Pteromalids, so far as is known, attack monocotyledons (orchids and grasses). Prof. H. Kolbe uses the beetles to support the theory of a connection through the Antarctic continent between the south of South America (Archiplata) and Australia (including New Zealand). Dr. O. Staudinger discusses the Lepidoptera of the Magellan region, and describes more than a score of new species. The small collections of Trichoptera and Ephemeridæ are reported on by G. Ulmer; Prof. Fr. Klapálek describes a few new Plecoptera; Dr. F. Ris has based his report on Odonata on more material than the collection afforded, and he has been able to show the striking contrast between the Atlantic and the Pacific sides as regards their dragon-flies. Dr. C. Schäffer had a large collection of Apterygota to deal with (including twenty-two new species), and he has established five new genera. He directs attention to the presence of a large number of European forms, *e.g.* species of Achorutes, in South America.

E. Simon deals with the spiders, many of which are new. He points out that the Clubionæ and Agelenidæ form more than half the whole arachnoid fauna in the Magellan region. In connection with *Bigois antarctica*, n.sp., he refers to the occurrence of the only other species, *B. pupa*, in the Philippines, "one of the strangest facts of geographical relations, of which no adequate explanation can be suggested at present." He also reports on a couple of scorpions, a book-scorpion, and two Opiliones. The Gonyleptidæ, or Opiliones Laniatores, are dealt with by W. Sörensen, and the mites by Prof. P. Kramer, who remarks on the absence of any characteristic Magellan genera. Dr. Carl Graf Attems reports on three myriopods—apparently the first to be recorded from the Magellan region. One of them is the widespread European and North American *Scolopendrella immaculata*; the second is a new species of Scolioplanes—a genus the representatives of which are known from Europe and the East Indies; the third is nearly allied to the European and north African species of Schendyla, but is made the type of a new subgenus, Schendyloides. It is thus evident that, so far as may be judged from these three species, the Magellan myriopods have close affinities with Palæarctic forms.

Mr. T. V. Hodgson describes three new species of pycnogonids belonging to the genera Nymphon, Tanystylum, Colossendeis; Dr. Carl Zimmer deals with a new species of Neomysis and six new Cumacea. Dr. W. Weltner discusses the Cirripedia, and compares the Arctic and Antarctic forms, showing that the seven genera and the four species which are represented both in the north and the south are cosmopolitan in their distribution. Of the fresh-water ostracods described by Dr. W. Vávra, three are European and cosmopolitan, and five new species belong to widely distributed genera. The same authority deals with the fresh-water Cladocera, of which four are new. Al. Mrázek discusses the fresh-water copepods, and lays emphasis on the distinctiveness of the southern Centropagidæ, among which Parabroteas, Lovenula, and the genera centred around Boeckella are especially characteristic.

L. Calvet reports on sixty-one species of marine Bryozoa, of which three are cosmopolitan, seven occur also in Arctic seas, and three others are sub-Arctic. Of the thirty-five genera represented, no fewer than twenty-five have Arctic as well as sub-Antarctic species. Thus, as regards *genera*, there is considerable resemblance between the north and the south, but a similar resemblance exists between the tropical littoral genera and those of the north or south. There is not much resemblance between north and south as regards *species* of Bryozoa, and it cannot be said that there are in the deep sea any connecting links between the Arctic and Antarctic contingents.

Dr. W. Fischer's short report on four Gephyrea is very interesting, for he shows that the Antarctic forms of Phascolosoma are simply varieties of the Arctic *Phascolosoma margaritaceum*, Sars, that *Priapulus caudatus* is

also bipolar, and that the southern *Echiurus chilensis* and *Priapuloides australis* have their counterparts in the northern *E. unicinctus* and *P. typicus*. Prof. R. Blanchard describes six new species of leeches belonging to the genera Trachelobdella (1), Helobdella (4), and Semiscolex (1). Mr. Frank E. Beddard deals with a large number of new Oligochæta. Thus he establishes a new genus of Limicolæ, Hesperodrilus, with four species, and among Terricolæ he describes thirteen new species of Acanthodrilus and eight of Microscolex. He regards the south of South America as the headquarters of these two genera, while the Geoscolecidæ and the genera Kerria and Ocnerodrilus are as distinctively northern. The collection included eight Lumbricidæ, which are all European species, and probably imported. Dr. Michaelsen also makes a report on the Terricolæ, adding some new forms and adjusting the names of others in accordance with his system of classification. Dr. H. Ude deals with the Enchytræidæ, and points out that the genera represented in the sub-Antarctic region, *e.g.* Enchytræus, Pachydrilus, and Marionina, are familiar European or even boreal genera. This indicates the world-wide distribution of an ancient fresh-water fauna. But, curiously enough, the genus Mesenchytræus is not represented at all in the Antarctic region.

Prof. Ernst Ehlers reports on the Magellan Polychæta—eighty-five species (thirty-six new) in fifty-five genera—and gives an interesting description of the general features of the polychæt fauna, such as the strong representation of Syllidæ and Phyllodocidæ. The following species occur in the boreal and notial regions, but not in the intermediate tropical and subtropical seas:—*Nephthys longisetosa, Glycera americana, Scolecolepis vulgaris, Arenicola assimilis*, and *Notomastus latericeus*. How this "bipolarity" is to be accounted for Prof. Ehlers does not say.

Dr. von Linstow has some very remarkable facts to relate regarding nematodes. Thus *Ascaris osculata* of northern Fissipedia occurs also in exclusively Antarctic forms, and *Ascaris adunca* occurs in northern and southern fishes the habitats of which in no way overlap. From cases like these, and from the character of the free-living nematodes, von Linstow argues that in past ages the conditions of life and evolution must have been more uniform over the earth, and the occurrence of types much more widespread. Dr. O. Steinhaus points out that four species of Chætognatha are common to the far north and the far south. As to nemerteans, Prof. O. Bürger directs attention to the complete absence of Protonemertini from southern waters, and to the occurrence of *Carinoma patagonica* in the Straits of Magellan—its only known congener being the rare *C. armandi* of the British coast. He thinks that the resemblance of the boreal and notial nemerteans is undeniable, so long as we fix our attention on genera.

Prof. Lönnberg remarks on the close resemblance between three southern cestodes and Scandinavian species. It is the similarity of host that counts. The northern host of *Bothridiotaenia crostris* is a gull or a fulmar; the southern host of the same is a penguin. Prof. Max Braun establishes a new genus of trematode, Lophocotyle, which ranks among the Monocotylidæ; Dr. Rudolf von Ritter-Záhony establishes two new genera of polyclads; and Prof. L. Böhmig describes three new rhabdocœlids and five new triclads.

It should be noted that most of the authors have increased the value of their contributions by including in their survey all the forms recorded from the Magellan region. As regards the question of "bipolar" distribution, to which most of them refer, the impression left on a reader's mind is that it is very difficult to generalise. It appears that the state of affairs differs in regard to different sets of animals. In some cases, *e.g.* holothurians, the dissimilarity of boreal and notial forms is more striking than the resemblance; in other cases, *e.g.* Bryozoa, there is a marked resemblance as to the genera represented at the two poles, but this does not extend to any identity of species; in a few cases, *e.g.* Gephyrea, the same species occur north and south, but some of the instances of this kind have to be discounted when the species in question (*e.g.* of Cirripedia) are cosmopolitan.

BOTANY AT THE BRITISH ASSOCIATION.

THE proceedings of Section K at Dublin, under the presidency of Dr. F. F. Blackman, were rather above than below the average standard of quality, and were characterised by more homogeneity than is usually the case, a large proportion of the papers dealing with certain aspects of physiological botany. Several of these dealt with those fields of investigation in which progress at present consists in the application of physico-chemical principles and quantitative methods to the experimental analysis of complex physiological phenomena into their component processes and factors.

The presidential address (NATURE, October 1, vol. lxxviii., p. 556), which was entitled "The Manifestations of the Principles of Chemical Mechanics in the Living Plant," dealt with this aspect of physiology, and urged the view that in some cases the internal metabolic changes of the organism which follow external changes should be regarded, not as reactions of protoplasm to stimulation, but as inevitable alterations of metabolic reaction-velocity.

Physiological Papers.

The death of individual cells as brought about by chemical poisons or high temperatures is a complex phenomenon, the experimental quantitative investigation of which leads to important biological conceptions. Two papers were communicated on this subject after the delivery of the presidential address. The first, by Miss Harriette Chick, dealt with the death-rate of bacteria under the action of disinfectants. When a crowd of similar bacteria are treated with any disinfectant they die off at such a rate that the "number surviving" after successive intervals of time fall into a logarithmic curve. The process of killing is thus continuous, and there is no definite time of exposure which can be said to be fatal. The killing goes on in a way that recalls the progress of a monomolecular reaction according to the "law of mass." It is shown that the different times of resistance of the bacteria are not due to permanent differences between the individuals, but that these differences are temporary and possibly phasic. Viewed in this way, the rate of killing is a phenomenon of reaction-velocity, and it is found that increase of temperature accelerates the reaction-velocity of disinfection just as it does that of a chemical reaction.

This paper was followed by one by Miss Nora Darwin and Dr. F. F. Blackman, dealing with the death-rate of cells of higher plants in fatal conditions. When it is realised that bacteria die off logarithmically under uniform unfavourable conditions, it becomes at once interesting to determine whether the cells of a tissue of a higher plant die in the same independent way, or whether their closer protoplasmic connection leads to their behaving all alike. Experiments on this point are being carried out with strips of potato, fuchsia stamens, and other organs, using the shortening of the tissue resulting from loss of cell-turgor on death as an indication of the progress of the death-rate. An optical lever was used to record the shortening, and submersion in hot water as the fatal condition. The cells of the tissue appear to behave like a number of bacteria, and to die off progressively and logarithmically, but this interpretation has yet to be firmly established. Seeds submerged in water at 42° C. to 50° C. exhibit clearly a logarithmic death-rate.

Other physiological papers were communicated on Thursday by Prof. H. H. Dixon, on the influence of living cells on the transpiration current, and by Prof. Bose, on the mechanical and electrical responses of plants. Prof. Dixon described experiments to show that there is no evidence of vital activity as a contributory factor in raising the transpiration current in a branch. The rate of transmission of water in a branch from above downwards was found to be the same before and after killing by steam or picric acid. The fading of leaves on a steam-killed branch is shown to be directly due to a poison liberated into the transpiration current by the dead cells, and is not to be taken as evidence that some preexisting vital raising force has been extinguished by the killing.

Prof. Bose gave a summary of his views on plant-responses as expounded in his recent books. His paper was

illustrated by experiments with the ingenious apparatus devised by him for investigating the mechanical and electrical responses universally exhibited by plants on stimulation.

Friday morning was occupied with a series of five papers on photosynthesis by workers at Cambridge. The president gave an introductory paper on photochemical action in the test-tube and the leaf, which consisted of a short account of the quantitative laws governing such chemical changes *in vitro*, followed by an inquiry as to how far the conditions under which photolysis of CO_2 takes place in the leaf would allow these laws to come into action.

Mr. Thoday then read a paper on increase in dry weight as a measure of assimilation. This is the first critical examination of Sachs's classical method, with the object of directly determining the nature and magnitude of possible errors that the procedure involves. Many investigators have used it confidingly, but recently it has been suggested that the method gives uniformly too high results, possibly due to fixation of water in the cell during insolation, in addition to the formation of carbohydrates. Mr. Thoday has proved that there is no such fixation of water by finding that organic analysis of the increased carbon content makes it clear that practically the whole increase of dry weight may be reckoned as carbohydrate. Further, it is shown that the excessively high values sometimes obtained are really due to another cause, namely, to shrinkage of the leaf-surface by transpiration. Records were exhibited showing that an attacked leaf of sun-flower fluctuates in area to the extent of 5 per cent. in the course of a few hours, shrinking during periods of insolation, recovering when passing clouds check the rate of transpiration.

Following this Mr. A. M. Smith gave an account of his work on the factors influencing photosynthesis in water plants. This work was carried out with an apparatus designed by Dr. F. F. Blackman, in which a complete knowledge of the whole amount of assimilation is obtained by combining an analysis of the bubbles given off by the assimilating plant with an estimation of the diminution in CO_2 content of the water flowing over the plant.

The magnitude of assimilation in relation to the amount of dissolved CO_2 in the surrounding water was first investigated, and it was found that the assimilation varied proportionally with the CO_2 supply until the limit set by the temperature or light intensity (in the particular conditions of experiment) was reached. No indication of an optimum CO_2 content was found, and assimilation only begins to be depressed when the water is one-third saturated with CO_2.

It was further shown that aquatic flowering plants possessing an "internal atmosphere" can work up a greater proportion of the CO_2 supply than an aquatic moss (Fontinalis) which has no "internal atmosphere."

Mr. Parkin communicated a paper on the carbohydrates of the snowdrop leaf and their bearing on the first sugar of photosynthesis. The work of Brown and Morris in 1893 on the carbohydrates of the leaf of Tropæolum brought forward the new view that sucrose rather than glucose plays the important part in the "up-grade" sugars of the foliage leaf. In that leaf the sugar metabolism is complicated by the fact that starch is abundantly present, and from it glucose could arise by hydrolysis. In the snowdrop starch never occurs, so that this leaf is a simpler case for investigation. Sucrose, levulose, and dextrose were found in abundance, and the fluctuations in their relative amounts followed. With increasing assimilation the sucrose steadily increases, while the amounts of levulose and dextrose remain fairly constant. This is interpreted as favouring the view that sucrose is directly formed in photosynthesis and that the hexoses are formed from it by hydrolysis.

This view falls more into line with the conception that the first sugar is split off from a complex protein aggregate than with Baeyer's view of progressive condensation from formaldehyde.

A paper by Mr. J. M. F. Drummond on the time factor in assimilation was communicated by the president. Experiments were made on the amount of assimilation taking place in cut-off leaves in a chamber lighted by artificial light continuously for several days. After a time the power of assimilation diminishes, and the object of the work was to find the precise explanation of this result. It was proved that part of this diminution is due to accumulation of the products of assimilation in the leaf, and that the power of assimilation is regained after the leaf has been kept in the dark for a period and has diminished its carbohydrate stores by vigorous respiration. A second cause of diminished assimilation is the shutting of the stomata by the high general turgor of the epidermis brought about by the high sugar content of the sap. This factor can be recognised by the increased assimilation which immediately follows incisions into the leaf or the application of dry air. The effect of stomatal closure can be overcome by increasing the CO_2 supply in the air current through the chamber.

Ecological Papers.

Friday afternoon was occupied by two papers on the woodlands of England, by Mr. Tansley and Dr. Moss respectively. Mr. Tansley devoted the first portion of his paper to an attempt to show that the great majority of English woodlands are actually derived from natural woods, and retain enough of their primitive character to be treated as natural or semi-natural plant associations. He went on to distinguish four great types of natural English woodland, determined by soil characters—the oak type, the oak-birch-heath type, the ash type, and the beech type—and to explain the distribution, character, composition, and principal subtypes of each of these.

Dr. Moss, agreeing with Mr. Tansley's main scheme of classification, dealt especially with the woods of the Pennines, on which he distinguished upland oak (*Quercus sessiliflora*) and birch woods, with transitions between them. These, which occur on siliceous soils, he regarded as differentiations of the oak-birch-heath type, according to the factor of altitude. Opposed to these, and of essentially different character, are the woods belonging to the ash type, which occur on the mountain limestone of that region. The woods of the lowlands of northern England agree ecologically with those of the south, but the beech type is entirely absent.

Prof. R. H. Yapp gave an account of his observations on the evaporating power of the air in different strata of the marsh formation of Wicken Fen. The average evaporation in the free air above the tallest plants is about 1·7 times that in the layer immediately below the tops of the tallest plants, and 6·8 times that in a stratum 18 inches below the surface of the vegetation and just above the soil-level.

Morphological and Palaeobotanical Papers.

On Tuesday morning Mr. W. C. Worsdell read a paper on the origin of dicotyledons, in which he based his view of the phylogeny of this group on the doctrine of "anaphytosis," or the building up of the plant body from a colony of distinct individuals or "phytons," budding one from another as the stem grows in length. He held that the facts of embryogeny in vascular plants are entirely opposed to the ordinary view that the plant primarily consists of a single shoot bearing leaves as lateral appendages. The primary individual of the colony of phytons, as represented by the embryo of the higher plant, is phylogenetically derived from the bryophytic sporogonium, of which the capsule, seta, and foot correspond with the primary phyllome, caulome, and root of the vascular plant. The facts of embryonic segmentation and the dominance of the cotyledonary organs were cited as being opposed to the monaxial view, in which the stem is regarded as the dominant organ and the leaves as appendages. From this position the author deduced the primitiveness of the monocotyledonous type with its terminal cotyledon, which must have preceded the dicotyledonous type, in opposition to Miss Sargant's theory of the derivation of the monocotyledonous from the dicotyledonous type by fusion of the two cotyledons. Anatomical evidence was adduced to show that the scattered bundle arrangement of monocotyledons is primitive, and that vestiges of this arrangement are found in many dicotyledons. The absence of anatomical evidence in seedlings pointing to such a conclusion was attributed to space-relationships. Finally, pleiomery of the flower was recognised as primitive, and the prevailing trimery of monocotyledons as reduced from such a condition. Mr. Worsdell's views were criticised, mainly from a hostile standpoint,

by Miss E. N. Thomas, Mr. Parkin, Prof. Bower, and others.

Prof. H. H. W. Pearson, of Cape Town, contributed a note on the morphology of endosperm, in which he described the development of the endosperm in Welwitschia and discussed the homologies of this tissue with the endosperm in the angiospermous embryo-sac. At an early stage of development of the endosperm of Welwitschia all the cells are multinucleate, while at a later stage each cell has a single nucleus (Pearson, Phil. Trans. R. Soc., 1906). An examination of material collected in 1907 showed that the latter condition is brought about by the fusion of nuclei in the cells of the young endosperm. The original nucleus of an embryo-sac produces by repeated division rather more than 1000 nuclei; the sac then elongates, and the free nuclei are re-distributed, with the result that two regions are differentiated, a micropylar region with scattered nuclei and a lower region with more crowded nuclei. The sac is next divided into compartments, those at the micropylar end having two to six, and the others usually twelve or more nuclei. The compartments containing more than six nuclei are converted by nuclear fusion into uninucleate cells; the nuclei in the micropylar compartments remain free, and the wall of each "cell" grows upwards into an embryo-sac tube ("prothallial tube"), into which pass the nuclei and cytoplasm; these nuclei are functional gametes. The conclusion is that the endosperm of Welwitschia represents a new organism, which it is proposed to call the *trophophyte*, intercalated in the life-cycle, belonging neither to the sporophyte nor to the gametophyte. It is the opinion of the author that the trophophyte of Welwitschia is phylogenetically related to the endosperm of angiosperms.

On Tuesday Prof. Weiss read a paper on the primary wood of Lepidodendron and Stigmaria. A new Stigmaria was described in which the xylem of the stele consists of a central strand of long, narrow, protoxylem-like elements mixed with parenchyma, surrounded by normal centrifugal secondary wood. This type of stele was compared with that of *Selaginella spinosa* and of the "hypocotyl" of *S. Kraussiana*, and also with that of *Lepidodendron selaginoides*. The general relations of the steles of the Lepidodendreæ were discussed.

Mr. H. H. Thomas communicated a paper by Mr. Newell Arber and himself on the structure of *Sigillaria scutellata*, Brongn. This was the first full account of the structure of a Sigillarian stem of the Rhytidolepis type. The primary xylem of the stele forms a continuous ring of scalariform tracheids surrounding the medulla. Secondary xylem is also present. The characteristic external ribs are really formed of cortical tissue, not of fused leaf-bases, and are largely composed of phellodern. A ligule in its pit was demonstrated for the first time. The leaf-trace in the leaf-base contains a double xylem strand with widely separated xylem groups of the Sigillariopsis type.

Mrs. D. H. Scott described some curious spindle-shaped bodies in Burntisland material, naming them *Bensonites fusiformis*. She inclined to the view that they are glandular structures belonging to *Stauropteris burntislandica*, with which they are associated. A sporangium of this species was found to contain germinating spores.

Miscellaneous Papers.

On Thursday Colonel H. E. Rawson contributed a striking account of colour changes in flowers produced by controlling insolation. He has found that by shading various plants (such as nasturtiums) from the direct rays of the sun during certain hours of the day the colours of the flowers produced are changed from scarlet and orange to mauve, and in other cases to deep carmine. The variations thus produced breed true, both from cuttings and seeds. In other instances bronze, old-gold, rose-salmon, and sallow flesh-coloured flowers have been produced by similar means. Dahlias and other flowers appear to be as susceptible as nasturtiums to this treatment.

Mr. W. L. Balls contributed two papers on the mechanism of mitosis and on the natural crossing of the cotton plant.

Mrs. D. H. Scott read a paper on the contractile roots of the aroid *Sauromatum guttatum*, in which she showed that if the tuber of this plant is planted on the surface of the soil it throws out leaves and subsequently disappears below the surface, and in two months' time is found at a depth of 6 inches. The descent is caused by the thick fleshy roots sent out from the upper surface of the tuber, which firmly attach themselves to various objects in the soil, and then contract to about half their original length, pulling the tuber down. Later on these contractile roots are cut off from the tuber by regular alseris layers. If the tuber is replaced on the surface it sends out a fresh set of contractile roots, and is again pulled down to the normal depth.

Mr. M. Wilson contributed notes on the life-history of *Haematococcus lacustris*, in which he described the results of various culture experiments on this species. The red cells were found to be produced in starved liquid cultures, and to be alone capable of withstanding the effects of drying. Dr. Lotsy contributed an interesting paper on the segregation of characters of a perfectly fertile species-hybrid.

Mr. Harold Wager made a contribution on the optical behaviour of the epidermal cells of leaves. He discussed Haberlandt's theory that the convergence of light rays brought about by the lens structure formed by the papillæ of the epidermal cells of many leaves brings about a differential illumination of the protoplasm on the basal wall, and thus creates a stimulus which results in the appropriate orientation of the leaf to the incident light. It was pointed out that the objection to this theory, based on the absence of epidermal lens papillæ from heliotropically sensitive grass-seedlings, may be met by the fact that the epidermal cells of the first (sheathing) leaf and of the young leaves enclosed in the sheath do actually cause convergence of light rays in spite of the absence of papillæ. In the author's opinion too little attention has been paid to the view that the lens structures in question may be concerned with the more efficient illumination of the chloroplasts. It is also possible that the structures in question are accidental, and not to be regarded as adaptations, since they also occur on the lower epidermis of various leaves, on the epidermis of some petals, and in the fungus Russula. Mr. Wager exhibited well-defined photographs of various objects made through these epidermal lenses.

Monday morning was devoted to a joint discussion with Section D on the determination of sex. This is reported in the article on "Zoology at the British Association" (NATURE, October 22, vol. lxxviii., p. 647).

Members of Section K were fortunate in being able to meet in Prof. H. H. Dixon's beautiful new botanical institute at Trinity College, where everything was arranged for their comfort and convenience.

The sectional excursion was held on the Saturday to the Murrough of Wicklow, a long stretch of shingle beach backed by marsh, under the leadership of Mr. R. Lloyd Praeger.

MR. LLOYD GEORGE ON THE ENDOWMENT OF UNIVERSITIES.

ON November 13 the University of Wales conferred the degree of Doctor of Laws, *honoris causa*, on Mr. Lloyd George. At the complimentary banquet given by the University College of North Wales, Lord Kenyon announced a donation of 1000*l.* from Sir Herbert Roberts to the college building fund. In replying to the toast in his honour, Dr. Lloyd George alluded to the sacrifices the Welsh people have made in building up their system of higher education, and pointed out that the University of Wales has entirely altered the status of the Welsh people. It would be the worst thing for the Government to take the task entirely out of their hands, but the time has arrived for the Government to render further assistance, and one great need of the colleges is a very commonplace one—cash. Further assistance of a substantial character would make a vast difference in the immediate prospects. One of the ablest committees has investigated the claims of the Welsh colleges, and the conclusions arrived at are very favourable. The committee indicated several directions in which more could be done if the colleges had more money.

Dr. Lloyd George had to consider the report of the committee, and it was his duty as Chancellor of the

Exchequer, viewing the circumstances of Wales, Ireland, England, and Scotland, to make a very substantial contribution to the funds of the University. The building fund of the college at Bangor has already received a Treasury grant (20,000*l.*), and it is the duty of the people of North Wales to complete that work; but in regard to what has been said about raising the status and improving the staff and equipment of the college, Dr. Lloyd George fully approved of every word. One of the first things will be to increase the salaries of those who have devoted their ability to establishing and maintaining higher education in Wales. It cannot be expected that the services of the best men will be secured at the present inadequate salaries. The sacrifices made by those who have remained on in spite of better inducements elsewhere are appreciated, but the time has come to recognise the fact that if a first-rate staff is wanted it must be made worth while for the members of the staff to remain. At present the professors too often do work which ought to be relegated to tutors.

Turning to the question of research, Dr. Lloyd George pointed out that what is wanted is not only teachers, but also explorers. Science has its dark continents, unlimited continents—mapless, unlimited oceans—chartless. He would believe in the triumph of Welsh education when he could see sheets that are now mere outlines crowded with the discoveries of Welsh explorers. The greatest universities are, however, not the product of thirty years. There should be closer contact between the universities and the Welsh industries. Germany has said, "You must have a university to teach and to educate and to develop the German mind," and now the effect is seen in the German industries.

Dr. Lloyd George went into one of the largest workshops in Germany three months ago, and was taken round by a professor. He asked what a professor had to do with it, and was told "The professors are our experts." The Germans get their ideas from their professors. We in this country heave coal and blast rocks, but the great industries that finish these products are elsewhere. We must start as discoverers. All this is coming. Bangor has two factories, one in the lower town and one new factory the buildings of which are beginning to rise in Upper Bangor, while in Cardiff, also, new buildings have been erected for the University College, which, however, are not nearly so fine and imposing as the municipal buildings. These are the factories where the future of the country is being forged. There is no investment that will produce such a return, not to the investor, but to generations to come, as the endowment of higher education. The Chancellor of the Exchequer further referred to what has been done in the past by the people of Wales, the need of private as well as public support, and the future prospects of the University. G. H. B.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. J. M. Dobbs has been appointed chairman of the examiners for part i. of the mathematical tripos, 1909 (old regulations), and Mr. Fitzpatrick chairman of the examiners for the natural sciences tripos, 1909.

The general board of studies has approved for the degree of Doctor in Science Prof. W. W. Watts, F.R.S., and Prof. T. J. I'A. Bromwich, F.R.S.

The general board of studies will shortly proceed to the appointment of a university lecturer in zoology. Candidates are requested to send their applications, with testimonials if they think fit, to the Vice-Chancellor on or before December 2.

Mr. A. Wood has been appointed demonstrator of experimental physics.

LONDON.—The Senate of the University has awarded the Rogers prize of 100*l.* for original research in medical science to be divided equally between Dr. David Forsyth, assistant physician to Charing Cross Hospital, and Mr. F. W. Twort, assistant bacteriologist to the London Hospital.

MANCHESTER.—The completion of the new buildings of the Manchester Royal Infirmary, in close proximity to the University, has already led to a marked increase in the number of students entering for courses in the medical school. The new hospital, which is to be formally opened next year by His Majesty the King, is to be occupied by the end of the present month.

The new buildings of the engineering department are making rapid progress, and a portion is already in use. The extension of the chemical laboratories has also been commenced; the additional accommodation, which will cost from 15,000*l.* to 20,000*l.*, will be primarily devoted to the increasing requirements of research in organic chemistry.

The establishment of a new chair in botany, for which an endowment was received some months ago, is in contemplation.

The Court has resolved to recognise the Harris Institute, Preston, as a privileged institution, attendance at courses in mathematics, physics, and chemistry being accepted as satisfying the attendance requirements for the Inter. B.Sc. and Inter. B.Sc. Tech. courses.

Up to October 30 the number of students who have entered for courses of study in the University is 1320, against 1219 a year previously.

DR. GEORGE DEAN, chief bacteriologist at the Lister Institute of Preventive Medicine, has been appointed to succeed Prof. D. J. Hamilton in the chair of pathology in the University of Aberdeen.

MR. G. H. KENRICK, Lord Mayor of Birmingham, has made a gift of 10,000*l.* towards the funds of Birmingham University. This is his third contribution toward the development of the University, his total gifts amounting to a sum of 25,000*l.*

MR. H. G. WELLS will preside at the first annual dinner of old students of the Royal College of Science, to be held at the Criterion Restaurant, Piccadilly Circus, on Wednesday, December 9. Dinner tickets, price 7*s.* 6*d.*, may be obtained from the honorary secretary of the dinner committee, Mr. T. L. Humberstone, 3 Selwood Place, Onslow Gardens, London, S.W. It is hoped that the dinner will lead to the formation of an association of old students of the college.

PROF. PERRY has again sent us the balance-sheet referring to bursaries distributed by him to students at the Royal College of Science, South Kensington, during the two sessions 1906–7 and 1907–8. The fund for these bursaries represents a response to an appeal made by Prof. Perry for the means to assist deserving students at the college with secret gifts when necessary, it being understood that every student who receives such assistance shall repay the money to the fund when in a position to do so. Among the contributions to the fund are 100*l.* each from the Drapers', Goldsmiths' and Skinners' Companies, and 50*l.* from the Clothworkers' Company. As a number of students at the college have to maintain themselves and purchase their books and instruments out of scholarships having a value of about 17*s.* 9*d.* a week each, the institution by Prof. Perry of a system of small bursaries privately bestowed has provided a means of preventing unnecessary privation without injuring the self-respect of the recipients.

A COMMON criticism of the methods of teaching science adopted in schools for girls is that they are too academic and have little or no bearing upon the duties the girls will be called upon to perform in after life. This weakness is, we are glad to know, becoming less common, and earnest efforts are being made in several centres to arrange courses of work in which elementary science and the home arts are taught together, the latter being treated largely as applications of the former. In a recent address to the Teachers' Guild, Mr. John Wilson, president of the Association of Technical Institutions, dealt exhaustively with the methods by which science can be connected with domestic training. His address is printed in *Education* for November 6 last. Mr. Wilson is of opinion that, ideally, the teacher should be a woman, thoroughly well skilled in chemistry and physics, &c., and a first-class diplomée in cookery, laundry work, and housewifery. At

present such women cannot be obtained. Referring to students undergoing training with the view of teaching home arts scientifically, he said the main difficulties the instructors of these students have to contend with are that, even at this late date, a number of the students have not had any previous scientific training at the secondary school. Many of the students *will* keep their minds in water-tight compartments. To them, the science work is one thing, the domestic subjects another, and between the two they draw no connections; and, greatest of all, to develop the subject logically we have to work in the laboratory from the simple to the complex.

LORD ROSEBERY, Chancellor of the University of London, in opening University College Hall, Ealing, on Tuesday, made some remarks upon the functions of a university. The hall provides a place of residence for students at the college. In declaring the building open, Lord Rosebery said it marked another milestone on that path of university development which seemed to open broader and with more promise at every step. First, the University of London was a purely examining university, then it developed into a teaching university, and now it is a university with some of the old collegiate aspects as well. The University is no longer, if it ever was, a purely London university; it is more and more developing into an imperial university. Each day sees it summoning from every part of Great Britain and of the British Empire students anxious to obtain the advantages of its constituent schools. A university should comprehend everything that is wholesome and valuable for the development of brain and of character. The hall now opened is one of the many symptoms of the growth of corporate life in the University. University associations of various kinds are growing up, and it is obviously a very thin-blooded, one-sided university that only provides for the intellect of its students. Human sympathy, human contact, all the valuable human elements that go to build up character are required, for a university which produces nothing but brain and neglects the formation of character is no university at all. The function of a university is not merely to pump knowledge into units by teaching and to extract it afterwards by examination, but to produce living men, who are going to take a part in the vast fabric of society within these islands.

THROUGH the generosity of Mr. Edric Bayley, who gave a sum of 5000*l.* to the building extensions, and by a large supplementary sum given by the County Council, a considerable extension has been made at the Borough Polytechnic Institute. It consists, in the first place, of a large examination hall, which can also be used for entertainments and public meetings, and below this hall new laboratories and class-rooms have been built. A very complete laboratory for oil and colour work is one of the most striking of the additions. This has accommodation for forty students, besides the lecture theatre, balance room, and laboratory; there is also a portion set apart for colour mixing and for grinding of colours, so that, besides working on the test-tube scale in the laboratory, the students can work on a semi-commercial scale. There is also an extension to the bakery department and a new book-binding workshop. The opening ceremony took place on Friday evening, November 13, when Lord Carrington, in a short speech, declared the buildings open. He referred to the fact that when he was at school, although the fees were high, they learnt very little except Latin and Greek. Science and laboratory equipment were absolutely unknown, and now in London, and also in the provinces, the highest scientific training can be obtained almost for the asking. He thought that the nation owed a very great debt of gratitude to public supporting men like Mr. Bayley, who made it possible for education to be placed within the reach of even the poorest. The chairman, Mr. Spicer, in his opening remarks said that the governing body will be well repaid for any trouble they have taken by the stimulus given to the work of the institute by the erection of these new buildings. Sir Philip Magnus, chairman of the education committee of the institute, said that the governors have always resisted the temptation to use the institute as a place for obtaining degrees, as it was founded to give education to the artisan classes, and they have always kept this object in view in any alterations or extensions. The trade classes are particularly fostered in the institute. Mr. Robinson, chairman of the London County Council, expressed his pleasure at being present, and said that the County Council, before it gives money, always wishes to know whether it gets value for money, and there is no doubt that in giving to an institute of this kind value is obtained.

THERE has been in recent years a serious decline in the number of pupils studying German in the secondary schools throughout the country. It is true that many subjects clamour for increased attention and others for recognition in the curriculum of these schools, while the number of hours available for instruction is limited. Headmasters find it difficult nicely to adjudicate between the conflicting claims; but from the point of view of the man of science and of the needs of great commercial houses the claims of German to generous recognition seem very strong. We are glad, therefore, to notice that a letter on the subject, signed by representatives of the Modern Language Association, the London Chamber of Commerce Education Committee, the Society of University Teachers of German, the Teachers' Guild, and the British Science Guild has been sent to the President of the Board of Education urging the paramount importance of encouraging the study of German in secondary schools. The letter points out that there is much to do if the unfortunate decay of German teaching is to be checked, and it proceeds:—"We therefore venture to suggest that your Board should consider the desirability of calling the attention of educational authorities, governing bodies, and the principals of secondary schools to the steady decline in the study of German, and should, by means of a circular, as in the case of Latin, or such other method as may be thought fit, submit to those authorities and to the public generally the many weighty and urgent reasons for regarding an acquaintance with German as being of the first importance to great numbers of young men and women, and a widespread knowledge of the language a national necessity. We would urge, moreover, that the Board should encourage and foster schools of the type of the German Realschule and Oberrealschule, in which two modern languages, but not Latin, are taught. The latter of these in Prussia ranks in standing with the Gymnasium, and its leaving certificate confers the same rights. Of schools devoting special attention to modern, as against classical, languages, there are at present in this country very few. Lastly, we would suggest that it should, as a general rule, be required that schools should make provision for the teaching of German to those pupils who wish to learn it, as it is now required that provision should be made for the teaching of Latin."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—"Transparent Silver and Other Metallic Films." By Prof. Thomas **Turner.**

In a Bakerian lecture, delivered fifty-one years ago, Faraday showed that thin sheets of gold or silver, if mounted on glass and heated, became transparent. Beilby has also studied the annealing of gold-leaf and wire. The present research deals with a study of the conditions under which gold and silver become transparent, and extends the inquiry to copper and to certain other metals. It is shown that gold when about 1/300,000th of an inch in thickness becomes transparent if heated to 550° C. for a few moments. The effect is the same whether the atmosphere be oxidising or reducing, and if the supporting medium be changed. Transparency is due to the gold aggregating, and permitting white light to pass through the intermediate spaces.

In the case of silver the effect is quite different. No transparency is obtained with sheets about 1/120,000th of an inch in thickness so long as the atmosphere is a reducing one, such as hydrogen or coal gas. In air, however, transparency begins at about 240°, and is complete in a few moments at 390°. White light is now transmitted, and the transparency is remarkably complete. Transparent silver does not become opaque if heated in a reducing atmosphere, but it can be converted into the

opaque variety by burnishing, as in writing on the surface of the glass with an agate stylo. The change does not take place if silver-leaf be heated *in vacuo*, but it occurs readily with one-fiftieth of an atmosphere of oxygen. The silver does not increase in weight or the oxygen alter in volume, though oxygen appears to be necessary in order to produce the change. It is suggested that an oxide of silver may be momentarily formed and again decomposed by heat in the presence of more oxygen. The thinnest rolled metal obtainable, about 1/3000th of an inch thick, does not become transparent. Intermediate thicknesses have yet to be examined.

Thin sheet copper, about 1/75,000th of an inch in thickness, remains opaque when heated in a reducing atmosphere. In air or oxygen, however, it becomes transparent if heated for a suitable time at temperatures between about 200° and 400° C. At the lower temperatures the transparency is very marked, and the light transmitted is a brilliant emerald-green. As the temperature rises further oxidation takes place, and the colour gradually passes through olive and dark red to black. If the light-green transparent metal be treated with a diluted acid, metallic copper with a brilliant metallic lustre is obtained, while the green transparency disappears. The effect is due to oxidation, as the copper absorbs oxygen continuously during the heating.

Aluminium and Dutch metal do not appear to become transparent, nor have transparent films yet been obtained from sulphides. It is suggested that transparent films such as have now been obtained from copper are formed in all cases where a succession of spectrum colours are obtained on heating a metal in air.

Royal Microscopical Society, October 21.—Dr. J. W. H. Eyre, vice-president, in the chair.—The mouth-parts of the Nemocera, and their relation to the other families in Diptera—with corrections and additions to the paper published in 1904: W. **Wesché**.—(1) The resolution of periodic structures; (2) an auxiliary illuminating lens: E. M. **Nelson**.—*Micrococcus melitensis*: A. A. C. E. **Merlin** and E. M. **Nelson**.

Physical Society, October 23.—The meeting was held at the National Physical Laboratory, Bushy House, Teddington, by invitation of the director. All departments of the laboratory were thrown open for inspection, and, in addition, a number of special demonstrations were arranged.

Society of Chemical Industry, November 2.—Dr. Lewkowitsch in the chair.—Chemical industry in relation to agriculture: Prof. A. **Frank**. After referring to the great services of Liebig to agriculture, the author gave an historical survey of the manufacture and agricultural uses of phosphates, and the production of potash. Ammonium sulphate, Chile saltpetre, and the utilisation of atmospheric nitrogen were also discussed, and an account was given of the author's own work in effecting the combination of atmospheric nitrogen with carbides of the alkalis and the alkaline earths. By decomposing the calcium cyanamide with water under high pressure ammonium salts are formed. Possibilities of calcium cyanamide as a fertiliser are dealt with, and some statistics relating to the output of calcium carbide are included. The work of Mond on the simultaneous production of power gas has made it possible to utilise the large stores of energy accumulated in bog areas in the form of peat. The author and Caro, with the assistance of Mond, have been able to gasify peat containing 50 per cent. to 55 per cent. of water without difficulty.

Zoological Society, November 3.—Mr. Frederick Gillett, vice-president, in the chair.—Mammals from Inkerman, near Townsville, North Queensland, collected by Mr. W. Stalker and presented to the National Museum by Sir William Ingram, Bart., and the Hon. John Forrest: Oldfield **Thomas** and Guy **Dollman**. The collection showed clearly that the Townsville region belonged faunistically to North Australia, the species being nearly identical with those of New South Wales and Victoria. Several species and subspecies were described as new.—(1) Takins from Sze-chuen and Bhutan; (2) An Indian dolphin and porpoise: R. **Lydekker**.

PARIS.

Academy of Sciences, November 9.—M. Bouchard in the chair.—The president announced to the academy the death of M. A. Ditte.—The products of the reaction of sodium amide on ketones: A. **Haller** and Ed. **Bauer**. Benzophenone, treated in benzene or toluene solution with sodium amide, if the materials are perfectly free from moisture, gives the compound $C_6H_5C(ONa)(C_6H_5)(NH_2)$, and this on treatment with water regenerates the benzophenone, together with ammonia and caustic soda. In presence of a trace of water a different reaction takes place, and the addition of water to the reaction product gives benzene, benzamide, and caustic soda. This reaction appears to be general with the aromatic ketones, anthraquinone being an exception.—The mode of formation of the Puy de Dôme and the rocks which constitute it: A. **Lacroix**. A detailed examination of the structure of the Puy de Dôme shows that it is comparable, not with Mt. Pelée, but with Guadeloupe. Each of the domes, forming the chain of the Puys, has a distinct history requiring separate examination.—M. Henneguy was elected a member of the section of anatomy and zoology in the place of the late M. A. Giard.—Physical observations of the comet 1908*c*, made at the Observatory of Lyons: J. **Guillaume**. A detailed account of the numerous changes in the appearance of the nucleus and tail of this comet observed between September 5 and October 20.—The use of compasses of great magnetic moment: Louis **Dunoyer**. A discussion of the theory of the correction of compasses of great magnetic moment (2000 to 5000 C.G.S. units). The formulæ developed have been submitted to an experimental control.—The geometrical applications of certain remarkable movements: J. **Haag**.—The formation of centres of gyration behind an obstacle in motion: Henri **Bénard**. The vortices produced behind a cylinder moving in a liquid with a uniform velocity were studied by means of kinematographic methods. The vortices were spaced at equal distances behind the moving body, this equidistance being found to be independent of the velocity, but increasing in the same direction as the viscosity of the liquid.—The ionisation of phosphorus and phosphorescence: Léon and Eugène **Bloch**. Experiments are described proving that phosphorescence, ionisation, and ozone are all produced in the same region. This region can be completely separated from the phosphorus if the velocity of the air current is increased above a certain limit, and it is possible to separate this region several metres from the phosphorus. These facts indicate that the phosphorescence, ionisation, and the ozone are not produced by the direct oxidation of the solid phosphorus, but by the oxidation of a substance emanating from the phosphorus and carried off by the gaseous current. This substance is most probably phosphorus anhydride.—The radio-activity of the gases from the thermal water of Uriage (Isère): G. **Massol**. The gases escaping from the water have a radio-activity only one-fourth of that of the gases remaining dissolved in the water. This emanation evaporates at the same time as the water; the saline residue from a half-litre of the water evaporated on the water bath was completely inactive.—The polarisation of the living man submitted to the action of the continuous current: M. **Chanoz**.—The radio-activity of the waters of Uriage-les-Bains (Isère): Paul **Besson**.—Contribution to the study of lenses: C. **Maltézos**.—A monotelephone with a note capable of regulation: A. **Blondel**. The apparatus is less sensitive than that recently described by M. Abraham, but possesses the advantage of being less easily broken.—The reaction of the ether on matter as the cause of universal attraction: O. **Keller**.—The true atomic weight of silver according to the experiments of Stas: Louis **Dubreuil**. The author has applied the method developed by him in a previous paper to the experiments of Stas on the atomic weight of silver. The general mean arrived at is 107·9021, or practically 108.—The alloys of silicon and silver: G. **Arrivaut**. The current views regarding the existence of a silicide of silver are divergent, Wöhler, Warren, and Chalmot regarding the existence as proved, Percy, Moissan, and Vigouroux holding the opposite opinion. The author has determined the melting points both of the first crystallisation and the eutectic of a series of mixtures of silver and silicon. The results do not sup-

port the view of the formation of a definite compound of the two elements.—The identity of ilicic alcohol with α-amyrine: E. **Jungfleisch** and H. **Leroux.** Ilicic alcohol was isolated by J. Personne from birdlime, and was regarded by him as an alcohol of the formula $C_{25}H_{44}O$. This alcohol is completely identified by the authors as identical with α-amyrine, an alcohol met with in various resins, but the composition $C_{30}H_{50}O$ is shown to accord best with its analysis and that of its derivatives.—Sparteine. A new method of cyclisation of α-methylsparteine by the action of iodine: Amand **Valeur.**—The eruptive rocks of Gebel Doukhan (Red Sea): M. **Couyat.**—The discovery of a Quaternary human skeleton: Émile **Rivière.** The discovery of this skeleton was announced in 1905. The present note is chiefly occupied with the proof that the skeleton is really of the same age as the deposits in which it was found.—Certain cutaneous spots resisting the action of radium and disappearing under the influence of the high-frequency spark: Foveau **de Courmelles.**—Concerning the anatomical characters of *Bradypus torquatus*: M. **Anthony.**—The presence of limestones containing *Productus giganteus* in Nova Zembla: G. W. **Lee.**—A new type of petiole of the fossil fern: Fernand **Pelourde.**—Contribution to the study of the transformation of sedimentary deposits into sedimentary rocks: J. **Thoulet.**—The seismic movements of November 6, 1908: Alfred **Angot.**—The subterranean river of La Grange, Ariège: E. A. **Martel.**

CAPE TOWN.

Royal Society of South Africa, September 16.—Mr. S. Hough, F.R.S., president, in the chair.—The pollination of *Belmontia cordata*: Dr. **Marloth.** The flowers are scented, and possess small appendages at their anthers, called Brown's bodies. They contain a sugary fluid, and this, it has been ascertained now, attracts a tiny, small insect, hardly a fifteenth of an inch long, belonging to the thrips family. The flowers possess two kinds of stigmas for the reception of the pollen, a structure which is not known from any other plant. This secondary stigma secures pollination in case the terminal stigma should not have received some pollen in time.—Embryo-sac of the Penæaceæ: Miss E. L. **Stevens.** The embryo-sac of this order differs from that of the typical angiosperm in containing sixteen nuclei instead of eight (these sixteen nuclei being organised into four egg-apparatus) and a definitive nucleus formed by the fusion of four of the nuclei. The early stages in the development of the sac show none of the polarity considered to be so characteristic of the angiosperm sac, and the whole structure of the sac is confirmatory of Dr. Pearson's hypothesis regarding the origin of the endosperm of angiosperms.—Endosperm: Prof. H. H. W. **Pearson.** It is suggested that the endosperm of the angiosperm is derived by a series of reductions and degrees of specialisation from a primitive type, essentially similar to that now found in Welwitschia. This hypothesis is strengthened by the fact that stages in this process can be identified in living angiosperms.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—Memoir on the Theory of the Partitions of Numbers. Part IV.: On the Probability that the Successful Candidate at an Election by Ballot may Never at any Time have Fewer Votes than the One who is Unsuccessful; on a Generalisation of this Question; and on its Connection with other Questions of Partition, Permutation, and Combination: Major P. A. MacMahon, F.R.S.—The Propagation of Groups of Waves in Dispersive Media, with Application to Waves on Water produced by a Travelling Disturbance: Dr. T. H. Havelock.—On the Refraction and Dispersion of Krypton and Xenon and their Relation to those of Helium and Argon: C. Cuthbertson and M. Cuthbertson.—Note on Horizontal Receivers and Transmitters in Wireless Telegraphy: Prof. H. M. Macdonald, F.R.S.—On Optical Dispersion Formulæ: Prof. R. C. Maclaurin.—(1) On the Accumulation of Helium in Geological Time; (2) On Helium in Saline Minerals and its Probable Connection with Potassium: Hon. R. J. Strutt, F.R.S.—Note on the Effect of Hydrogen on the Discharge of Negative Electricity from Hot Platinum: Prof. H. A. Wilson, F.R.S.—On Measurement of Rotatory Dispersive Power in the Visible and Ultra-violet Regions of the Spectrum: Dr. T. Martin Lowry.

CHEMICAL SOCIETY, at 8.30.

LINNEAN SOCIETY, at 8.—On a New Species, Symphyla, from the Himalayas: Prof. A. D. Imms.—The Freshwater Crustacea of Tasmania, with Remarks on their Geographical Distribution: Geoffrey Smith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address by the President: Mr. W. M. Mordey.

FRIDAY, NOVEMBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Resistance of Materials to Impact: Dr. T. E. Stanton and L. Bairstow.—Different Methods of Impact Testing on Notched Bars: F. W. Harbord.

MONDAY, NOVEMBER 23.

ROYAL SOCIETY OF ARTS, at 8.—Twenty Years' Progress in Explosives: Oscar Guttmann.

TUESDAY, NOVEMBER 24.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Primitive Pottery and Iron Making in British East Africa: W. Scoresby Routledge.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* Glasgow Central Station Extension: D. A. Matheson.

WEDNESDAY, NOVEMBER 25.

ROYAL SOCIETY OF ARTS, at 8.—The Goldfields of Eastern Peru and Bolivia: Sir Martin Conway.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, NOVEMBER 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Some Experiments made to test the Action of Extract of Adrenal Cortex: S. G. Shattock and C. G. Seligmann.—Further Results of the Experimental Treatment of Trypanosomiasis; being a Progress Report to a Committee of the Royal Society: H. G. Plimmer and Captain H. R. Bateman, R.A.M.C.—A Trypanosome from Zanzibar: Colonel Sir David Bruce, C.B., F.R.S., and Captains A. E. Hamerton, D.S.O., and H. R. Bateman.—The Proportion of the Sexes produced by Whites and Coloured Peoples in Cuba: W. Heape, F.R.S.—Further Researches on the Etiology of Endemic Goitre: Captain R. McCarrison, I.M.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Domestic Electricity Supply (including Heating and Cooking) as affected by Tariffs: W. R. Cooper.

FRIDAY, NOVEMBER 27.

PHYSICAL SOCIETY, at 5.

CONTENTS.