THURSDAY, FEBRUARY 6, 1908.

TRANSPIRATION AND ANATOMICAL STRUCTURE IN TROPICAL PLANTS.

Der Einfluss des Klimas auf den Bau der Pflanzengewebe. Anatomisch-physiologische Untersuchungen in den Tropen. By Dr. Carl Holtermann. Pp. viii+249; plates. (Leipzig: W. Engelmann, 1907.) Price 12 marks.

DR. HOLTERMANN'S investigations, mainly carried out in Ceylon, include a long series of experiments on the transpiration of different tropical plants. His tables show great variations in the amount of transpiration for the same plant during the same hours of different days, and these are in many cases not explained by the differing temperature and relative humidity, which are the only other data given. Thus, for instance, in the case of *Canna indica*, between 9.40 a.m. and 5.40 p.m. on January 11 (with a relative humidity of 61 and a temperature of 25°·4 at 10 a.m.), the transpiration was 0·37 gr. per hour per sq. dm. of leaf surface, while on January 17, between 9.45 a.m. and 5.30 p.m. (R.H. 63, temp. 26°·2, at 11.15 a.m.), the transpiration was 0·92 gr. per hour per sq. dm., and on January 18 between 9.15 a.m. and 3.30 p.m. the transpiration was 2·60 gr. per hour per sq. dm. (no humidity or temperature data are given within the period of the experiment, but judging from the late afternoon figures the day did not differ much from the others). This, though an extreme case, is only one out of several similar ones, and the effect of such figures on the reader is decidedly bewildering, though the striking variations may be explicable by changes of insolation, or the irregular occurrence of drying winds. As they stand, the author's figures only demonstrate that the transpiration of the plants studied exhibited startlingly wide fluctuations which remain quite unexplained.

The author's general conclusion from his experiments is that while the highest transpiration figures per hour in the tropics are considerably higher than any north European ones, yet active transpiration begins later and stops earlier in the day in the case of a damp tropical climate, so that the daily average is no higher than in Europe, while in the wet season transpiration may cease for weeks at a time. He thus does not disagree with the conclusions either of Haberlandt or of Giltay on this question. Dr. Holtermann holds that water-tissue is essentially an arrangement to supply water to the transpiring tissues during these short periods of excessive evaporation, not a means of lessening transpiration, and this view he supports by showing that it is especially developed in actively transpiring plants liable to be subjected to these sudden demands. It is characteristic of the leaves of tropical plants growing in a climate which is neither quite xerophytic nor constantly moist, and this harmonises with the short daily period of very active transpiration already mentioned. The mangroves, which ordinarily possess characteristic water tissue well developed, form much less or none at all in the leaves of examples cultivated in garden soil, which transpire very much more freely than plants growing in the natural salty soil. If these plants cultivated without salt are now watered with 3 per cent. salt solution and placed in the sun, they show a wilting of the leaves, and the mesophyll becomes shrivelled. Mangroves growing in their natural habitat also show wilting on hot afternoons, but only the water-tissue is partially emptied and the leaves recover during the night. For the rest the author holds that the xerophily of mangroves and of other halophytes has been much overrated by Schimper and others. They are scarcely, if at all, more protected in this respect than many trees growing in similar situations but not in a salty soil.

Dr. Holtermann describes three other formations of strand-plants besides the mangroves, viz., first the plants of moist sand, which fall into two categories, (1) those growing on the edge of the sea, absorbing salt water, and possessing water-tissue; (2) those growing further from the sea, with fresh bottom-water, which have no special xerophilous adaptations. Secondly, the dune plants, a highly xerophilous type; and, thirdly, the plants growing on salty mud, which have internal water-tissue, and resemble succulent desert-plants in many anatomical features. These three formations have close parallels among the strand formations of temperate regions. This classification is good so far as it goes, but it ignores the beach-jungle (Barringtonia-formation of Schimper), which the author apparently includes with the damp lowland forest type. Yet this formation, though not well developed in Ceylon, certainly has an independent existence; it is much in need of exact study and delimitation.

The author goes on to describe the damp lowland woods, the dry plains of the north and east, and the upland vegetation, as also the epiphytes and parasites of Ceylon. Many interesting observations are contained in this part of the work. Dr. Holtermann also discusses at some length the question of leaf-fall in the tropics, and concludes that though it is a hereditary character, it is, in the endemic species, determined by the dry season, and, in general, leaves fall when their structure does not fit them to withstand the conditions prevailing during the time the trees are bare. A similar explanation is given of the occurrence of annual rings of growth in the wood, the author relating the renewed formation of wide xylem elements to the increased transpiration taking place when a crop of young leaves is produced.

The final section of the work is devoted to a discussion of "Direct Adaptation," in the course of which an account is given of many interesting experiments which add considerably to our knowledge of adaptive reactions under new conditions. The author rightly classes all these as phenomena of irritability, but draws the conclusion that such characters, acquired during the lifetime of the individual, can in process of time be fixed and inherited. This conclusion is, of course, wholly unwarranted; in fact, it is totally irrelevant. And meanwhile the mystery of

adaptive reaction, so widespread a phenomenon in the biological world, remains unsolved. Until we know a great deal more than we do at present about the physico-chemical connection of stimulus and response it is likely to remain so. A. G. T.

CLIMATE AND MAN.

The Pulse of Asia: a Journey in Central Asia illustrating the Geographic Basis of History. By Ellsworth Huntington. Pp. xxi+416. (London: A. Constable and Co., Ltd.; Boston and New York: Houghton, Mifflin and Co., 1907.) Price 14*s.* net.

IN NATURE, vol. lxxii., 1905, p. 366, some account was given of the expedition of the Carnegie Institution of Washington to Eastern Persia and Turkestan. Mr. Huntington showed his descriptive power in the joint memoir issued in that year; and he dedicates his new book to Prof. W. M. Davis, his instructor in the "rational science" of geography, and his companion in arduous travel. Mr. Huntington states that, thanks to the help of Prof. Davis, he spent three years in Central Asia, in addition to four previously spent in Asia Minor. His study of languages has again and again been of service to him; and it is interesting to note at one point (p. 153) the struggle between his natural sympathy and the need for a little self-assertion, which, to the Oriental, is an outward sign of self-respect. His relations with the Khirghiz, and even with the feebler Chantos, were pleasant in the extreme; we fancy that something more fundamental than a training in geography gave him his thoughtful perception of the conditions and limitations of their lives.

The map of Asia, and no small part of it, is required to reveal the significance of the author's routes. The high passes of the Kwen Lun and Tian Shan ranges are mere incidents in these loops of travel, which lead us from Batum across Bokhara, and as far east as the shrinking salt-lake of Lop Nor.

Nine months were spent in the Lop Basin alone, and one of the finest things in the book is the general account of the succession of physical and climatic zones (chapter iv.), as one descends from the mountains across a ring of river-gravels to the edge of the region of desiccation. Here the fine sands and muds of old flood-plains are to-day whirled up before the wind, and are deposited as loess on the mountain-pastures to the south. The life of the nomadic inhabitants of the basin is practically limited by this pastoral land, which occupies all but the highest parts of the plateau-zone; and this zone terminates in steep slopes inwards, rising "like a continental ring around a sea forever dry." Down below, patches of forest-land are already poisoned by salt, and dying tamarisk bushes mark the spread and triumph of the desert.

All through Mr. Huntington's chapters we trace the same compelling influence. The desert, with its rippled and shifting dunes, its "hateful haze," swept onward by the wind, its inexorable hostility, demanding an inexorable endurance (p. 260), is driving man steadily before it, and has him, as it were, over leagues of country, by the throat. Old irrigation-channels have been abandoned, from failure at their source; old roads around lake-basins have given place to direct tracks across their floors. Even in mountain-gorges, streams have run dry, leaving the lower ground dependent on the sudden and dangerous torrents that follow on each melting of the snows. Springs may temporarily arise in desiccated areas, and may furnish real rivers as time goes on (p. 182); but such incidents only temporarily retard the retreat of man, who leaves lost cities behind him, still "beautiful in the clean, graceful shrouds of their interment in the sand." Archæological research, local legends, the experience of recent generations, all show that the drying up of Central Asia is a continuous phenomenon; yet a "climatic pulsation" in an opposite direction is traceable, both in the Caspian and Lop Nor Basins, in the "Middle Ages" following on 500 A.D.

The conditions of the still older dry or "interfluvial" epoch have not even now been reproduced, since (p. 351) there are places in the Tian Shan range, now too cold and wet for agriculture, where canals were once made to provide for irrigation. Mr. Huntington throughout acknowledges the work of Brückner and his other predecessors in these fields of travel, observation, and deduction, and has, in his later pages, urged the climatic aspect of human movements to an almost hazardous extreme. He set out (p. 6) to use Central Asia as a text "to show the immense influence which changes of climate have exerted upon history." In this respect his book does not quite rise to the anticipated level, which is reached more nearly in the memoir issued by the Carnegie Institution. But, with its simple record of perilous adventures, its excellent illustrations, and its clear devotion to science first of all, it forms a noteworthy and inspiring work of travel. Throughout it we feel, as the author means us to feel, the insistent pressure of natural law against the will and work of mortals—the helplessness of millions of men against the untimed pulse of Asia.

GRENVILLE A. J. COLE.

THE MODERN MICROSCOPE.

Microscopy: the Construction, Theory, and Use of the Microscope. By E. J. Spitta. Pp. xx+472; 16 plates. (London: J. Murray, 1907.) Price 12*s.* 6*d.* net.

MICROSCOPISTS are at present divided into two factions. There are those of the old school, who are content with the principles under the guidance of which such great improvements have been made in microscope construction since the earlier days of Abbe; and there are those whom we may call the "Gordon rioters," who hold that Abbe's experiments were inconclusive and even misleading, and have found a new prophet. The new theory—the adjective has at least some justification—has been duly set forth, with a mint of strange phrases, in Sir A. E. Wright's "Principles of Microscopy," already reviewed in these pages (vol. lxxv., p. 386, February 21, 1907). Mr. Spitta is of the older school. He is for "legitimate methods of observation." He casts an oblique and somewhat mistrustful glance upon the new practices, and hurries by to surer and more familiar ground.

Not so Mr. Conrady, who contributes to the present volume a couple of chapters on the undulatory theory of light, and on Abbe's diffraction theory of the microscope image. Mr. Conrady "has no use" for the new theory, propounded long since by Dr. Altmann, and only of value in that it called forth a complete and overwhelming reply from Abbe in his well-known paper "Uber die Grenzen der geometrischen Optik." He urges strongly the adequacy of the diffraction theory to explain all the observed phenomena, and is emphatic as to the inapplicability to the microscope of the theory of the Airy diffusion-disc.

This, however, is not the place to enter on this much-discussed but fascinating topic, with which, indeed, Mr. Spitta's book, from its plan and object, is but little concerned. It is the practical rather than the theoretical to which attention is directed, to the intelligent handling of one of the most finished and delicate of optical instruments.

From this point of view, let us hasten to urge every student of the microscope who wishes to gain a thorough understanding of its principles and possibilities and its defects, and every user of the instrument who desires a work of reference to which he may turn for an explanation of some unexplained optical phenomenon, or for particulars of up-to-date apparatus, to procure a copy of Mr. Spitta's book without delay. It is a leisurely book—an unfriendly critic might even call it diffuse—but there is scarcely a chapter which will not repay careful reading; and when one comes to the chapter on "Testing Objectives," one can but feel grateful to Mr. Spitta for his admirable treatment of a difficult subject.

Mr. Spitta has called his work "Microscopy"; but it is only of one branch of microscopy that he treats. His subject is the theory and use of the microscope as an optical instrument; with the preparation of objects for the microscope he does not deal. The book will be of much interest and of great value to many who are in no sense "microscopists," but who use the microscope as an accessory in other physical investigation. The non-mathematician who desires to know the meaning of the terms "numerical aperture," the "sine-law," "resolving power," or to make himself familiar with the essentials of the Abbe theory, will find Mr. Spitta a satisfactory guide; and the microscopist proper will find innumerable useful suggestions as to the manipulation of his instrument.

It will be well to indicate shortly the ground Mr. Spitta covers. After a preliminary account of the elements of geometrical optics and the theory of the simple microscope, he proceeds to deal with the compound microscope in its modern form, fine adjustments, mechanical stage, substage, objectives—achromatic, semi-apochromatic, and apochromatic; dry and immersion—with details and illustrations of the work of the best makers. In connection with objectives the chief optical properties, spherical and chromatic aberration, the sine-law, &c., are discussed. Then follow chapters on numerical aperture, eyepieces, magnification—in which may be found the main principles of the Abbe theory—the substage condenser, and methods of illumination—critical light, monochromatic light, dark ground illumination, Rheinberg's multiple colour illumination, oblique light, illumination of opaque objects, polarised light. Then we come to "the use of the microscope," with which may be mentioned the valuable hints to workers with which the volume concludes. The binocular microscope and measurements with the microscope are treated, and a long chapter is devoted to the discussion and illustration of microscopes by different makers for various purposes, which is a feature of the book.

Then follows the excellent account of the testing of objectives already referred to. Mr. Spitta confines himself to the use of the Abbe test-plate, and of specified test objects, but within these limits he goes into the matter in detail and with admirable clearness, and this chapter alone is sufficient to justify the work. The section is illustrated in sixteen plates by a beautiful series of photomicrographs. Mr. Conrady's two chapters follow, with another on accessory apparatus. The usefulness of the book is completed by a satisfactory index.

We have said enough to commend Mr. Spitta's volume. It teems with "tips," and is likely to command an even wider popularity than his previous books on allied subjects.

MATHEMATICAL TEXT-BOOKS.

(1) *Easy Exercises in Algebra for Beginners.* By W. S. Beard. Pp. x+134. (London: Methuen and Co., n.d.) Price 1*s.* 9*d.*

(2) *Plane Geometry for Secondary Schools.* By C. Davison and C. H. Richards. Pp. viii+411. (Cambridge: University Press, 1907.) Price 4*s.*

(3) *Cartesian Plane Geometry.* Part i. By Charlotte A. Scott. Pp. xiv+428. (London: J. M. Dent and Co., 1907.) Price 5*s.*

(4) *A Sequel to Elementary Geometry.* By J. W. Russell. Pp. viii+204. (Oxford: Clarendon Press, 1907.) Price 6*s.*

(5) *Text-book of Mechanics.* Vol. ii. By L. A. Martin, Jun. Pp. xiv+214. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 6*s.* 6*d.* net.

(6) *Elementary Statics.* By W. P. Borchardt. Pp. viii+398+xx. (London: Rivingtons, 1907.) Price 4*s.* 6*d.*

(7) *Elementary Trigonometry.* With Answers. By C. Hawkins. Pp. xiii+310. (London: J. M. Dent and Co., 1907.) Price 4*s.* 6*d.*

(1) THIS book is a collection of 3500 examples in elementary algebra up to quadratic equations. It will prove useful to those teachers who dictate the book-work instead of leaving their pupils to read it for themselves. The exercises are well arranged, and there is a good list of contents, so that the reader can at a moment's notice find a dozen or more examples of exactly the type he requires for class use. Answers and examination papers are given, and even though the book does suggest cramming, it has a practical value which will ensure it a welcome. The idea might with advantage be extended to other mathematical subjects.

(2) This book is written for schoolboys who have had a preliminary training in practical geometry, and is devoted almost entirely to theoretical work. The authors are not very fortunate in the first few pages, but when once the reader is fairly started, he will find very little to which he can take exception, provided he is in sympathy with the general arrangement of the book. The authors adopt a conservative point of view, and give a very strong Euclidean flavour to their treatise, but they show themselves capable of appreciating the chief lessons to be learnt from recent experiments in geometrical teaching. Hypothetical constructions are allowed if it can be proved that the construction is possible. The theory of parallels based on Playfair's axiom is deferred until after the principal properties of congruent triangles have been proved. The book covers the substance of Euclid i. to vi.; those of Euclid's theorems which are not included in the text are set as riders together with a large number of well-chosen examples. The treatise is very complete within the limits chosen, and contains sections on loci, geometrical dissections, the nine-point circle, inscribed and escribed circles, Ceva's theorems, &c. A teacher who has conservative views could, on the whole, hardly wish for a better text-book.

(3) The treatise on analytical conics in this series was undertaken by Mr. R. W. H. T. Hudson, and Miss Scott, while pursuing her own plan, has had at her disposal the outline he drew up before his death. The book will prove interesting to the teacher on account of the extreme novelty of the arrangement. The author claims to have shown deference to existing conventions, but it is not so easy to see where self-restraint has been exercised. Apart from the professed innovation of introducing line-coordinates concurrently with point-coordinates from the very first, we have the novelty that the circle is taken as a special case of the ellipse, change of axes is deferred until necessary for the tracing of conics, and so on.

The chief fault of the treatise is probably that the arrangement is far too confused. Properties of the circle are spread over three or four chapters in various parts of the book, interspersed with theorems on conics and straight lines, which theorems are in their turn introduced apparently incidentally, then recapitulated further on, only to be extended in a still later chapter. It seems very doubtful whether a pupil brought up on this method would be able in any way to systematise his knowledge.

Introductory remarks and definitions are apt to be a little obscure, but this is amply compensated by excellent diagrams and very intelligible examples worked at full length. It is a pity that no answers to the exercises are given.

(4) This book is somewhat on the lines of Casey's sequel to Euclid, and covers a good deal of the same ground. It is in many ways an improvement on that standard treatise, and will probably replace it with those students who are just beginning an honours course in mathematics. The chief criticism we have to make is that the contents are of too miscellaneous a character; no one subject is treated quite fully enough, and the reader is led from one idea to another with almost bewildering rapidity. Perhaps some improvement might have been effected by omitting the chapter on "recent geometry," which contains very little that is new except the nomenclature, and treating more important subjects at greater length.

In a book of this kind the chief danger lies in the insertion of artificial geometrical proofs of theorems best established by analytical or other methods. The author is to be congratulated in having avoided this danger, on the whole, with marked success, though perhaps it would be better to solve Fermat's problem and other examples in chapter xi. by the more instructive methods of chapter xii. The reasoning adopted is of a simple character, and in many cases alternative proofs of equal elegance and simplicity are given. There is a plentiful supply of well-chosen exercises; in many cases concise but useful hints are given in the text for their solution, and a key to the remainder of the examples is promised. The book will prove very inspiring to the beginner, and give pleasure to the more advanced reader.

(5) Mr. Martin's book is intended for readers who have a fair knowledge of differential calculus and are beginning integral, and it covers the more elementary portions of uniplanar dynamics of the particle and rigid body. There is room for such a treatise, but the present one is not entirely satisfactory. Much of it is carelessly worded, *e.g.* a movement is called the motion of a "point" and of a "particle" in the same section, the definition of a radian is unintelligible, &c. Some of the proofs, as in the case of normal acceleration, are far too cumbrous, while others are hardly rigid—an instance of this is the absence of any mention of D'Alembert's principle or a substitute therefor. The 420 examples will be useful, though no answers are given.

(6) In this treatise an attempt is made to cover the ground very thoroughly; for instance, three distinct proofs are given of the resultant of two parallel forces and the three requisites of a good balance are discussed, while chapters on work and energy, frameworks, virtual work, elasticity, &c., are given. The object aimed at is to include all that part of statics which can be profitably discussed without the use of the calculus. The result is a book which every teacher should possess; it contains all the bookwork he is likely to want and more, while it is a most useful mine of excellent examples. It is more doubtful whether the book is equally suited to class use; it is hardly simple enough for beginners, and the practical experiments are not described in sufficient detail to be of much use for such a purpose. Readers who have Borchardt and Perrott's "Trigonometry" will have a very fair idea of the style and aim of this "Statics."

(7) Mr. Hawkins's book is rather attractive; for a boy who was learning trigonometry in order to become a surveyor it would be ideal. It may be doubted, however, whether the ordinary pupil will take much interest in so many technical details of land-measurement, even granting that practical applications have a fascination for beginners. With a

little judicious skipping, however, the book may be suited to ordinary class use. It is well written, very intelligible, pleasant reading, and mathematically sound (except in § 88). An interesting feature is that the use of the sine and cosecant in solving triangles, finding areas, &c., is explained before the definition of the cosine and secant, and similarly the applications of the cosine are given before the tangent and cotangent are introduced. The contents of chapters ix. and x., with the exception of an isolated section on inscribed and escribed circles, might well be left to a more advanced treatise. The diagrams throughout are excellent. Demoivre's theorem and similar theoretical developments are not included.

OUR BOOK SHELF.

(1) *Mining Tables.* By Dr. F. H. Hatch and E. J. Vallentine. Pp. viii+200. (London: Macmillan and Co., Ltd., 1907.) Price 6*s.* net.

(2) *The Weights and Measures of International Commerce.* Tables and Equivalents. Pp. 59. (London: Macmillan and Co., Ltd., 1907.) Price 2*s.* 6*d.* net.

In the former of these works the authors give a comparison of the units of weight, measure, currency, and mining area of different countries, together with tables, constants, and other data useful to mining engineers and surveyors. In the second work, they reprint a selection of tables that appeal to others besides mining engineers. On the whole, the authors have carried out their difficult task in an admirable manner. It is customary for engineers to get together data for use in their professional work, and the reprint of the authors' collection cannot fail to be of service to other workers in the same field. All such collections have, however, their limitations, as the requirements of no two engineers are precisely the same. We miss, for example, information relating to the strength of materials, tables for converting kilograms per square millimetre into tons per square inch, and the like, and in the table of rates of exchange for money, any reference to Spain, Portugal, or the South American republics.

While it is easy to point to omissions, we have not been able to detect any errors in the figures given, notwithstanding a careful comparison, for example, of the tables for the calculation of heights and distances from tacheometer readings with the similar tables communicated by Mr. Neil Kennedy to the Institution of Civil Engineers in 1890. In the text, typographical errors are few. There is a little want of uniformity in the spelling of the names of metric weights and measures, grammes and grams, metre and meter, litre and liter being used indiscriminately. Barbados is spelt incorrectly; and Mohs, the inventor of the scale of hardness, appears as Moh. On the title-page, too, Dr. Hatch describes himself as member of the Institute, instead of Institution, of Civil Engineers, and Mr. Vallentine as member of the Federated Institute of Mining Engineers, a society which dropped the term Federated in 1897, and has since been known as the Institution of Mining Engineers.

Les Aciers spéciaux. By L. Revillon. Encyclopédie scientifique des Aides Memoires. Pp. 188. (Paris: Gauthier-Villars, n.d.) Price 2.50 francs.

To understand even the present state of general knowledge with regard to special steels a very large and difficult field must be traversed, and the task of condensation to a reasonable limit will be a heavy one, but, for those who are unable from various causes to enter the field and would like to know the kind of work that is being done, this book may be helpful. To compare the results given with one's own ascertained tests of materials made under known conditions would be a considerable task, but a few general matters taken at random are worth noting as examples.

On p. 99 we are told that chrome steels are chiefly made in the crucible, even when large pieces, &c. What can the author think would prevent them being made in the open hearth? They are so made in large quantities. On p. 154, the author permits himself to dream that nickel chrome steels may also be made in the open hearth (they are made extensively) as nickel steels and chrome steels are (which seems to contradict p. 99). P. 118, "Vanadium remains a scientific curiosity . . . excepting for steels of high price such as tool steels." It was a source of great pride to the late Auguste Wiener that he had obtained the recognition of vanadium as an element of practical industrial importance in the manufacture of special structural steels, and Kent-Smith's success in making vanadium chrome and vanadium nickel steels was the main reason why he was taken to America, undoubtedly to carry on similar work.

One regrets to find in a work on this subject, where names are freely used, that the only mention of Prof. Arnold, who has done so much in connection with nickel, vanadium, and chrome steels, is in chapter xv., on nickel vanadium steels:—"There exist also several tests by Prof. Arnold." Perhaps there is some kind of poetic justice in the fact that, to take one example only, the author's readers will not know that a nickel steel given by him at 61 tons per square inch, with an elongation of 3·5 per cent. on 100 mm., when properly made, gives the extraordinary test of about 90 tons per square inch and 10 per cent. elongation on 2″.

A. McW.

Voice Training in Speech and Song. By H. H. Hulbert. Pp. xii+83. (London: W. B. Clive, 1907.) Price 1*s.* 6*d.*

This book is primarily designed for the use of teachers, who, as the author points out, are probably the greatest voice-users, but it will interest all who speak or sing in public. Voice production is difficult to teach even when the pupil has the advantage of performing exercises under the personal supervision of the instructor, and it may be doubted if much improvement in the use of the organs of speech can be effected by reading text-books alone; but what is possible in the direction of describing suitable exercises appears to have been accomplished with success by the author. The book provides an account of the structure and use of the vocal organs, and the means of securing distinct articulation; it should be useful to all persons who are attending practical classes for the cultivation of the voice.

Revisio Conocephalidarum. By H. Karny. Pp. 114. (Jena: Gustav Fischer, 1907.) Price 4.50 marks.

This compilation dealing with a subfamily of the Locustidæ, was published in the Abhandlungen der k.k. zoologisch-botanischen Gesellschaft of Vienna, and provides a serviceable continuation of the monograph prepared by Redtenbacher that appeared in the Behandlungen of the same society in 1891. Revised analytical tables are given for several of the genera to include recent determinations by the author and other workers. Three genera are here described for the first time—Paroxyprora, Rhytidogyne, and Pœcilomerus. A considerable number of new species are made, principally additions to the tribe of Conocephalini; many were collected in South America, and six were obtained in New Guinea.

LETTERS TO THE EDITOR.

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

The Cotton Plant.

ATTENTION has been directed in NATURE of January 16 to a work in which a writer on economic subjects deals with "The Wild and Cultivated Cotton Plants of the World." The subject is as difficult as it is important, and your reviewer, whose expert opinion is held in regard, shows that some of the questions involved may have two sides.

Your reviewer remarks that this work has been doomed to failure owing to the mode of study adopted by its author. If this means that the work is not without error and does not attain finality, the judgment has been anticipated by the author. But if this also means that the work adds nothing to what is known by those who do not happen to be experts in cotton, its readers will find that the verdict cannot be sustained.

The work is compared unfavourably with another on this subject by the late Prof. Todaro. Your reviewer attributes success to Todaro's book because Todaro dealt for the most part with living plants grown by him from seed. It is possibly true that the material studied by Todaro was, for the most part, obtained from the living plants the cultivation of which is related in the introductory fifth part of his monograph. But it is not the case that Todaro's revision of the cottons of the world was based for the most part on this material. Those who have studied Todaro's work know that, of the fifty-four species of Gossypium there enumerated, only eleven were certainly described from living plants, although it is possible that others may have been seen by him in the living state. In dealing with the remaining thirty-eight, Todaro has had to rely on the mode of study which your reviewer tells us is doomed to failure; indeed, as regards a considerable number of the species recognised, Todaro has had to depend on the accuracy of descriptions by other writers, because he did not have access to authentic herbarium specimens.

We are, however, less concerned with the work of Todaro than with the continuation and extension of that work which your reviewer says was needed, and which Sir G. Watt has tried to supply. A study of Watt's work shows that its chief merit and value lie in the exhaustive way in which it brings together references to all conceivable sources of information. On this account it will be indispensable to anyone who may hereafter be seriously at work on cotton, who will find it a comprehensive guide to the literature of the subject and to the whereabouts of authentic material. Its readers must follow the rule that applies to the study of subjects so critical, and reserve perfect freedom of judgment as regards the acceptance of Watt's conclusions. They are not bound to agree with Watt as to the provenance or the pedigree of any particular cultivated cotton, nor are they bound to adopt the advice Watt may give as to the kinds most suitable for a particular locality. But when, in deference to other views or on intuitive grounds, we question the validity of Watt's opinion, we are not entitled to do more than reserve our assent unless and until we have critically examined, and if need be supplemented, the material on which that opinion is based.

Believing, as he explains, that the work of Todaro does not require to be corrected, your reviewer is justified in refusing to accept any opinion expressed by Watt which is at variance with that of Todaro, and is free to imagine that, because Watt at times differs from Todaro, Watt's volume is rather a retrogression than an advance on Todaro's work. He is also entitled to assert the right to criticise details as to which he considers himself a competent judge. But his decision that when Watt differs from Todaro therefore Watt must be wrong does not prove this to be the case; his belief in the infallibility of Todaro does not establish that unusual quality; we know, indeed, that at least one of Todaro's species of Gossypium does not belong to the genus.

In exercising his right to criticise, your reviewer occasionally raises a doubt whether sound judgment as to the value of a cotton need include full appreciation of the difficulties connected with its botanical status, while his terminology does not make it clear that his conception of botanical characters, and his interpretation of words like "species" and "variety," accord with established usage. This prevents our commenting on his estimate of Watt's system of classification, which is based on those characters that Watt believes to be least subject to variation in truly wild cottons. That among cultivated forms even these characters prove unstable is only too true; but they may still be the best available, and the reviewer does not suggest an alternative method of arrangement.

In certain specific instances your reviewer directs attention to what he terms errors. Thus the treatment by Watt of *G. obtusifolium*, Roxb., and *G. Wightianum*, Tod., is cited as a case of "erroneous synonymy." The situation is this:—Todaro has shown that he only knew of *G. obtusifolium* from Roxburgh's description, and that he did not recognise Roxburgh's species in any of the plants he grew. Todaro has further concluded that a plant which most Indian botanists have treated as a form of *G. herbaceum* does not belong to *G. herbaceum*; this plant he has named *G. Wightianum*. Dealing anew with the subject, Watt has agreed with Todaro in considering *G. Wightianum* distinct from *G. herbaceum*. But Watt also thinks that he can recognise the plant which Roxburgh named *G. obtusifolium*, and believes that *G. Wightianum* is only a variety of *G. obtusifolium*. However the case may stand as to these conclusions, the synonymy they involve is accurate. Even if, as is possible, your reviewer by "erroneous synonymy" only implies that Watt differs from Todaro, the criticism fails. We are unable to say whether, if Todaro had been able to recognise *G. obtusifolium*, any difference of view would have existed. The subordinate questions as to whether Watt's limitation of *G. obtusifolium*, var. *Wightiana*, accords with natural facts, and whether *G. obtusifolium* proper and *G. Nanking*, var. *roji*, should be kept apart or united, are only differences of opinion between Watt and your reviewer on points as to which they are equally entitled to form a judgment.

Your reviewer cites two cases in which he believes that plants have been wrongly identified by Watt. He states that the figure of *G. microcarpum* given by Watt (plate 36) represents a plant other than the one figured by Todaro as *G. microcarpum*. He points out that Todaro describes the two lobes on either side of the central lobe as unequal, and states that the figure given by Watt does not display this peculiarity. On examining the figure of *G. microcarpum* given by Watt, we find that it does show this peculiarity, and on consulting the text we see that it is *G. microcarpum* of Todaro and no other species that is intended to be represented. There may be some mistake with regard to this species; if it be the case that the *G. microcarpum* grown by the reviewer is the true *G. microcarpum* of Todaro, and is at the same time the plant figured by Watt as *G. Schottii*, then the figure which Todaro has given of *G. microcarpum* can hardly represent his own species accurately; it is unlikely that a suggestion as to the identity of *G. Schottii* as figured by Watt (plate 35) and *G. microcarpum* as shown in Todaro's plate will be generally admitted. In the other case, your reviewer's conclusion as to misidentification rests partly on a statement that the name "Piura" indicates a cotton other than the one it connotes in Watt's book, partly on an assertion that Lamarck describes his species *G. vitifolium* as having the underside of its leaves glabrous. The incidence of vernacular names is not always so exact as to justify implicit confidence, but in this instance Spruce, who collected the Piura cotton in Peru and has described it with care, assigns the name to the plant with which Watt associates it. Finally, what Lamarck says with regard to the leaves of his *G. vitifolium* is:—"Elles sont glabres en dessus, un peu velues en dessous."

What we now await is a work on the cultivated cottons from the pen of your reviewer.

D. PRAIN.

Kew, January 20.

The Inheritance of "Acquired" Characters.

I HAVE looked with much interest for some reply from your reviewer to the queries put to him in the letter of Mr. Spicer (January 16, p. 247).

But while he does not attempt to enlighten us, Mr. Archdall Reid, one of the principal exponents of "the infant science of heredity," seeks to show in your columns of January 30 (p. 293) that there is no real basis for this controversy—that Weismann and Herbert Spencer, and all others who have dealt with the question, are alike in error in supposing that there is any real difficulty to be solved.

Mr. Reid seeks to establish his position in this way. He objects to the distinction commonly drawn between "innate" and "acquired" characters; he says these are inaccurate distinctions, and that they have given rise to a long drawn but "futile controversy." He holds the peculiar view that "in man the main difference between the infant and the adult is due to the use acquirements made by the latter during development." Thus, he says:—"Nutriment supplies the material but *not* the stimulus, for *all* growth. Up to birth, the human being, for example, develops wholly, or almost wholly, under this stimulus. Subsequently some of his structures continue to develop under it, for instance, his hair, teeth, external ears, and organs of generation, which grow whether or not they be used. But most of his structures now develop mainly, if not solely, under the stimulus of use, for example, his voluntary muscles, limbs, heart, and brain." But surely the fact that use occurs during the development (and therefore, of course, has some share in promoting the growth) of some parts of the human body must not blind us to the probable fact that the post-natal growth is essentially due to the same inherent causes as pre-natal growth. That being so, is it not absurdly inaccurate to say that "in man the main difference between the infant and the adult is due to use acquirements"?

Then, again, Mr. Archdall Reid seems to assume (in the face of multitudinous difficulties) that the germs of all human beings are potentially alike. He says "innate characters arise inevitably as the child develops, whereas some acquirements are more or less rare. But this is *only* because the stimulus of nutriment is inevitably received, whereas the stimulus of a particular *use* or *injury* may not be received. If, however, the latter be received, *the acquirement arises just as inevitably as the innate characters.*"[1]

This may, and probably does, hold good for the result of injury and the production of scar tissue, but surely not in regard to the effects of use. No amount of use exercise could make a colour-blind man a good colourist, or enable many persons having, as it is commonly said, "no ear for music" to be good musicians. Thus in some persons what in the majority should be innate qualities are found to be wanting (owing to defects in organisation), while in other persons, wholly independent of any commensurate amount of use exercise, powers like those possessed by a Turner or a Watts, by a Mozart or a Beethoven, or such powers in the direction of mental arithmetic as were found in Bidder, Inaudi, and others. One person has highly developed auditory centres and cerebral regions in association therewith, another has a poor development of the same parts, and the same thing holds good for the visual centres and their associated cerebral mechanisms. Some of those having highly developed auditory centres may prove to have unusual musical abilities, while other persons, like Inaudi, may have marvellous powers in dealing with figures.

It is, in fact, notorious that the stimulus of nutriment and the stimulus of use being present, the results in the way of acquirement will vary *ad infinitum* in accordance with innate differences in individual germs. Yet it is upon the basis of such views as I have quoted that Mr. Reid strives to show that the controversy as to the alleged "transmission" of acquired characters is due to a misunderstanding. "Had the true nature of the distinction between innate and acquired characters been realised," he says, "had it been realised that the difference is one of stimuli, not of innateness or inheritability, and that acquirements are just as much products of evolution as innate characters, it is impossible that the controversy as to the alleged 'transmission' of the former could have endured so long as it did."

I venture to think that many will not be satisfied with Mr. Archdall Reid's doctrines, and will still consider that the controversy is not closed, as he seems to suppose, but that there is a real problem open to discussion; and certainly those who believe that the effects of use and disuse may be inherited will not find anything in Mr. Reid's letter to show that they are wrong.

In your pages in 1905 (June 15, p. 152) there was a brief communication on this subject from Mr. Woods Smythe which I take to be of considerable importance. He says:—"Lately I heard a missionary at a May meeting tell of the marvellous facility with which Chinese children memorise whole books of the Bible; the four Gospels, and sometimes the Acts also, being an easy feat for children of ten or twelve years. Having carefully sought information from other authorities, I find these facts confirmed, and that the same applies to Mohammedan children. We are aware that for ages their ancestors have been compelled to memorise long portions of their sacred books, and although occasionally we meet with a child of any nation with a gigantic memory, that differs widely from the case of a people where it has become a general characteristic."

Facts of this kind are very difficult, if not impossible, to understand except upon the supposition that use and practice carried on through many generations have led to the begetting of germs having modified developmental tendencies.

How would Mr. Reid explain such facts? In his letter he says:—"Memory, the power of learning, develops under the stimulus of nutriment, but intelligence and reason develop under the stimulus of use." Memory is, therefore, for him one of the so-called "innate" characters which develops independently of the stimulus of use and exercise. For him, therefore, there ought to be no such remarkable memorial powers as those which have been referred to by Mr. Woods Smythe.

H. CHARLTON BASTIAN.

The Athenæum, London, February 3.

[1] No italics here in original.

The Nature of Röntgen Rays.

IN NATURE of January 23 (p. 270) Prof. Bragg defends his neutral pair theory of X-rays, and his explanation of scattering and polarisation on this theory, against a criticism which I made in a recent letter (NATURE, October 31, 1907). Though he appears to have enlarged his conception of the possible function of the ether pulse in X-ray phenomena, he contends that my one assumption is unjustifiable, consequently is of no value as a critical test. Prof. Bragg had assumed that a pair revolves in a plane containing its direction of translatory motion, that when incident on light atoms it is liable to be taken up only by an atom revolving in the same plane, sometimes to be ejected again, and that if ejected again it continues to rotate in the same plane. My assumption in calculating the distribution of intensity of secondary radiation was that after being *taken up* by an atom its liability to be ejected again is equal in all directions in that plane. This does not appear quite so unjustifiable as, from Prof. Bragg's letter, one would judge it to have been.

It is evident, however, that this assumption is not a necessary part of the argument against the neutral pair theory, though it appeared, and still appears, to me to be the nearest approximation one can make to the probable behaviour of a pair, if we accept Prof. Bragg's previous assumptions.

But to make calculation possible in place of such a definite distribution we may assume any one of a score of others, as Prof. Bragg does not suggest one. Still, experiments supply what appears to me to be absolutely conclusive evidence in favour of the ether pulse theory. For, after measuring the intensity of secondary radiation proceeding in a direction perpendicular to that of propagation of the primary beam from a substance of low atomic weight during the transmission of "soft" X-rays (conditions producing the most complete polarisation), I have found that the intensity of radiation in a direction opposite

to that of propagation of the primary rays as experimentally determined is within 5 per cent. of that calculated on the ether pulse theory (see *Phil. Mag.*, February, 1908). If Prof. Bragg can suggest a distribution of ejected pairs that will produce such close agreement between the calculated and experimentally determined intensities, it will be time to consider the theory further.

My argument has not been concerned with γ rays, but with the type of radiation with which I am experimentally more familiar—X-rays of ordinary penetrating power.

University of Liverpool. CHARLES G. BARKLA.

The Wave-length of Röntgen Rays.

IN his theory of thermodynamical radiation, Planck has found the simple law $e=h_0 n=h_0\frac{c}{\lambda}$, where e is an element of energy, $h_0=6.55\cdot10^{-27}$ a constant, n the frequency, λ the wave-length of an electromagnetic resonator, c the velocity of light; according to this "elementary law" the energy of an electromagnetic resonator changes during a period by a multiple of e.

Applying Planck's elementary law on the emission of Röntgen rays by stopped kathode ray particles, I have found the following (*Physik. Zeitschr.*, viii., 882, 1907). Let $e_k=\frac{m_0 v^2}{2}$ be the kinetic energy of a kathode ray, ϵ its electric charge, V the freely traversed potential difference, the total kinetic energy may be, by stopping, transformed into energy of radiation. The smallest wave-length of the emitted Röntgen radiation is then $\lambda_k=\frac{2h_0c}{e_k}=\frac{2h_0c}{\epsilon V}$; for a working potential difference of 60,000 volts on a Röntgen bulb λ_k becomes $6\cdot10^{-9}$ cm. Haga and Wind (*Ann. d. Phys.*, x., 305, 1903) have found by their experiments on diffraction for the wave-length of the used Röntgen rays the value $\lambda=5\cdot10^{-9}$ cm.

It is clear that the reversed phenomenon—the transformation of Röntgen rays into kinetic energy of electrons—gives the emission of secondary kathode rays by Röntgen rays, or more generally by light. I have deduced from Planck's elementary law that the maximum of the velocity of secondary kathode rays is independent of the nature and temperature of the radiating body, but inversely proportional to the square root of the absorbed wave-length. This statement is in agreement with the observations of Innes (Proc. Roy. Soc., lxxix., 442, 1907); the observations cannot be explained by the hypothesis of J. J. Thomson and W. Wien that the emission of secondary kathode rays is produced by some radio-active process.

It may be added that Planck's elementary law is also confirmed by my observations on the Doppler effect on Kanalstrahlen; the simple or two-fold minimum of the intensity in this effect is explained by that law (*Physik. Zeitschr.*, viii., 913, 1907). Applying the law to a hypothesis of the origin of banded spectra, it is possible to calculate an inferior limit for the spectral position of the banded spectra of the saturated and "loosed" valencies in chemical compounds (*Physik. Zeitschr.*, ix., 85, 1908).

J. STARK.

The Orientation of the Avebury Circles.

IN Sir. Norman Lockyer's notes on the orientation of stone avenues printed in NATURE, January 16, pp. 249–257, in dealing with Avebury, he founds his argument as to the existence and direction of the Beckhampton avenue upon Stukeley's statement as to the remains of it visible when he wrote in 1724. He then passes to the Kennet avenue, and says:—

"As will be seen from the map, this avenue apparently was connected with the southern circle as the Beckhampton one was with the northern one. If this were so, certainly the enormous bank, erected apparently for spectacular purposes, which is such a striking feature of Avebury, was not made until after the Kennet avenue had fallen out of any astronomical use."

In accordance with this statement, Sir Norman Lockyer marks on the map reproduced to illustrate his notes the course of the south-eastern or Kennet avenue as a straight line making directly for the centre of the southern circle *across the existing bank and ditch* well to the left of the present road leading to Kennet. In this he entirely ignores the fact that Stukeley (in the map given by Long, "The Temple at Abury surveyed by Dr. Stukeley in 1724") marks two prostrate stones of the avenue actually in the existing gap in the earthworks by which the Kennet road enters Avebury, and furthermore notes that they were "broke 1722." Aubrey, too, in his plan taken in 1663 (reproduced in Jackson's "Aubrey," p. 319), shows seven stones of the avenue as lining the sides of the existing road *immediately* on its leaving the gap in the mound. Lastly, there is standing at this moment a few yards on the right-hand side of the Kennet road a large stone which is the only one now remaining of those seen by Aubrey and Stukeley at the point where the avenue struck the earthwork circle. This stone was apparently not noticed by Sir Norman Lockyer.

Surely if anything can be said to be certain at all about Avebury, it is that the Kennet avenue joined the outer circle through the existing gap in the rampart by which the Kennet road enters it to-day, and did not make straight for the centre of the southern circle over the bank and ditch as shown in Sir Norman Lockyer's plan. Theoretically, perhaps, it ought to have done so, but as a matter of fact, if any weight is to be attached to the statements and plans of Aubrey and of Stukeley, and to the position of the one existing remnant of the avenue on the spot to-day, it did not. In the interests of accuracy it seems desirable to point this out. ED. H. GODDARD.

Stability in Flight.

MR. MALLOCK (January 30, p. 293) seems to presume, as a great many others do, that an apparatus on the aëroplane principle "demands constant attention on the part of the aëronaut" to maintain its stability in the air. We are apt to get ideas from watching the behaviour of little bits of paper floating in the gusts of wind, and to forget that the flying machine of the future may run into tons of weight. Though a frail canoe may easily capsize, the big ship seldom turns over even in the roughest of seas. Even so primitive a contrivance as we may presume that of Mr. Farman to be is some 33 feet across and weighs, complete, half a ton. Such a structure is not easily upset by mere puffs of wind. But it is also evident that a machine can be designed possessing nearly perfect automatic stability. Langley's model, away from all human control, flew steadily on over the billows of the air for a minute and a half. A well-designed and well-balanced machine is automatically stable without any pendulums or other appliances; in fact, it forms a pendulum of itself. B. BADEN-POWELL.

32 Princes Gate, S.W., February 1.

REFERRING to the letter which appeared under the above heading in NATURE of January 30, I have given some little attention to this subject for the past few years, and thoroughly endorse your correspondent's views.

Any balancing apparatus must be automatic in its action if it is to respond to the changes in the relative motion of the air without delay. It would seem to me that any such apparatus must, as is suggested in the letter referred to, depend on the conservation of angular momentum in a pendulum or fly-wheel. Such a pendulum (or system of pendula) or fly-wheel may operate directly or indirectly, *i.e.* the torque of resistance opposing change of angular momentum may be employed to right the aëroplane, or may operate mechanism to control the position of guide planes or jockey weights, or rotate the main planes in a suitable manner. The first case is analogous to the Brennan mono-rail system, the second to the Obry torpedo balance. HERBERT CHATLEY.

32 Britannia Road, S., Southsea, February 1.

The Stresses in Masonry Dams.

I DO not think that Prof. Pearson proves his point. Is it not an axiom of practical mathematics that nearly identical functions (within certain limits) may have widely different second differentials? Between o and π, for

example, a parabola can be found differing but little from $\sin x$. To show that the stresses $\widehat{xx}$ and $\widehat{zz}$ are widely different in a plate dam and in a complete dam, it would therefore seem essential to integrate the two equations given by Prof. Pearson in his last letter, and to compare these integrals, or else to decide the matter on other considerations. The integration is, I understand, impracticable, and this being so, the argument in my letter of January 2 would seem to apply. It was to the effect that if in the case of a plate it is permissible to write $\widehat{xy}=\widehat{yz}=\widehat{yy}$ throughout, then to the same order of approximation the stresses $\widehat{zz}$ and $\widehat{xx}$ are the same in the plate dam and in the actual structure. If the stresses $\widehat{xy}$ and $\widehat{yz}$ are zero in the case of the plate, then the stresses $\widehat{yy}$ which are developed when the lamina forms part of the complete structure cannot, themselves, give rise to any such shears as $\widehat{xy}$, $\widehat{yz}$, or $\widehat{zx}$, and as the dam is not constrained at top or flanks, it is difficult to see how, in the absence of these shears, the stresses $\widehat{xx}$ and $\widehat{zz}$ can be affected. Certainly not by the 30 per cent. which Prof. Pearson gives as the order of the error.

83 St. James's Road, Croydon. H. M. MARTIN.

SOME SCIENTIFIC CENTRES.

No. XII.—THE BOTANICAL INSTITUTE OF THE UNIVERSITY OF BONN.

THE traveller visiting the well-kept Rhenish city of Bonn, on taking a stroll down the beautiful Poppelsdorfer Allee, finds at the end of this delightful avenue a large square building within an enclosure, the Poppelsdorfer Schloss. This building, which is two stories high, enclosing a circular court, bears no external evidence of containing within its walls a great centre of biological research, for the edifice was originally a palace, having been used up to the beginning of the last century as a summer residence of the electors of Cologne. The building is now owned by the university, and is occupied by the biological laboratories and the natural history museum. The rooms of the second floor on the north-east and south-east sides are occupied by the botanical laboratories and by the residence of the professor in charge, one of the greatest botanists of all times, Geheimrath Prof. Edouard Strasburger.

The young botanist who is familiar with the writings of Prof. Strasburger, and has formed some idea of this famous botanical institute, on entering the laboratories for the first time is only surprised and perhaps disappointed, for he sees little that suggests a modern and well-equipped laboratory. The fact that the building was erected in the first half of the eighteenth century, and for another purpose, explains why the rooms are not well adapted for their present use. However, the windows are large, and since there is ample room for apparatus and materials, the investigator has little cause for complaint.

The Botanical Institute includes an elementary laboratory, one for advanced students, a large lecture room, and rooms for assistants and the professor extraordinary. The lecture room is provided with a profusion of charts and diagrams for illustrative purposes. The rooms adjoining the laboratories on the south-east side of the building are occupied by the professor as a residence. Two rooms of his residence Prof. Strasburger devotes to his own work, one serving as a laboratory and the other as a library. In these rooms, which are plainly furnished, everything is orderly arranged and kept scrupulously clean. The library contains, in addition to files of periodicals, all the important works on morphology and cytology. Perhaps the most valuable part of the library is the series of reprints on histological subjects. A copy of almost every cytological paper published, whether treating of animal or plant, is to be found here.

The principal windows of the laboratories and of the residence overlook the palace garden, which has been the botanic garden since the founding of the university. The garden, though small in area, is well stocked and rich in flowering plants. The latter occupy the central part of the grounds, which are carefully laid out and arranged according to the system of Eichler. On either side of the central part is the arboretum, containing many fine specimens of European and some American trees. The arboretum is rich in conifers, one, a cedar of Lebanon, being unusually large and beautiful. A portion of the old palace moat is maintained as a pond for aquatics. The large palm house, the Victoria house, and other greenhouses contain many interesting exotics. The garden has also its special beds of poisonous, economic and medicinal plants, as well as one containing plants, widely separated in relationship, but which have solved certain problems of adaptation in the same way. But it is neither the laboratories, the library, nor the botanic garden that has made the institute at Bonn famous; rather the enthusiasm, earnestness and profound resourcefulness of the master mind that directs it.

Prof. E. Strasburger. From a photograph by K. Fujii.

Prof. Strasburger began his notable series of investigations upon the conifers where Hofmeister left off. In 1872 appeared the large volume with numerous plates upon the morphology and fertilisation of conifers and the Gnetaceæ. This was followed in 1879 by another volume, dealing with the embryology of gymnosperms and angiosperms. His attention having been attracted by the nuclear figures in the endosperm during his earlier studies on gymnosperms, he soon brought to publication a series of observations upon nuclear and cell division. Just thirty-two years ago the nucleus was traced in continuous sequence from

one cell-generation to another, thus establishing for the nucleus beyond all question of doubt the rank of morphological unity. The classic and path-breaking work, "Ueber Zellbildung und Zelltheilung," reached the third edition in 1880, while its author was professor at Jena.

Since going to Bonn, Prof. Strasburger's more important contributions, dealing chiefly with the division of the nucleus and of the cell, with the growth of the cell-wall, the structure of the vascular bundle, and with the process of fecundation, have appeared in five or six volumes, each bearing the principal title "Histologische Beiträge." The bulkiest of these volumes (No. 3), and probably one of the most noteworthy, is on the structure of the vascular bundle ("Ueber Bau und die Verrichtungen der Leitungsbahnen in der Pflanzen"). Apart from several other very important monographs, Prof. Strasburger has prepared the best and one of the most elaborate laboratory manuals and handbooks of microscopic technique known to biological science. "Das botanische Practicum" is now in its fourth edition. "Das kleine botanische Practicum," an abridged edition for the use of more elementary students, was also prepared. A translation of this volume by Hillhouse is still one of the very best botanical handbooks in the English language. With the aid of his former collaborators, the late Prof. A. F. W. Schimper, Prof. Fritz Noll, now of the University of Halle, and Prof. Heinrich Schenck, of the Technical University of Darmstadt, the text-book of botany was prepared, which has gone through several editions and has been translated into several languages.

In more recent years the results of certain important investigations carried on in the institute have been published conjointly by Prof. Strasburger and his students. The most important of these is the volume known as the "Cytologische Studien," which marked the beginning of the more modern phases of cytology. The especial value of this collection of papers consists (1) in the perfection of the best cytological methods known at present for a number of widely differing plants, (2) in the proof that no such structures as centrosomes or centrospheres exist in higher plants, and (3) in the complete establishment of true sexuality in the ascomycetes. Occasionally, Prof. Strasburger carries his private work into fields somewhat removed from the general subject of his life work, though such studies have been comparatively few. In this connection may be mentioned the elaborate study with dicœcious plants, having for its object to determine, if possible, the effect of environmental conditions upon the control of sex. During the past few years the chief work of the institute has centred about problems relating to the physical basis of heredity, such as the individuality of the chromosomes, the transmission of characters in hybrids, &c.

A glance at the vast amount of literature issued from this most famous centre of cytological research is sufficient to convince one who is not a special student of cytology that the main object and life-work of its director is to understand the meaning of the cell by knowing in the most detailed manner its structure at every step of its activity in all kinds of plants, from the lowest to the highest, and that which has been discovered is only a fair index of what is still to be known.

Probably a summary of the day's programme at the institute will not be without interest to the reader. During the winter semester Prof. Strasburger lectures upon the morphology of the plant groups below the spermatophyta, four lectures being given per week. Once a week, on Fridays, the public lecture is given, which is open to all who wish to attend. The subject of these public lectures varies from year to year, but it usually pertains to some topic of general interest concerning plants, and is treated from a philosophical standpoint. In the summer semester the lectures deal with the anatomy and physiology of the higher plants. Before going to the lecture room, the professor makes his daily rounds in the advanced laboratories, visiting each investigator, making inquiries concerning the progress made during the past twenty-four or forty-eight hours, and at the same time offering suggestions and criticisms. A visit is frequently made to the laboratory after the lecture or in the afternoon, depending upon the interest in the particular line of study.

Prof. Strasburger's wonderful grasp of the whole field of morphology and physiology, as brought out in frequent discussions in the laboratory, increases daily one's admiration and quickens in one the consciousness of being in the presence of a master mind. When the marvellous results of this centre of scientific research are considered, and the relatively meagre equipment and lack of convenience, the success can only be attributed to the genius of the man who is the centre of its activity and the source of its inspiration.

D. M. MOTTIER.

EXAMINATION v. *RESEARCH.*

A UNIVERSITY is as much a place for compromise as a party caucus or a church. It has to provide for different needs and to satisfy conflicting interests. It has to preserve its corporate balance against the attacks of specialists and extremists who try to drag it on to a side-track. And it has to do all these things with limited means and limited wisdom. From time to time doubts may well arise as to how far it succeeds in steering the best course. Oxford at present is in the throes of such a discussion. Always critical, she is more critical of herself than of anything less near and dear, and is now enjoying a perfect orgie of self-criticism. But such emotional delights should not lead to oblivion of the fundamental facts of academic life.

Oxford has to find a working compromise between four distinct functions which lead up to four distinct ideals (or exaggerations) of a university. She has to educate, to teach, to examine, and to research, to say nothing of governing herself, which is not, perhaps, the supreme ideal, as our officials are apt to imagine.

(1) Educationally, Oxford is a place where those who can afford it, or are selected by private or public charity as fit recipients of scholarships, may obtain an intellectual training which will fit them (more or less imperfectly) for a number of professional pursuits, and are subjected to a moral discipline which (again somewhat imperfectly) induces them to do less harm to themselves and to create less disturbance in the community than similarly situated youths are wont to do in any other country. Thus Oxford is not an ideal university. But it is as incapable of being the university of Bohemia as of Utopia. Its educational ideal conducts to the perfect gentleman, or, if it fails, to the perfect snob.

(2) As a teaching institution Oxford is expensive, but (on the whole) efficient. It is expensive because it sacrifices the teacher to the taught, and leads the former to bestow upon the latter a great deal of individual attention, more, possibly, than is good for him, more, certainly, than is necessary or than he gets elsewhere. It is efficient because the college spirit is strong, and the competition between the colleges is keen. Wherever this inducement fails, *i.e.* wherever the university conducts the instruction or the college takes no pride in it (*e.g.* in the case of

the "pass" man), the tutor has *not* rendered the "coach" superfluous. Elsewhere the teaching is good of its kind. But since good teaching aims at enabling every fool to appear a genius, it is not an end in itself. The teacher's ideal therefore has to be controlled by a higher, the *examiner's*.

(3) These two functions are quite distinct. The good examiner is not necessarily a good teacher, nor *vice versâ*. The excellence of the teacher lies in his ability to instil knowledge and a desire for knowledge; that of the examiner is held to be the exposing of ignorance and pretence. Experience has shown, also, that competitive examinations are among those aids to learning which appeal most forcibly to the national character. They appeal strongly also to the critical faculties of the academic man, and to the love of power in a class which has naturally few occasions for gratifying this instinct. It has been discovered that though knowledge is power, yet the power of testing knowledge confers *superior* power. It is possible to control all knowledge by conducting examinations in it. This, therefore, is what we have set ourselves to do, and the regular genesis of a new branch of study is, first an examination, then students, and last of all the provision of teachers. This is distinctly suggestive of Looking-Glass Land, but to one who has grasped the rationale of examinations it will not be the paradox it seems.

Now it need not be wholly denied that examination has its uses. A certain amount thereof is necessary, and even beneficial to the soul of the examinee, promoting in him a willingness and capacity to absorb and reproduce teaching and to arrange his knowledge which are very conducive to mental efficiency. But the qualities which examination fosters and rewards are not the only qualities of value. Moreover, the benefits to the soul of the examinee are offset by grave dangers to that of his examiner; for the ideal examiner becomes one who is wholly devoted to the exercise of his function, and wholly critical. He can examine everything but produce nothing.

When, therefore, for these and other reasons which it would hardly be decorous to mention, a university sets up an examination system, and gives it power over the whole realm of knowledge, it runs a risk of sacrificing to this idol all its other functions. Teachers and taught alike are sacrificed to it at the annual holocausts, the results of which are contemplated with such reverence that their fame clings to their victims throughout life, and forms an important factor in their subsequent success or failure. Hence it is an ingenuous refinement of cruelty when professors of eugenics argue statistically that there is a "high degree of correlation" between success in examination and in life. Does it not follow rather that when a university conceives too great an admiration for its examinatorial function, it will grow a mental atmosphere which affects the national mind, and is deadly to all its other ideals? The "perfect gentleman" and the devotee of culture (mental or physical) will be forced by the menace of examination into undignified and banausic efforts to escape expulsion. The ideal of the perfect researcher will hardly be allowed to germinate; for such a university will have as little use and real regard for researchers as for "pass" men.

(4) Yet the Laputan ideal of an academic life of pure contemplation (or, in a more modern but lowered version, of scientific productiveness), exempt from the sordid duties of disciplining, teaching and examining, is in some ways the prettiest dream of them all. It is a sad pity that ever since the days of Dean Swift mankind has laughed at it. For there is some good in the researcher's ideal, even though in its extreme form it is absurd. In practice *no* seat of learning can be made up of professors who do not teach, and exist only as objects of distant contemplation by students fearful of perturbing their sacred meditations. Neither the country, nor our purses, nor our sense of humour, would stand it. Besides, it is a psychological fact that a certain amount of teaching is good for research, just as a certain amount of research is good for teaching. The one helps to clarify the worker's exposition, just as the other helps to imbue the teacher with a flavour of originality. Whether a similar connection could be traced between researching and examining seems more disputable.

But there can be no doubt that at present Oxford sets too low a value on research because it sets far too high a value on examination. This sterilises research both by the excessive selection of minds possessing the excellences of the examinee without possessing those of the real student or of the scientific originator, and by the enormous absorption of time and mental energy which our vast masses of examining exact. The wonder is that with such a system we produce anything at all. It is a still greater wonder that, despite contrary assertions based on our habits of self-depreciation, our scientific output, taking it all in all, is not inferior in quality or even in quantity to that of any other academic institution in the world. The explanation lies in the excellence of our recruiting system. We make ourselves so attractive that even the ablest will welcome an opportunity of joining our ranks. And then the perversity of human idiosyncrasy will divert some of this surplus ability into researches which we tolerate without encouraging. For genius, like murder, will out. But with the high average of ability we have in Oxford we could, and should, produce much more, if only more value were put upon productiveness and less store set by criticism.

Enough has been said, perhaps, to give an idea of the root of the evil. But it is not so easy to suggest remedies; for radical measures are Utopian, and ignore the psychological hold which the examination-system has over the national character. But the following suggestions at least seem wholly practicable. (1) In some subjects, *e.g.* natural science (but not, perhaps, in classics, mathematics, and philosophy), the lead just given by the modern historians might be followed, and a research thesis be permitted to form part of the undergraduate's examination. (2) Most of the university prizes, &c., should be awarded to the best researcher rather than to the best examinee. (3) There ought to be a great development of graduate study, and our teachers ought to be enabled, and even required, to acquire a greater initial superiority in knowledge over the taught than is compatible with a system under which most of them are appointed immediately after examination. It will be a red-letter day when an Oxford college elects a research student pure and simple, a mere B.Sc. or B.Litt., to a fellowship. (4) Fellowship examinations of the sort we now have ought to be abolished; for what is the use of deciding over again whether a man possesses the qualities of a good examinee? A college should ascertain rather whether he possesses also the capacity of working at his subject. And, as we saw, he is not the less likely to make a good teacher on this account. From this point of view it is to be hoped that our new Chancellor will give us at least an object-lesson in self-reform by inducing an alteration in the All Souls fellowship examination. (5) The university and the colleges should largely increase the inducements to their members to proceed to "superior degrees" and to undertake the researches which a doctorate ought to imply. At

present only the "new" doctorates of Science and Letters connote any considerable intellectual achievement (though they all mean much spare cash), and so they are manufactured chiefly for export, and hardly half-a-dozen of the existing college tutors (of whom the present writer was unwise enough to become one) have found it desirable to take them.

There are, I know, difficulties of detail in the way even of these moderate suggestions; but even their partial and gradual adoption would abate the fascination of our examination system, and check the tendency to identify the good examinee, functioning as a good examiner, with the ideal of academic man.

F. C. S. SCHILLER.

PROF. C. A. YOUNG.

FEW astronomical books have acquired or have deserved a wider reputation than has been accorded to the "General Astronomy" of Prof. C. A. Young, and all who have profited by the accuracy and completeness of that work will regret to hear of the death of the distinguished author, who identified himself so closely with the progress of the Princeton Observatory (N.J.). Other popular works, such as "The Sun," have been well received, for Prof. Young's qualities as a writer and teacher were well known and acknowledged. But though accident may have given him distinction as a writer of elementary works, of which his long career as a teacher had shown him the necessity, he had far greater claims on our respect and gratitude. Son of a distinguished astronomer, Dr. Ira Young, of Dartmouth, he was early and severely trained in mathematics and astronomy, and for fifty years he gave of his best to forward the interests of the science he loved. Moreover, his activity synchronised with the recent development of physical astronomy; he was one of the pioneers of solar spectroscopy, and his continued and successful researches in various directions entitle him to ample recognition.

His first appointment was to the chair of mathematics in the Western Reserve College, a post from which he retired only to serve his country in a military capacity during the War of Secession. After the war, he succeeded his father as professor of astronomy at Dartmouth College, leaving that post in 1877 to accept a similar position at Princeton, where his energies found sufficient exercise during the remainder of his professional career.

Like most astronomers who have occupied themselves with solar phenomena, Prof. Young found it necessary to follow the track of many eclipses. The most famous of these is that of 1870, when he, for the first time, saw and described the now familiar appearance of the reversed Fraünhofer lines at the instant of the inner contact of the limbs of the sun and moon. Owing to the much-debated "reversing layer," which he suggested as the true cause of the flash, this eclipse has become historical. He took part in the observations of the solar eclipse of 1878 which passed over the American continent, and visited Europe in 1887 for the Russian eclipse, but without result, owing to bad weather. Onwards to 1900 he was a diligent observer of eclipses, and extended our knowledge of the sun's surroundings as well by his acute observation as by his luminous discussion of results obtained. His early explanation of the spectrum of the corona is now received practically as he gave it.

But Prof. Young's researches were not limited to exceptional opportunities. He gave constant and assiduous attention to the solar spectrum at all times, and was an indefatigable observer of the spectrum of sun-spots, repairing to favourable situations in order to secure good observing conditions. The chromosphere, no less than sun-spots, was the subject of his care, and his catalogue of chromospheric lines, begun so far back as 1872, is a memorable piece of work. Further, he was among the first to determine the velocity of the solar rotation at various heliographic latitudes by measuring the displacement of solar lines due to motion at the source of light. The spectra of planets and comets, of stars and nebulæ, were all made the subject of profound study, for his industry was as untiring as his resource was abundant. His work was recognised by the Royal Astronomical Society, which enrolled him among its associates in 1872, and many other learned societies paid him similar honours. He was the recipient of the Janssen medal of the French Academy of Sciences in 1891, but his great reward must have been the consciousness of the amount and variety of work he had accomplished for the promotion of astronomical science.

NOTES.

WE regret to announce that Prof. J. B. Pettigrew, F.R.S., Chandos professor of medicine and anatomy in the University of St. Andrews, died on January 29 in his seventy-third year.

WE observe with great regret the announcement that Mr. W. A. Shenstone, F.R.S., senior science master in Clifton College since 1880, died on Monday, February 3, at fifty-eight years of age.

A REUTER message from Brussels announces the death of M. A. Lancaster, director of the meteorological department of the Royal Observatory of Belgium at Uccle.

PROF. W. RIDGEWAY, professor of archæology in the University of Cambridge, has been elected president of the Royal Anthropological Institute.

THE French Physical Society has undertaken the publication of a collection of physical constants. The general secretary, M. H. Abraham, has issued an appeal to members of the society to assist in the collaboration.

THE King, who is patron of the Society of Arts, has granted permission to the society to prefix to its title the term "Royal," and the society will consequently in future be known as the "Royal Society of Arts."

ON Tuesday next, February 11, Prof. Stirling will begin a course of six lectures at the Royal Institution on "Membranes: their Structure, Uses, and Products." The Friday evening discourse on February 14 will be delivered by Dr. C. W. Saleeby on "Biology and History," and on February 21 by Sir Oliver Lodge on "The Ether of Space."

SIR PHILIP WATTS, K.C.B., F.R.S., Director of Naval Construction, has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public services."

THE annual general meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 14 and 15. The annual dinner will be held—under the presidency of Sir Hugh Bell, Bart.—in the Grand Hall of the Hotel Cecil on Thursday, May 14. The autumn meeting will be held in Middlesbrough on September 29 and following days.

IN *Engineering* of January 31 there is a sympathetic account of the career of Dr. Coleman Sellers, the eminent American engineer, who died on December 28, 1907, at his residence in Philadelphia in his eighty-first year. He was best known in connection with machine tools, but he will also be remembered for his scheme for utilising the water-power of Niagara Falls, and by his inventions in photography and microscopy.

A CORRESPONDENT asks if the use of wires stretched horizontally at a height of 15 feet or 20 feet in concert halls, churches, and other buildings where the acoustic properties are of the first importance is not based upon erroneous ideas. He expresses the opinion that though the wires are supposed to remedy some fault in the acoustics, they do not produce any useful effect. We are informed that, theoretically, the wires absorb some of the energy and radiate it again in all directions, thus diminishing the amount of regular reflection, constituting echoes, from the walls. But the fraction of the vibrations thus treated is so small that it is difficult to believe the wires have any real, beneficial effect.

MR. H. F. WITHERBY, editor of *British Birds*, informs us that an inquiry is being made into the nature and origin of the disease from which many wood-pigeons have died this winter. The subject is of considerable interest; moreover, possibly the disease, which is very infectious among wood-pigeons themselves, may also be contracted by other birds, and especially game birds. A systematic inquiry into the disease has therefore been undertaken, and schedules of questions have been posted to readers of *British Birds*, the editor of which will be glad to send schedules to anyone who may be in a position to give information on the subject. All the observations will be collated and studied by Dr. C. B. Ticehurst, of Guy's Hospital, who will draw up a full report at a later date.

THE fourth International Congress of Mathematics will be held in Rome on April 6–11. The congress will be divided into four sections. The first section will be concerned with arithmetic, algebra, and analysis, and discussions will be inaugurated by Profs. Arzelà, Capelli, Pascal, and Pincherle. The second section will deal with geometry, and the work will be introduced by Profs. Bianchi and Segre. The third section, covering mechanics, mathematical physics, geodesy, and various applications of mathematics, will be addressed by Profs. Levi-Civita, Luiggi, Pizzetti, and Toja. The fourth section will take up philosophical, historical, and didactical questions, and addresses will be given by Profs. Enriques, Loria, and Vailati. Numerous lectures have been arranged, and among these may be mentioned that by Prof. Forsyth, F.R.S., on the present condition of partial differential equations of the second order, as regards formal integration. Other lectures will be delivered by Profs. Darboux, Hilbert, Klein, Lorentz, Mittag-Leffler, Newcomb, Picard, Poincaré, Veronese, and Volterra. Full particulars of the congress can be obtained from the general secretary, Prof. G. Castelnuovo, 5 Piazza S. Pietro in Vincoli, Rome.

REFERRING to the letter by the Rev. John J. Hampson in our issue for January 30 (p. 295) dealing with "stock frost" or ground ice, Mr. D. O. S. Davies, of the Norwich Technical Institute, reminds us of a volume on the subject of "Ice Formation, with Special Reference to Anchor-ice and Frazil," by Prof. H. T. Barnes, of McGill University, Montreal. Prof. Barnes provides information on the points raised by Mr. Hampson in his letter. The book, a descriptive review of which appeared in the issue of NATURE for January 17, 1907 (vol. lxxv., p. 267), is published in this country by Messrs. Chapman and Hall, Ltd.

THE *South-Eastern Gazette* of January 28 contains an obituary notice of the late Mr. Edward Bartlett, who from 1875 until 1890 occupied the post of curator and librarian of the Maidstone Museum. The deceased naturalist was a son of the late Mr. A. D. Bartlett, the well-known superintendent of the Zoological Society's menagerie in the Regent's Park. In his earlier years Mr. Bartlett travelled as a natural history collector in Upper Amazonia, where he obtained many valuable specimens. Later on, 1863–4, he accompanied the late Canon Tristram to Syria and Palestine, and in 1891 left Maidstone for Sarawak, to act as curator of Raja Brook's museum, a post which he occupied until 1897, when he returned home. Mr. Bartlett edited his father's well-known work "Wild Animals in Captivity," and was himself the author of several papers on natural history subjects.

NO. 13 of the Bulletin of the Imperial Academy of Sciences of St. Petersburg for 1907 contains a paper, unfortunately in Russian, by Mr. D. Dejneka, on the nervous system of the nematode worms.

WE have received copies of two papers published by the author at Lancaster, Pa., as Nos. 1 and 2 of a new serial, *Weber's Archives*, in which the author, Veterinary-Surgeon Weber, claims to have bred from the eggs of the ordinary gnat, *Culex pipiens*, two other species of gnats or mosquitoes, in addition to the normal progeny. "Mutation in Mosquitoes" is the title of the second and larger paper. The earlier one, which contains a preliminary account of the same alleged phenomenon, is a reprint of an article published two years ago in *Natur und Haus*, vol. xv., May, 1907.

TWO papers on the reproductive organs of sharks have recently appeared within a short time of one another. The first, by Mr. Albert Krall, is published in vol. xxxvii., part iv., of the *Morphologisches Jahrbuch*, and devoted specially to the "claspers" on the pelvic fins of the male of *Hexanchus griseus*, and generally to the corresponding organs in other sharks. In the second, which appears in vol. xxxviii., part iv., of the *Zeitschrift für wissenschaftliche Zoologie*, Dr. Victor Widakowich describes the uterus of the spiny dog-fish (*Squalus acanthias*), with remarks on the developmental history of allied species. The structure of the uterus is described in great detail, and a figure given of a portion of its wall containing an embryo.

CONSIDERABLE interest attaches to an account by Mr. C. H. Danforth, published in vol. xxxiv., No. 1, of the Proceedings of the Boston Society of Natural History, of a new genus and species (*Paedoclione doliiformis*) of pteropod mollusc from Casco Bay, Maine. The new form, which was taken in plankton, "does not properly fall under any established family, although perhaps it approaches most nearly the Clionidæ, from which it differs in having an odd number of cephalocones and the entire posterior part of the body filled by the viscera." In life the creatures swam for some time by means of their fins, and then sank for a time below the surface, after which the swimming was resumed. With the exception of numerous vacuoles in the integument filled with yellowish or yellowish-brown fluid, the body is transparent.

THE distribution of the pine-marten in England and Wales forms the subject of an article by Mr. H. E. Forrest in the January number of the *Zoologist*. In the midland

and south-eastern counties of England the species, it appears, became rare during the first half of last century, and in most of these it was exterminated before 1860, although isolated occurrences have been recorded since that date in Hertfordshire, Surrey, and Sussex. In Lincoln, Norfolk, and Suffolk it survived until the 'eighties, and there have been recent occurrences in Leicestershire. The Lake District and the west of north and central Wales are, however, at present the sole strongholds of the species. Many of the isolated occurrences appear to be due to the remarkable degree to which the marten wanders.

In addition to the well-known fishery of the pearl-oyster, Ceylon, it appears from an article by Dr. A. Willey in *Spolia Zeylanica* for November, 1907, possesses a source of pearl in beds of the "window-pane oyster" (*Placuna placenta*) in the backwaters of the eastern province. These beds occur in the backwaters of two neighbouring divisions of the Trincomali district, one of which includes Lake Tamblegam, the headquarters of the Placuna fishes. As the lease of this fishery recently expired, Mr. Willey was sent to the district to report on the best means of improving the product of oysters. These molluscs, it seems, are liable to be destroyed in large numbers by unusually heavy falls of rain such as took place a year ago; nevertheless, the species is in the main a hardy creature, capable of living for several hours out of water, and of surviving for long periods in earthenware vessels if the water be from time to time changed. No mention is made by the author of the annual value of the pearls yielded by the Placuna fishery. The paper includes an account of cysticercoid larvæ found parasitic in these oysters.

Mr. W. Taliew contributes to the *Bulletin du Jardin Impérial Botanique* (vol. vii., part iii.), St. Petersburg, a paper on the distribution of forests in the district of Starobjelsk, which furnishes evidence that the "steppes" were formerly wooded areas. Mr. A. A. Sapehin discusses the method by which water is absorbed by the sacs in such liverworts as Frullania.

Lieut.-Colonel F. Bailey and Mr. R. C. M. Ferguson both contribute articles to the Transactions of the Scottish Arboricultural Society (vol. xx., part i.) on the Interlieven State forest. The purchase by Government of this estate in Argyllshire affords great satisfaction to British foresters, but it is hoped that it is only the first step in the policy of acquisition by the State of land for afforestation purposes. The estate, consisting of 12,000 acres, carries very little timber, so that while it affords an opportunity for showing how timber crops can be scientificially grown and for recording data, it will not for many years provide a demonstration forest. It is urged that two wooded areas should be acquired for this purpose, one in the lowlands where hardwoods are cultivated, and one in the highlands stocked with conifers.

It is a debated question whether it is preferable for science students to undertake practical experiments with instruments of their own construction or to make use of apparatus manufactured by instrument makers. Prof. F. W. Ganong, formerly an advocate of the former method in botanical physiology, now declares in favour of instruments of greater precision, and with this purpose has designed several pieces of apparatus that are being manufactured by Messrs. Bausch and Lomb; a descriptive catalogue can be obtained from their agents in London, Messrs. Staley and Co., Thavies Inn. Among the instruments are a transpiration balance, clinostat, autographic transpirometer, leaf-area cutter and leaf clasp, but the photosynthometer and respirometer will probably be found the most useful on account of the functions they record.

A batch of pamphlets issued from the Royal Botanic Gardens, Ceylon, as Nos. 2 to 5 of vol. iv. of the Circulars and Agricultural Journal, has been received. Mr. E. B. Denham, writing on the use and objects of agricultural societies, attaches much importance to the visits of travelling instructors and to the distribution of leaflets printed in the vernacular; also he suggests that the local societies should make it their business to collect agricultural data. In connection with camphor production, Mr. J. K. Nock has prepared a useful circular on propagation. Practical hints are given for preparing the seed beds and raising the seedlings. If good seed is not obtainable, it is recommended to propagate by means of root cuttings. The chief object of a circular by Mr. T. Petch is to direct attention to a stem disease caused by the ascus-bearing fungus *Massaria theicola*. The hyphæ of the fungus fill up the vessels of the wood and cut off the supply of water and salts. The disease can be traced by the discoloration of the wood. A catalogue of plants available for distribution from the gardens has been prepared by the curator, Mr. H. F. Macmillan. The economic list comprises certain spice, rubber, fibre, and drug plants.

We have received the first number of the *Quarterly Journal of Experimental Physiology*, a new periodical issued under the editorship of Profs. Schafer, Gotch, Halliburton, Sherrington, Starling, and Dr. Waller. The four papers contained in it maintain a high standard; they are:—(1) on the time taken in transmission of reflex impulses in the spinal cord of the frog, by Florence Buchanan; (2) some comparisons between reflex inhibition and reflex excitation, by C. S. Sherrington; (3) the freezing of frog's nerve, with special reference to its fatigability, by John Tait; and (4) on protagon, by R. A. Wilson and W. Cramer. We could have wished that it had been possible to avoid the issue of a new journal, but with so distinguished an editorial committee we presume its appearance is necessary for the advancement of physiological science.

In the third report to the Gas Engine Research Committee, presented to the Institution of Mechanical Engineers on January 17 by Prof. F. W. Burstall, the results were given of an interesting series of experiments carried out during the past two years on an adapted form of one of the Premier Company's existing types of gas-engine. The engine employed was capable of giving 150 horse-power at a speed of 170 revolutions per minute, the size of the cylinder being 20 inches in diameter with a 24-inch stroke. The diameter of the cylinder was reduced to 16 inches, and an entirely new breech end was constructed with the admission and exhaust valves horizontal. The tests were undertaken to determine the thermal efficiencies based on the indicated horse-power at various compressions, having regard to the richness of the mixture, and to formulate, if possible, the law connecting efficiency and compression. The results of the experiments appear to show that the most economical mean pressure is very considerably below the maximum that can be obtained, and that the highest economies are obtained with a comparatively low maximum temperature. Both these conclusions imply that the engine should not only be subjected to lower pressure, but to lower temperatures as well, and thus many of the difficulties that arise in large engines from rich charges might be avoided, and the maximum pressures kept down to quite

reasonable limits. This applies only to the indicated power; the conclusions as to the brake horse-power would be widely different. If, however, the engine is constructed to work only with these moderate pressures and temperatures, the whole of the working parts might be very much lightened, and a good mechanical efficiency obtained with the very moderate mean pressures.

AT the meeting of the Institution of Engineers and Shipbuilders in Scotland on January 21, two papers of considerable interest were presented. In the first Mr. J. J. O'Neill discussed the inter-relation of the theory and practice of shipbuilding, with special reference to the speed-power aspect of the question. He considered that the lengths of the present Atlantic liners warrant the belief that greater power can be obtained, providing that the power their dimensions invite is present. The curves of power also show that the present speeds can be attained on shorter lengths, and that the variations of form involve relatively small gains. The possibilities of the future of the steam turbine, the chief function of which is its capability to obtain greater powers on a given weight than its competitors, widen considerably the vista of engineering practice. With regard to the screw-propeller, the author is inclined to think that, had the same attention been devoted to the screw-propeller problem as has been bestowed on the form of the vessels, greater advantages than the slight variation of form effected would have been secured. In the second paper Mr. I. V. Robinson gave some comparative figures of the cost of power generated by gas and by water. The results show that power generated from blast-furnace gas costs about the same as water-power when the capital cost of the generating station, with or without transmission lines as may be required, is about 18*l*. per horse-power delivered at the consumers' boundary.

THE new French ethnographical review, *Revue des Études ethnographiques et sociologiques*, under the editorship of M. A. van Gennep, starts its career in the number for last month with an excellent programme. Dr. J. G. Frazer contributes a chapter from the new forthcoming edition of the "Golden Bough" on "St. George and the Palilia." The Palilia is a Roman spring agricultural feast, at which the herdsman used to make a sacrifice to Pales and invoked his protection for the flocks, praying him to grant rain for the pastures and to protect the cattle from wolves. In Esthonia, about the same time of the year, a feast is held in honour of St. George, who grants fertility to women and flocks. In eastern Europe the saint seems to represent the old spring god of the Lithuanians, Pergrubius, and, further east, Tammuz or Adonis. With his wide knowledge of peasant rites and ceremonies, Dr. Frazer has no difficulty in establishing the connection between these varied cults of agricultural and pastoral life. This paper is followed by an elaborate sketch by M. M. Delafosse of the Siena or Senoufo tribe, who inhabit the French territory in West Africa in the region adjoining the British Ashanti frontier. M. C. Boreux discusses the decorated pottery of pre-dynastic Egypt. Some reviews and a bibliography complete a publication which promises to be of considerable value to ethnologists.

THE current issue of the Journal of the Scottish Meteorological Society (No. xxiv., third series) contains memorial notices of Dr. Buchan from several men of science, including Prof. Hann (Vienna), Dr. Shaw and Dr. Mill (London), testifying to the enduring value of his numerous and "epoch-making" investigations. Mr. H. Bell contributes an article on thunderstorms at the Ben Nevis observatories and on the Scottish coasts, on which subject Dr. Buchan was recently engaged. Tabular statements show the cases of occurrence of thunder and lightning from 1884 to 1904, together with their seasonal and diurnal range. The atmospheric conditions which determined the displays were of a very complex character, and are not yet fully understood. The same journal contains (1) an interesting article, by Mr. R. G. K. Lempfert, on the present condition of telegraphic weather services in various countries; especial reference is made to the great importance of recent extensions of area due to the exertions of the Danish and Egyptian Governments. (2) Rain-producing east winds and their influence on the summer of 1907, by Mr. R. Richardson; the author considers that one of the principal causes of the phenomenally bad character of that summer was the frequent sudden shifting of the wind to the east.

MM. P. WEISS and V. Planer give the results of their comparison of the energy losses due to hysteresis in iron, steel, and nickel, in alternating and rotating magnetic fields respectively, in the *Journal de Physique* for January. As previous observers have found, the loss in a rotating exceeds that in an alternating field for comparatively weak fields, but the authors find that for electrolytic iron the loss in the rotating field reaches its maximum when the intensity of magnetisation is about 1200, and decreases to zero at intensity 1700. For steel, the maximum occurs at 1000 and the zero at 1600. For nickel the corresponding numbers are 300 and 500 respectively. The energy losses at the maxima are 17,000, 120,000, and 17,000 ergs per c.c. per cycle respectively.

THE small intensity of the electric waves emitted by a sender consisting of a comparatively short vertical wire, to the top of which a long horizontal wire is attached, in the direction in which the latter points, and the great intensity of the waves sent in the opposite direction, was pointed out by Mr. Marconi in 1906, and in the *Physikalische Zeitschrift* for January 15 Dr. J. Zenneck works out the theory of a receiver of the same form. Such a receiver is most sensitive to waves coming from the direction opposite to that in which the horizontal wire points, for then both the vertical and horizontal components of the electrical field are utilised. The best ratio of vertical and horizontal lengths depends on the ratio of the corresponding components of the wave, and on the conductivity of the soil, but in any case the efficiency of the receiver may be increased by attaching a wire to the base of the vertical wire and extending it on or under the surface of the soil towards the arriving waves.

IN a communication to the Royal Academy of Belgium (Bulletin, 1907, No. 6, p. 684) Prof. Walthère Spring gives an account of his further researches on the nature of the allotropic forms of sulphur. Whilst in a previous paper (see NATURE, vol. lxxv., p. 182) he was able to show that the sulphur obtained on decomposing a solution of hydrogen sulphide with sulphur dioxide is a hydrate, S_8,H_2O, it is now demonstrated that the material precipitated by the action of ferric chloride on a solution of hydrogen sulphide is not hydrated, but is a new allotropic form of the element. The new variety has a density which is sensibly the same as that of orthorhombic sulphur, and like the latter dissolves in carbon bisulphide, but it differs from it and from all other known forms of the element in its specific heat. Precisely the same form, giving identical values for the density and specific heat, is also obtained on decomposing an alkaline polysulphide in solution by means of an acid.

In a note published in the *Atti dei Lincei* (vol. xxvi., 2, p. 717) under the title "The Origin of Stereochemistry," Prof. E. Paternò points out that in 1869, five years prior to the publication by Le Bel and van 't Hoff of the doctrine of the asymmetric carbon atom, he suggested that if *three* isomeric forms of the compound $C_2H_4Br_2$ actually existed, the fact could be explained by assuming the four affinities of the carbon atom to be directed towards the corners of a tetrahedron. This was the first occasion on which the hypothesis of the tetrahedral configuration of the carbon atom was definitely formulated. Although the validity of Prof. Paternò's claim has already been admitted in some quarters, it is not generally known to chemists that the conception of a tetrahedral carbon atom, the basis of modern stereochemistry, had been proposed earlier than the year 1874, when it was brought forward simultaneously by Le Bel and van 't Hoff.

The whole of the mathematical and physical library of the late Prof. A. S. Herschel, F.R.S., and also works from the library of the late Mr. F. Moore, author of books on the Lepidoptera of India and Ceylon, are included in a catalogue just issued by Mr. T. Thorp, Guildford, Surrey, who offers the books for sale.

An enlargement by four diameters of a photograph of the moon taken by Mr. W. Rice with a Goerz telephoto lens, the exposure being three-fifths of a second, has been sent to us by Messrs. G. Philip and Son, Ltd. The photograph was taken twelve hours before the moon was full, and though the enlargement, which is 6 inches in diameter, is not remarkable for any details it shows of lunar features, it gives a real impression of our satellite as a ball in space, this appearance of relief being accentuated by the bright streaks radiating from the crater Tycho near the south lunar pole.

At the anniversary dinner of the Royal Society on November 30 last, Lord Dunedin bewailed the fact that few men of science make any attempt to describe their investigations in language which can be understood by men of culture without special scientific knowledge. This speech, as was pointed out in Nature (vol. lxxvii., p. 111), gave rise to a correspondence in the *Times*, in which the advantage of increasing interest in scientific work by making the results as widely known as possible was insisted upon in many quarters. A similar necessity has been recognised in America, and an attempt is being made at Columbia University to provide literature of the kind required. The Columbia University Press has arranged to publish in the form of pamphlets a series of twenty-two descriptive lectures in non-technical language of the achievements of science and modern scholarship. We have received copies of the first two pamphlets; the first, on mathematics, is by Prof. C. J. Keyser, and the second, on physics, by Prof. E. F. Nichols. A doubt may be expressed as to whether the language of these lectures will be simple enough for the public for whom they are intended. The pamphlets partake largely of the character of the Royal Institution lectures, reprints of which are often available in this country, and contain terms and ideas which, though simple enough to the reader with some training in science, present difficulty to the student whose education has been chiefly on literary lines. It will be interesting to learn later the extent of the encouragement received by the Columbia University Press. The price of the pamphlets is in every case to be 25 cents.

OUR ASTRONOMICAL COLUMN.

The Distortion of Photographic Films in Stellar Work.—In No. 1, vol. i., of the Publications of the Allegheny Observatory (Pennsylvania), Dr. Frank Schlesinger discusses the possibilities of error introduced into photographic star-measures by reason of the distortion undergone by the film during the process of development. He further describes some experiments and measures he has made in order to determine the magnitude of this error. By developing, drying, and measuring a negative in the ordinary way, and afterwards putting it through the developing, fixing, washing, drying, and measuring processes again, he has obtained the data from which he draws his conclusions. Briefly, he finds that this error is much smaller than the error of bisection for good star images, being of the order of one one-thousandth of a millimetre for the kind of plate employed.

Two Hundred New Double Stars.—Lick Observatory Bulletin No. 125 contains a list, and measures, of 200 double stars discovered by Prof. Aitken. This is the eleventh list of its kind, and the stars now announced bring the total of Prof. Aitken's published discoveries up to 1700. Nine fainter companions to previously known pairs are included in the present list, which also contains measures of the unusually bright and close pairs κ Ursæ Majoris and ν^2 Boötis (Aitken, 1585 and 1634) as follows:—

	Date	Angle	Distance	Mag.	Annual proper motion
κ Ursæ Majoris	1907·83	283°·2	0″·21	4·6–4·2	0″·079 in 211°·1
ν^2 Boötis	1907·55	237°·0	0″·03	5·5–5·5	0″·04 „ 246°

A New Astronomical Journal.—The members of the progressive astronomical society of Antwerp having expressed a desire for a publication which would give the various ephemerides, and a simple account of the astronomical phenomena to be observed from time to time, the council of the society has commenced the publication of the *Gazette astronomique*, which is to appear monthly, and is designed to fill the gap indicated; popular articles on astronomical subjects are also to appear. No. 1 (January 4) contains various ephemerides, notes on phenomena occurring during January, accounts of the recent transit of Mercury, and a series of notes dealing, respectively, with the planets, asteroids, meteors, comets, &c. The annual subscription for this useful publication is three francs, post free in all countries, and all communications should be addressed to "Gazette astronomique," Chaussée de Turnhout, 342, Borgerhout, Antwerp, Belgium.

The Study of Meteor Trains.—The *Monthly Weather Review* (U.S.A.), vol. xxxv., No. 9, contains a suggestive article by Prof. Trowbridge on the utility of the precise observations of meteor-train drifts for the determination of atmospheric currents at altitudes otherwise inaccessible. This altitude, of meteor trains seen at night, ranges from forty-five to sixty-five miles, and Prof. Trowbridge believes that the conditions of pressure and temperature at about fifty-five miles above the earth's surface are possibly peculiarly suitable for the production of trains; careful study may enlighten us as to these conditions. Several recorded trains are illustrated in the article and fully discussed, and the author suggests that valuable results may follow from an organised series of careful observations.

The Accuracy of Double-star Measures.—A paper by Prof. Doberck, appearing in No. 4229 of the *Astronomische Nachrichten* (p. 65, January 21), should appeal to double-star observers. In it the author gives the probable constant errors, and the residuals after applying these constant, or the mean, errors to the observations, in position-angle and distance for some fifty past and present observers. The probable errors are based on the comparison of the results of the various observations with the positions calculated from the orbits of thirty double stars recently determined by Prof. Doberck. The effects of difference of colour, which, as Prof. Doberck remarks, must be considerable, are not discussed in the present paper, but the same worker expects to deal with them later. The variations of the probable errors caused by increase of the distance between the components, and by

greater differences of magnitude, are well shown in some of the results, although in other cases magnitude appears to have made no difference. Thus Admiral Smyth's results show a probable error in angle of $\pm 0''.031$ below $3''$ and $\pm 0''.049$ above $3''$, but it is not certain whether the magnitudes have any influence; there is no evidence of systematic error in the distances, but an average constant error of $\pm 0''.073$ is indicated. Prof. Doberck states that these observations are of very great value. In the case of H. Struve the magnitude coefficient is probably considerable.

FORTY-ONE NEW VARIABLE STARS.—Circulars No. 134 and No. 135 of the Harvard College Observatory announce the discovery of forty-one variable stars. Of the sixteen announced in the former, two show remarkably large variations. One of these, D.M.$-30°.2883$, situated in Columba, decreases from magnitude 10·4 to below magnitude 15·0, whilst the other, D.M.$-46°.14688$, situated in Phœnix, ranges from 8·5 to less than the twelfth magnitude. The variations of a number of stars announced in Circular No. 129 have been confirmed visually, and of these TT Aquilæ is especially interesting on account of its brightness and probable colour changes. The second circular gives particulars of twenty-five newly discovered variables found in regions Nos. 24, 36, and 42 of the Harvard map. In this research the number of variables found to be of the Algol type has been a remarkable feature, and of the twenty-five now published, eight are probably of this, or of the β Lyræ, class. The large number of variables found in map 42 appears to be significant, and should be taken into account in any discussion of the region, which includes a large portion of the constellation Scorpio and the nebulous region in Ophiuchus.

AMERICAN ETHNOLOGY.

THE American Bureau of Ethnology, with its usual energy, has lost no time in extending its operations over the new colonial possessions, the Philippines, and some West Indian islands. The most important contribution to the twenty-fifth volume of its reports, for 1906–7, is an account of a preliminary survey of Porto Rico and the neighbouring islands, conducted by Dr. J. W. Fewkes.

Porto Rico, the smallest of the Greater Antilles, is naturally linked with Venezuela by the chain of the Lesser Antilles, which stretch southwards to the mouth of the Orinoco. It lies within a region of volcanic disturbance, and it is possible that when it was first occupied by man it may have formed part of an isthmus connected with the South American coast. A temperate climate and a productive soil naturally invited colonisation. The fauna and flora are of the South American type, and many considerations support the conclusion that Porto Rico and the adjoining islands were peopled from the valley of the Orinoco. Thus the houses of the people of both these regions are similar in type, and we find no traces of stone buildings which would naturally have been erected by emigrants from the Maya or other Yucatan tribes. The use of cassava, a South American product, and the care which the primitive inhabitants of Porto Rico, like those of the Orinoco, devoted to the preservation of the skeletons of their dead, are facts pointing in the same direction.

Except in the interior of the island, few traces of the aborigines survive. The inhabitants were massacred by the Spaniards, who re-peopled the island with slaves from the Bahamas and negroes from Africa. From the intercourse of these people with their rulers a half-caste population sprang up. Thus the island at present is occupied by a mixed race, and the absence of a collection of the skulls of the aborigines renders it difficult to decide what their race character may have been. The accounts of their physique and character given by the early Spanish writers do not, however, conflict with the theory of their South American origin.

The relics of this forgotten race are to be found in the dancing plazas, shell-mounds, and caves scattered over the island. The character of their stone carvings and pottery indicates that they had reached a high grade of culture. The plazas were stone enclosures in which ceremonial dances were performed with the object of securing abundant rain and plenteous harvests, success in war, the cure of the sick, for commemoration rites of the dead, initiation and other ceremonies. They often contain

FIG. 1.—Lateral and top views of a three-pointed stone of the second type (Latimer collection); length 3 inches.

water-worn stones, which Dr. Fewkes supposes to have been emblematic of flowing water, and to have been used in some form of mimetic magic to control the rain. Their religion was of the animistic and shamanistic type, and its ritual largely consisted in the worship of Zemis, a term which included their gods, symbols of deities, idols, bones, skulls of the dead—in short, anything supposed to possess magical power.

The most remarkable idols were those of the "three-pointed" anthropomorphic type (Fig. 1). The interpretation of these objects is obscure, and many theories of their origin have been suggested. Dr. Fewkes regards them as clan idols or tutelary totems, the difference in their form denoting different conceptions of the Zemi in the various clans. Equally curious are the zoomorphic or anthropomorphic pestles (Fig. 2), which were employed with mortars in the preparation of food, and the stone collars, which, according to one theory, were used in association with the "three-pointed" images, and with them formed a snake idol. This explanation Dr. Fewkes rejects; but, except that they must have been used for some religious or ceremonial purpose, their meaning is still uncertain.

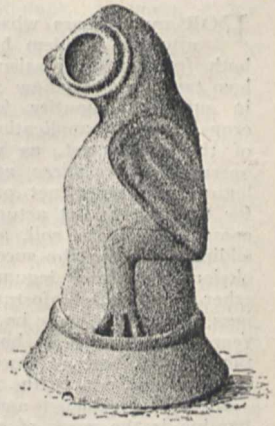


FIG. 2.—Bird-shaped pestle from Santo Domingo.

The rude pictographs or petroglyphs found in the island are equally remarkable. Some of the best specimens are engraved on boulders in rivers or in their vicinity, thus possibly indicating their use in some mimetic rain ceremony. Others, drawn with less care, differing from the river sculptures in size, shape, and apparently in significance, are inscribed in the caves so common in the calcareous rocks of the island. They represent in some cases a head furnished with horns, human faces, and rude representations analogous in type to the "three-pointed" images, with circles, spirals, and other symbols. Our knowledge of the aboriginal cults is at present too scanty for any attempt to explain their significance. That they represent objects of religious worship seems fairly certain.

Porto Rico is thus a most promising field for archæological investigation. The report of Dr. Fewkes suggests many interesting problems. It is well written, and, like other publications in the same series, is admirably illustrated.

Another article by the same writer describes a tour of exploration in eastern Mexico, undertaken with the object of ascertaining the relationship between the mound builders of the lower Mississippi and the people of the Mexican coast known as Totonac and Huaxtec. The Totonac metropolis, Cempoalan, was for the first time examined. From this investigation it seems probable that the mound builders of the southern States were more closely connected with the races of eastern Mexico than with those of the arid region of the south-west or even with the plateau tribes of eastern Mexico.

The third part of the thirteenth volume of the Journal of the Academy of Natural Sciences, Philadelphia, is devoted to a fresh exploration of Moundville, Alabama, and sites on the Crystal, Chattahoochee, and Lower Flint Rivers, and the Ten Thousand Islands of Florida, by Mr. C. B. Moore. The appearance of the Swastika symbol and other objects discovered at Moundville seems to indicate that this was an important religious centre, specially devoted to the worship of the sun, conducted in temples by an order of priests, who kept the sacred fire continually burning as an emblem of the luminary. The discovery at the Crystal River of an ear-ornament overlaid or covered with meteoric iron is an interesting proof of the skill of this race in metallurgy, and it seems to connect the races of Florida, who buried their dead in mounds, with the people of the Ohio valley region. This report also is provided with excellent illustrations of the remarkable series of finds which were secured by Mr. Moore's expedition.

THE NITROGEN PROBLEM IN AGRICULTURE.[1]

FOR many years what is known in agriculture as the nitrogen problem has received considerable attention both from men of science and from practical men. It has two aspects. Few soils contain nitrogen compounds in sufficient quantity for the needs of non-leguminous crops, and the application of nitrogenous manures is one of the commonest, as well as one of the more costly, operations of modern agriculture. On the other hand, leguminous crops not only need no nitrogenous manure for themselves, but actually increase the store of nitrogen compounds in the soil, and dispense with the necessity of adding more for the succeeding crop. The problem would obviously vanish if leguminous crops could be grown every other year, but unfortunately they are liable to "sickness," and can only be grown once in four or even six years. Even as it is, however, any method that increases the nitrogen-fixing power of a leguminous crop is a welcome addition to the resources of a farmer.

In 1886 Hellriegel and Wilfarth showed that nitrogen-fixation is the work of certain micro-organisms associated with the leguminosæ. It has since been shown that they can grow apart from the plant, and can be inoculated into soils, and also that an increased crop may follow such inoculation.

On three occasions cultures of these organisms have been widely distributed among farmers. In 1896 Nobbe sent out "nitragin"; in 1903 Moore's cultures were issued in America; and now we have Prof. Bottomley's cultures. Each time very great and widespread interest has been aroused, the matter has been discussed at length in the daily Press, and has even on occasion formed the subject of questions in the House of Commons. The subject appeals to almost everyone. Few scientific problems are more interesting than the wholly unparalleled synthesis of complex organic compounds from free nitrogen and other simple bodies effected by these micro-organisms at the low temperatures of the soil. The practical man sees in inoculation the possibility of increased leguminous crops and of less expenditure on nitrogenous manure for his other crops. The man in the street, who has always been ready to take an interest in nitrogen since Sir William Crookes's British Association address at Bristol in 1898, sees the threatened nitrogen famine averted and his food supply rendered secure for a long time to come.

Inoculation has proved very successful on virgin soils, or in dealing with new leguminous crops, but there is little or no evidence that it is effective when the soil is already in cultivation and the crop no longer new. Nobbe's cultures failed, and Moore's cultures were not particularly successful when applied in ordinary farm practice. Certain other less boomed cultures, *e.g.* Hiltner's, have done better, and have sometimes given 20 per cent. or 30 per cent. increases in crop. Prof. Bottomley tested his culture by distributing more than a thousand specimens; 80 per cent. of the reports received (unfortunately we are not told the actual number) showed an increase in crop. The pamphlet before us consists largely of extracts from these reports.

Experiments of this nature are very difficult to carry out. Great care is necessary in selecting the ground, proper control plots are needed, and the experiment must be continued for several years without essential modification. Under favourable conditions, the error of a field experiment lasting many years may be as low as 5 per cent., but for shorter periods it is much higher. We cannot find any evidence that these facts have been taken into account; on the contrary, most of the trials have obviously been made by novices. Only in a few cases have any weights been taken, and the results have usually been guessed. Here is an "experiment" with peas:—

"I planted the inoculated peas on land that had not been manured for many years, and had a crop of peas quite equal to those grown by a friend on manured soil" (p. 24).

Another:—"'Gradus' *without inoculation*, a fair crop, but they were soon over."

"'Sutton's A 1' *inoculated*, heavy crop, with abundance of well-filled pods" (p. 21).

Again:—"First sown peas, inoculated, a fine crop. . . . Second sowing, uninoculated, results very poor. . . . The ground on which first crop was sown had had no peas on it for several years, whereas the ground on which second crop was sown had had peas grown on it in the previous year" (p. 17)

It is scarcely necesary to say that statements of this kind are of no scientific value.

Fifty-two reports are quoted; fifteen must certainly be rejected, eighteen give no figures, thirteen give estimated figures, and six give weights. Confining our attention to the nineteen cases where figures are given, we find that in four the increased yield is 20 per cent. or less; this cannot be much greater than the magnitude of the experimental error. In nine cases the estimated increase is 30 per cent. to 50 per cent., and in five cases more than 50 per cent. A detailed discussion is obviously impossible; we can only point out that a few experiments properly made on sound lines would have been very much better than all these testimonials. So far as they prove anything at all, however, they go to show that the author has, like Hiltner in Germany, Moore in the United States, and Golding here, obtained cultures which may in suitable cases increase the yield of leguminous crops, and the increase seems to be estimated in the majority of cases at about 30 per cent. to 50 per cent.

Now if it this turns out to be correct it will be a very useful result, but in ordinary farming it can only be

[1] "Seed and Soil Inoculation for Leguminous Crops." By Prof. W. B. Bottomley. (London: *Country Life* Office.)

looked for once every fourth or sixth year, for it is not claimed that inoculation cures "sickness" and increases the frequency with which leguminous crops can be grown. Even a 50 per cent. increase in crop, useful though it would be, would in these circumstances hardly effect any particular revolution in agricultural practice. We are therefore unable to follow the author when he remarks:—"For a few thousand pounds the 21 million acres of poor barren land in this country could be made productive and rendered capable of finding work for and supporting such a population that both the food problem and the unemployed problem would be easy of solution. . . . Waste land reclaimed and made fertile for 6*d.* an acre! . . ." It would have been better if the author had induced an agricultural friend to revise this estimate. We are told on pp. 8 and 10 that inoculation will be a failure when the soil is too acid and in need of lime, when it is deficient in phosphates and potash, when the physical conditions of the soil are unfavourable, or when drainage is needed. Barren land in England commonly suffers from several or all of these defects. How far would sixpence an acre go in putting them right?

At a time when the farmer needs, and is willing to accept, all the assistance the scientific investigator can give him, the fact that an enthusiastic worker like Prof. Bottomley has directed his attention to agricultural botany is a matter for congratulation, and we can only regret that in this, his first appeal to the practical man, his enthusiasm should have outrun his judgment. However, although we must regard the present production as unsatisfactory, we still look forward to sound work from the author on this subject, and we wish him success in his work on the numerous and difficult problems connected with soil inoculation. E. J. R.

MATHEMATICAL EDUCATION AND RESEARCH.

THE annual meeting of the Mathematical Association was held at King's College, London, on Saturday, January 25. The proceedings bear abundant testimony to the great changes which are taking place in the methods of teaching mathematics, and show that these changes are not confined to the subject of elementary geometry. Mr. W. J. Dobbs showed what useful work could be done by means of simple home-made apparatus in the teaching of mechanics, his apparatus consisting merely of spiral springs with cardboard scales attached for illustrating applications of the parallelogram law, and suspended sticks for illustrating the principle of the lever and the balance. He further showed how the solution of problems on accelerated motion could be greatly simplified by the application of direct methods not involving such restrictions as to units as are necessary in working with "poundals" or "slugs." Mr. C. O. Tuckey made a distinct step in advance in his suggestions as to the methods of introducing the properties of convergent series to students who require these series principally in the study of the calculus, and it is interesting to compare his views with those which prevailed twenty or thirty years ago, when the calculus was regarded as something sacred which should not be handled by students until they had passed through a lengthy period of probation in working with algebraic series. Mr. F. J. W. Whipple's lantern-slides, showing how the convergency of certain trigonometric series could be illustrated by diagrams drawn by mere beginners, were a revelation to those who had approached the subject by the study of pages of long formulæ. Mr. W. E. Bryan suggested a very original way of introducing similar figures in geometry, a method which, however, may well form a basis of further discussion and criticism. An apparatus for drawing rectangular hyperbolas was shown by Mr. H. L. Trachtenberg.

In his presidential address Prof. G. H. Bryan, F.R.S., dealt with the uses of mathematics and the training of mathematical teachers. It was necessary that the public should be made aware of the important part which higher mathematical research had played, and was destined to play, in practical applications on which the prosperity of a nation depended. As an instance, Prof. Bryan referred to the seemingly unpractical and uninteresting study of the properties of imaginary quantities, without which modern applications of electricity to purposes of commerce, including wireless telegraphy, could never have reached their present developments. In order to overcome the existing lack of public interest in mathematical matters it was important that the university training of every mathematical teacher should afford him some insight into the research aspect of some one branch of the subject, and the experiments that had already been made in this direction in the university colleges of Wales showed that this ideal was quite capable of attainment. Turning to the teaching of mathematics in elementary schools, Prof. Bryan expressed the opinion that the children of the working man should learn to measure and calculate correctly in order that they might become more efficient and improve their positions in the labour market. If their teaching was conducted in such a way as merely to stimulate in them a spirit of luxury and discontent as distinct from a desire for self-improvement, the working classes had quite as much cause for complaint as the tax-payers. But in the training of elementary teachers, antiquated and unpractical methods are still prevalent, and are often greatly encouraged by examinational requirements.

RADIOGRAPHY IN PEARL FISHING.

THE products of the sea are commonly wasted to a very deplorable degree by those who gather and use them. In no instance is this waste more marked than in the search for pearls. By the old method, which is still in vogue as a general rule, an enormous number of the so-called oysters are taken from their habitat and destroyed without any thought of economy. It is said that only one pearl is found in 100 oysters, and only 1 per cent. of the pearls found are of any commercial value. Thus some 10,000 of the precious molluscs are sacrificed for every useful pearl obtained. Among these victims there must be a vast amount of immature pearls or seed, pearls *in posse*, which might grow and become valuable gems, which are deprived of that possibility by premature destruction.

In the year 1901 Prof. Raphaël Dubois took radiographs of pearls *in situ* within the shell of *Unio prolifera*, and obtained a clear view of their size and situation in spite of the thickness of the shell in which they were encased. He showed these radiographs at the Linnean Society of Lyons, and remarked that the X-rays might receive a novel application if used in the fisheries of Ceylon, and the destruction of a vast number of the prized molluscs might thus be avoided.

The difficulty of applying the X-rays to many thousands of shells *per diem* seemed sufficient to deter the ordinary person from such a laborious attempt. However, a few years later an electrical engineer of New York, Mr. John J. Solomon, who took an interest in the question of pearls, was struck by the same idea of using the X-rays to detect the existence of pearls within the shell of the living animal. He was then unaware of the earlier experiments of Prof. Dubois, but promptly set himself about the work from a commercial point of view.

He found that an exposure necessary to obtain a good picture did not in any way injure the animal, and even an exposure of ten times as long could be applied without causing its death from the effect of the rays. The dangers lay rather in the removal of the bivalve from its normal attachment and in the time required for its transit from its bed to the laboratory of the photographer: for the pearl oyster is really a kind of mussel, which holds on to some fixed object by a brush of fibrils (*byssus*) growing from its body.

Thus the fundamental principle of Prof. Dubois, to save the life of unremunerative bivalves, bids fair to be carried out by American ingenuity and capital.

For practical purposes, where many thousands of shells have to be radiographed daily, a completely novel kind of plant had to be devised. This was done, and final success was considered to be well in view, when 100 clear radiographs could be taken on an average every fifteen seconds.

Mr. Solomon often succeeded in taking as many as 500 per minute. In this process some hundred shells are exposed at a time to the rays. The oysters, spread on trays, are carried under the specially constructed cylinders by means of an electric motor. These great cylinders are cooled by means of suitable water jackets, and can thus be kept working continuously.

The oysters in which there is no sign of pearl formation are put back to their beds. Those in which good-sized pearls are detected are removed and opened, and the pearls promptly utilised. Those showing no pearls of adequate commercial value, but containing promising seed or immature pearls, are carefully placed in hospital. This hospital has rather a novel object; not the cure of the pearl disease (for the much prized gem is but a pathological growth), but, on the contrary, everything is done to keep the mollusc in *statu quo ante* so that the disease may progress as rapidly as possible to the production of valuable pearls and to the death of the incurable patient.

The question seems to arise, can the normal, or perhaps we should say the abnormal, conditions of the pearl-producing bivalve be well enough imitated in captivity to ensure the continued growth of the pearls? May not the "change of water" (as they must be kept nearer the surface) secure for the sufferers immunity from their diseased process? One might have imagined that a greater amount of sunlight, more oxygen, altered temperature, different nutrition, lessened pressure, and other changed conditions we think not of, would so influence the life of the mollusc that it might depart from its pathological but useful habit of producing these valued round bits of shell material, and the hospital might thus prove a true *Kur-Anstalt* instead of a pearl-breeding depôt. But Mr. Solomon tested these points, and he has satisfied himself that, if he can be certain to transmit in all circumstances the oysters to and from his laboratory without injury to their well-being, all other difficulties have already been overcome. As to the lucrative commercial value of the undertaking, time alone can tell; sufficient has not yet elapsed to make it demonstrable by actual proof that pearls can thus be hatched *en gros*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Two Graces will be offered to the Senate at the Congregation on Thursday, February 13; the first gratefully accepts the generous offer of the Drapers' Company to contribute a sum of 200*l*. a year until 1919 towards the stipend of a second professorship in the department of agriculture, and the second establishes in the University a professorship of agricultural botany.

The council of the Senate has reported that it is of opinion that the University should hold a Darwin celebration in the course of the year 1909. The council points out that Charles Darwin was born on February 12, 1809, and that the "Origin of Species" was published on November 24, 1859. The hundredth anniversary of the former event, and the fiftieth anniversary of the latter, will therefore fall in the course of the year 1909. It is suggested that representatives of universities and other learned bodies, together with distinguished individuals, should receive invitations to visit the University on the occasion. Should this report be confirmed by the Senate, the council will appoint a committee to consider the details of the proposed celebration. The week beginning June 20, 1909, appears to the council to be the most suitable time for the celebration.

LONDON.—The degree of D.Sc. has been conferred on Mr. H. B. Fantham for a thesis entitled "*Spirochaeta* (*Trypanosoma*) *balbianii* (Certes) and *Spirochaeta anodontae* (Keysselitz); their Movements, Structure, and Affinities," and other researches in zoology.

Dr. Otto Stapf has commenced a university course of ten lectures on "Grasses: their Structure, Biology, Distribution, and Classification," and Dr. Beddard, F.R.S., a course of four lectures on "The Circulatory System of Reptiles." Both courses are being delivered at University College on Mondays, the botany lectures at 4 p.m. and the zoology lectures at 5 p.m., admission to these lectures being free.

A university course of four advanced lectures in zoology on "Tooth Development and Morphology" will be given by Prof. H. W. Marett Tims, at Bedford College for Women, at 5 p.m. on Tuesdays, commencing March 3. Admission will be free.

Arrangements have been made for university courses in geology by Prof. Garwood, on "The Geology and Physiography of Arctic Europe" (in March); by Prof. Seeley, F.R.S., on "The Thames and its Tributaries" (in May); by Dr. Evans, on "Recent Advances in the Determination of Minerals by Optical Methods" (in June); and by Miss Raisin, on "The Geological Structure of the Area of the Vosges" (in October).

In future, a candidate for the D.Sc. degree may be required by the examiners, as an additional test, to submit within a given period a reasoned report on a subject prescribed by them. Candidates for the B.Sc. honours degree in mathematics as internal students are to be allowed, under certain conditions, to submit research work, and such work will be taken into account in estimating their qualifications.

THE Lord Alverstone, G.C.M.G., Lord Chief Justice of England, will present prizes and certificates to students of evening classes and the day college of the South-Western Polytechnic, Chelsea, on March 13.

THE Board of Education has issued a return (325) showing the application by local authorities of funds for higher education in England and Wales during the official year 1905–6. It appears that the total expenditure on account of education other than elementary during the year was 3,355,434*l*. Of this amount, 706,149*l*. was spent on secondary schools and 234,182*l*. on pupil-teacher centres. On behalf of evening schools and institutions for higher and technical education, 1,200,789*l*. was expended, and in day schools of similar scope 258,517*l*. Exhibitions and bursaries at secondary schools, pupil-teacher centres, evening and day technical institutions, accounted for 376,762*l*. The training of teachers cost 71,910*l*., the salaries of officers other than teachers 120,531*l*., and 150,660*l*. was paid on account of loans. The part of the total amount which was expended in Wales reached 214,185*l*., more than half of which was devoted to secondary schools.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 21, 1907.—"Note on the Sensibility of the Ear to the Direction of Explosive Sounds." By A. **Mallock**, F.R.S.

Soon after the introduction of modern rifles, which give their projectiles a velocity much higher than that of sound, the author noticed that when standing in a position in front of the gun, and not far from the line of fire, the sound seemed to come, not from the firing point, but from some point considerably in advance of the gun. The natural explanation seemed to be that the sound thus heard was not that of the explosion itself, but was caused by the wave-surface, which is generated in the air by the projectile moving at a velocity higher than that of sound. In 1898 the author made observations at the ranges at Broundown to see if the apparent directions agreed with this supposition; and in the present year he has again made similar experiments in much more favourable circumstances. It is clear (if the source of the sound is due to the wave caused by the projectile) that the apparent direction of the sound will be the normal to the wave-surface, and that if the direction of this normal is known, the velocity of the projectile, at the time that that particular portion of the wave-surface was generated which ultimately reaches the observer, can be calculated.

These observations are now recorded, not as giving a practical method of ascertaining the velocity of projectiles, but as showing that the ear can distinguish with considerable accuracy the direction of a sound which consists, not of a train of waves, but, at most, of two waves only. The figure gives the plan of the range and the stations at which the observations were made.

The arrows through these points show the direction of the sound as judged by ear. Each arrow is the mean

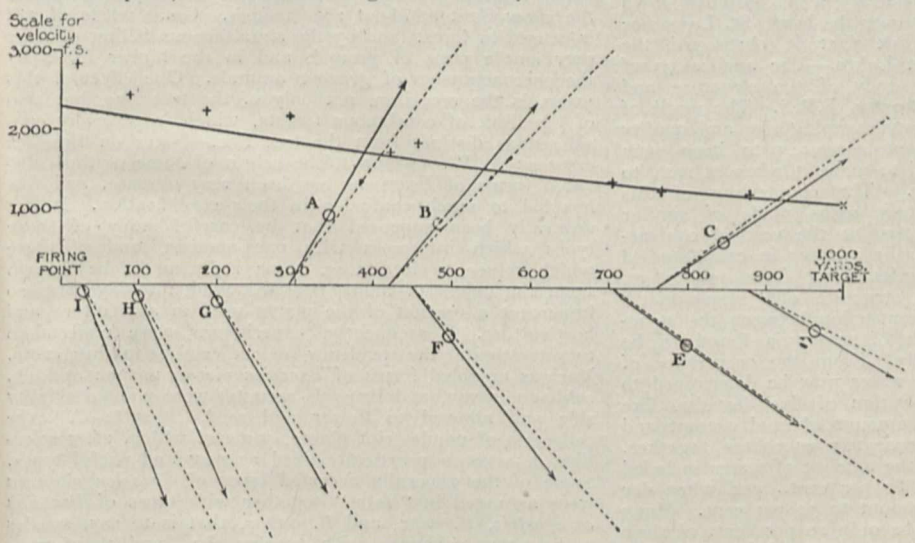
of eight observations, which rarely differed among themselves by more than two or three degrees.

That portion of the wave-surface which passes the observer at any station was generated at the point where the apparent direction of the sound cuts the line of fire, and since the trace of the wave on the trajectory necessarily has the velocity of the projectile at the place where it was formed, and moves along the normal with the ordinary velocity of sound, it is plain that at those points the velocity of the bullet is the velocity of sound ÷ the sine of the angle which the tangent to the wave-surface makes with the trajectory.

The spots, +, show the velocities thus computed, and the full curve gives the actual velocity, as determined by firing, at various ranges up to 1000 yards, into a ballistic pendulum.

The agreement of the values of the velocities thus obtained with the true velocities shows the degree of accuracy with which the direction of the sound was estimated. In this case the difference between the true and observed directions was seldom more than a few degrees, and was generally in one direction.

A sound which is caused by the detached waves, such as those which accompany a bullet, can scarcely be said to have a pitch, but the wave-length is certainly small



The arrows show the apparent direction of the sound at the stations A B C . . . The dotted lines are the normals to the wave-surface, calculated from the known velocity of the projectile. The full curve is the velocity of the projectile, obtained from experiments with the ballistic pendulum. The spots, +, are the velocities of the projectile, as deduced from the observed direction of the sound.

compared with the distance between the ears, and is, indeed, comparable with the dimensions of the bullet itself. It would seem, therefore, that the ears can determine the direction of a sound, not only by difference of phase, but by the actual difference in the times at which a single pulse reaches them.

"Results of the Interaction of Mercury with Alloys of other Metals." By Dr. J. W. **Mallet**, F.R.S.

It being well known that alloying metals with each other often modifies notably their relations to acids and other non-metallic reagents, it seemed desirable to ascertain what the behaviour would be of solid alloys to liquid metallic mercury.

In the experiments reported in this paper three alloys were used, namely, tin-platinum, silver-platinum, and copper-tin, approximately $PtSn_2$, $PtAg_4$, and $SnCu_4$. These were shaken up in a finely divided state with pure mercury in large excess. In the first case the tin was completely protected by the platinum from amalgamation, and neither of the solid metals was dissolved by the mercury. In the second case the presence of the silver brought about amalgamation of the platinum, which would not have been so affected if alone, and both metals were dissolved by the mercury, the platinum, however, in less proportion than that in which it was present in the solid alloy. In the third case, mere traces of the copper and tin were dissolved by the mercury, although each of the constituent metals of the alloy would by itself be readily taken up. A solid amalgam was, however, formed.

These experiments, which were interrupted by illness of the author, go to show that the relations of mercury to alloys are not the same—at any rate for those tried—as to the component metals taken separately.

December 5, 1907.—"The Reciprocal Innervation of Antagonistic Muscles. Note XI. Further Observations on Successive Induction." By Prof. C. S. **Sherrington**, F.R.S.

This communication announces that an essential part of the flexion-reflex of the limb is a contraction of the extensor muscles which sets in immediately the external stimulus which excites the reflex is discontinued. The external stimulus, it may be recalled, while exciting the flexor muscles to contraction, produces relaxation of their antagonists, the extensors. This latter it effects by quelling (inhibiting) all nervous discharge for the time being in the extensor moto-neurones of the spinal cord. The inhibition of the moto-neurones is on cessation of the stimulus followed by a superactivity in them accompanied by the discharge of impulses from them into the muscles they innervate, namely, the extensors. This tendency to motor discharge which follows on the inhibition had been noted in previous communications by Prof. Sherrington, but the evidence of it had hitherto been only indirect. It had been found that on withdrawing the inhibitory stimulus the inhibited part of the reflex arc showed itself more easily excitable by stimuli than it had been before the inhibition occurred.

In the present communication it is shown that the inhibited centre actually discharges spontaneously on withdrawal of the external inhibitory stimulus that depresses it. It is further shown that the inhibited centre will spontaneously discharge even in face of a weak inhibitory stimulus if that stimulus follows on a strong inhibitory one. The inhibition of the arc leads to or induces a subsequent superactivity of the arc is called *successive induction*, because of its analogy to certain processes in the physiology of vision which are also called inductive. The intensity of the successive induction increases with increase of the intensity of the inhibitory stimulus and with increase—up to certain limits—of the duration of the inhibitory stimulus. In other words, the stronger and longer the inhibitory stimulus, the greater the contraction which ensues on the withdrawal of the stimulus.

The contraction of the extensors of the limb which thus follows on their relaxation by reflex inhibition is probably an important, perhaps the most important, factor in the extension phase of the reflex stepping of the limb. Its occurrence supplies an explanation for the relatively poor representation of extension as a primary movement in the motor area of the cortex cerebri. It may be fundamentally analogous to the excitation which occurs in a peripheral nerve at the site of the anode of a voltaic current when the passage of the current is broken. It is, at any rate, perhaps the most striking instance known of a depression which in Arnim v. Tschermak's terms is *allonomic*, being followed by a reverse condition the process of which is *autonomic*. In other words, an allonomic depression

(? assimilatory) of the nerve-centre induces an autonomic (? dissimilatory) excitation.

Geological Society, January 8.—Sir Archibald Geikie, K.C.B., Sec.R.S., president, in the chair.—Chronology of the Glacial epoch in North America: Prof. G. F. **Wright.** In the case of Plum Creek, Lorain County (Ohio), the study of the activity of the stream and of the amount of work done since the Glacial epoch has yielded important results. This stream began erosion when the temporary lake, held up by the ice, was maintained at the level of its Fort Wayne outlet; it has never had anything more resistant than Till to act upon. From a section 5000 feet long it has excavated 34 million cubic feet of Boulder-clay, removing it from exposed banks 1600 feet long. Twelve years' erosion of a 500-feet length of a part of the trough of the stream gives a rate of 8450 cubic feet per annum. Therefore, the removal of 34 million cubic feet from the 5000-feet section would give a period of 2505 years. The erosion of the Niagara Gorge began later than that of Plum Creek, and dates from midway between the disappearance of the ice from northern Ohio and from Quebec. If conditions have been uniform, the age of the gorge would be 7000 years. The author concludes, with some confidence, that the gorge is less than 10,000 years old, and that the ice of the Glacial epoch continued down to that time to such an extent over the lower St. Lawrence Valley and Central New York that it obstructed the eastern drainage of the Great Lakes.—The application of quantitative methods to the study of the structure and history of rocks: Dr. H. C. **Sorby**, F.R.S. The angle of rest in the case of sand-grains of varying size and quality enables the velocity of current necessary to keep such sand drifting, and that needed to move it when at rest, to be ascertained approximately. The comparison of this angle with that in sedimentary rocks made of similar materials may be used to determine the vertical contraction of rocks since deposition, the average in cases studied in Tertiary and secondary rocks being from 100 to 57. The connection between the structure of "ripple-drift" and time is discussed. The connection between the structure of a deposit and depth of water is found to be difficult to study quantitatively. From the occurrence of "drift-bedding" the depth of water may be determined to within a few feet. The deposition of fine deposits, like clay, varies according to the amount of mud present and whether the grains subside separately or cohere together. When no pressure is applied, the amount of water included in the deposited clay may be 80 per cent., and when dry the empty spaces may still amount to 32 per cent. Many of the older rocks must now be only 20 per cent. of their original thickness. In the green slates of Langdale the volcanic eruptions sometimes occurred probably within a few weeks of one another, and at other times at more distant intervals. When deposited, part of the rock was probably analogous to fine, loose sand, and part to semi-liquid mud. In the Coal-measure sandstones deposition at the rate of 1 inch per minute was common, with intervals of little or no deposit. The volume of invisible cavities in rocks varies from 49 per cent. in some recent rocks to nearly 0 in the ancient slates. The packing of grains was discussed mathematically and experimentally. The methods of determining the volume of minute cavities in rocks were given. In some limestones the cavities have been reduced by pressure to close on the mathematical minimum, whereas in others the cavities are filled with carbonate of lime. Some oolites have had their cavities filled in a similar manner; in others most of the material of the original grain has been removed, and the present solidity is due to the filling-up of the cavities mainly by internal segregation. Among fine-grained rocks, the Chalk probably was originally a sort of semi-liquid with 70 per cent. of water, and in its present state is about 45 per cent. of its original thickness; the thickness of some clays must have diminished still more. By the measurement of green spots in slates it can be deduced that the rock before cleavage was more consolidated than rocks of the Coal-measures now are, and was then greatly compressed. The development of "slip-surfaces" in cleaved rocks is great, and furnishes additional proof that the cleavage is of mechanical origin. The volume of minute cavities in clay-rocks and their analogues of various ages were discussed. There is a distinct relation between it and the probable pressure to which the rocks have been exposed.

Zoological Society, January 14.—Prof. J. Rose Bradford, F.R.S., vice-president, in the chair.—Mammals obtained in the Shantung Peninsula, N. China, by Mr. M. P. Anderson, for the Duke of Bedford's exploration of eastern Asia: O. **Thomas.** No mammals had come from this region since the time of Consul Swinhoe, who visited it in 1866–8. The present series contained 106 specimens belonging to six species, of which one was new.—The musculature and other points in the anatomy of the engystomatid frog *Breviceps verrucosus*: F. E. **Beddard.**—The hermaphroditism of the amphipod *Orchestia deshayesii*, Audouin: C. L. **Boulenger.**

Linnean Society, January 16.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Stages of soil denudation and forest destruction in the Tyrol: A. P. **Young.** Slides were shown from photographs taken in two valleys, one north of the Brenner Pass, the Navistal, near Innsbruck, and one south of the pass, the Schalderertal, near Brixen, illustrating various limits, commencing near the upper limit of the vine cultivation at about 700 metres to the snow limit at about 2800 metres. Great waste of soil is caused in forest land by the simultaneous felling of trees over single plots of ground, and in the higher levels by the encroachments of grazing animals. One effect of this waste is the recession, not only of the tree line, but also of the limit of continuous forests, which is generally considered as distinct from the tree line.—Notes on Brassica crosses: A. W. **Sutton.** The origin of some of the cultivated forms of Brassicas has been very obscure, and this has led to much confusion in their classification. It has naturally been supposed that by careful study of those types which intercross with one another, and of those which refuse to intercross, some light might be thrown upon the origin of many Brassicas which to-day form so important a portion of the plants used in agriculture and horticulture. Consequently, experiments were undertaken to investigate the tendency or otherwise to intercross. Various accepted forms of *Brassica oleracea* (such as kale, cabbage, savoy, and Brussels sprouts) were planted side by side and allowed to flower and seed. *Result*:—A large collection of nondescript plants, some of which, after selection, have been practically fixed as new and useful types. Some of the generally accepted types of *Brassica oleracea* were arranged in "sets" together with types of *Brassica campestris*, *B. rapa*, and *B. napus*, that is to say, swedes with rapes, cabbages with turnips, &c., and these were allowed to bloom in juxtaposition. *Result*:—Many hybrid plants resulted from certain "sets" where natural cross-fertilisation took place, and in other cases the pure parental types were reproduced when no cross-fertilisation occurred. The results were quite in accordance with what experience led the author to expect. As in the preceding experiments several types had been seeded together, the experiments were repeated under carefully controlled conditions in order to find by artificial cross-fertilisation to which of the types the resulting hybrid forms were due. Artificial crosses (about eighty-six) were attempted between many of the different types of Brassicas. As was expected, many attempted crosses failed to produce hybrid forms, no seed being developed, probably showing that in these cases crossing was impossible. Other crosses gave seeds, in some cases these being well developed, but in others small and immature. These seeds when sown produced intermediate or hybrid plants quite unlike the parental forms, thus showing that cross-fertilisation was possible and had occurred, confirming experience gained in the practical work of seed-growing.—Revision of the genus Illigera, Blume: S. T. **Dunn.**

Chemical Society. January 16.—Sir William Ramsay, K.C.B., F.R.S., president, in the chair.—Colour and constitution of azo-compounds, part ii., the salts of *p*-hydroxy-azo-compounds with mineral acids: J. J. **Fox** and J. T. **Hewitt.** The authors accept Tuck's statement that benzeneazonaphthol and its ethyl ether are similar in structure, but not his hypothesis that this structure is of the

azo type. They also regard Baker's attempt to formulate these compounds as carbonium salts as unsatisfactory, since it would involve an assumption that *p*-bromobenzeneazophenol hydrochloride is identical with *p*-chlorobenzeneazophenol hydrobromide, and they suggest, instead of the formulæ hitherto proposed, the constitution of oxonium salts for these substances thus, $NHPh.N:C_6H_4:O(H \text{ or } Et)Cl$.—A new method of determining vapour densities, part i.: P. **Blackman.**—Studies in the camphane series, part xxv., action of diazomethane on the two modifications of *iso*nitrosocamphor: M. O. **Forster** and H. **Holmes.** Diazomethane produces with the stable *iso*-nitrosocamphor the N-methyl ether, whilst with the unstable modification isomerisation to the stable variety only takes place.—The oxidation of aromatic hydrazines by metallic oxides, permanganates, and chromates: F. D. **Chattaway.** Experiments on the oxidation of a number of hydrazines have afforded evidence of the correctness of the view already put forward by the author that an unstable hydroxyhydrazine is first produced, which, in presence of alkalis, breaks down into the hydrocarbon, nitrogen, and water.—Studies in fermentation, part ii., the mechanism of alcoholic fermentation: A. **Slator.** A number of conclusions are drawn as to the relative velocities with which the four principal hexoses are fermented by living yeast, and it is shown that the results can be explained on the assumption that the reaction, which mainly controls the velocity of fermentation, is the decomposition of a stable compound between the enzyme and the sugar. Yeast appears to contain *glucozymase*, fermenting dextrose and levulose; *galactozymase*, fermenting galactose; and *mannozymase*, fermenting mannose.—Organic derivatives of silicon, part iv., the sulphonation of benzylethylpropylsilicyl oxide and of benzylethyldipropyl silicane: H. **Marsden** and F. S. **Kipping.** The authors have prepared benzylethylpropylsilicyl oxide, and find that on sulphonation it furnishes a sulphonic acid identical with that previously resolved into optical isomerides, so that there can now be no doubt as to the constitution of this substance.—The formation and reactions of imino-compounds, part vi., the formation of derivatives of hydrindine from *o*-phenylenediacetonitrile: C. W. **Moore** and J. F. **Thorpe.**—Valency: J. A. N. **Friend.**—The esterification constants of the normal fatty acids: J. J. **Sudborough** and J. M. **Gittings.** The value $E^{15^\circ}_{MeOH}$ for formic acid is 1124, acetic 104, propionic 92, and from butyric to stearic varies from 50 to 54.—The anomalous behaviour of the hydrogen electrode in solutions of lead salts and the existence of univalent lead ions in aqueous solutions: H. G. **Denham** and A. J. **Allmand.**—Amphoteric metallic hydroxides, part i.: J. K. **Wood.**—The use of pyridine bases as hydrogen carriers: W. E. **Cross** and J. B. **Cohen.** It is shown that pyridine facilitates the chlorination of benzene and toluene, and the bromination of the same hydrocarbons and of chlorotoluene and naphthalene.—Decomposition of hyponitrous acid: E. **Divers.**

EDINBURGH.

Royal Society, January 20.—Prof. J. C. Ewart, F.R.S., vice-president, in the chair.—The arterial pressure in man, i., methods: Dr. G. A. **Gibson.** A brief historic sketch of the methods used and instruments devised to measure the arterial pressure was followed by a demonstration of Dr. Gibson's own improved form of sphygmomanometer. The records of the pulsations were obtained in the usual way by pointers moving over a smoked surface rolled round a slowly rotating vertical cylinder. To estimate the pressure, the method introduced by Riva-Rocci was adopted. It consisted in compressing the brachial artery above the elbow until the radial artery ceased to beat. The compression bag was connected by flexible tubes with a mercury manometer, the pressure value of which was indicated by a float to which one of the recording pointers was attached. The radial pulsation was recorded by a transmission sphygmograph. As the pressure on the radial artery was gradually diminished by opening the valve the oscillations of the mercury began to increase in amplitude, and at a certain point the radial pulsations began to show themselves. The pressure in the mercury manometer, as given by the height of the record above the abscissa at the instant when the radial sphygmograph began to show distinct oscillations, was the measure of the systolic pressure. The gradual diminution in average pressure of the compressing bag as measured by the manometer was accompanied by an increase in amplitude of the oscillation until a certain average pressure was reached, followed by a decrease until the pressure was the ordinary atmospheric pressure. The lowest point of the maximum oscillation was taken to be the diastolic pressure. The two simultaneous records thus obtained gave all the data at a glance. Interesting examples of records were shown bearing upon various diseases and abnormalities.—Seismic radiations, ii.: Dr. C. G. **Knott.** On the assumption of a particular law of variation of the speed of propagation of elastic waves with distance from the earth's centre, the forms of the rays and the times of propagation along them were calculated and compared with the results of observation. The conclusion was that the observed facts of the transmission of the preliminary tremors could be co-ordinated on the assumption that throughout all but a comparatively thin crust of the earth the elastic waves of highest speed were transmitted with a speed of 12·23 km. per second, and that within this crust, of thickness equal to one-tenth the radius, the speed increased from the value 6 km. per second at the surface to the value 12·23 at the depth one-tenth of the radius. The second phase of the preliminary tremors was similarly transmitted, but with speed less than that of the first phase in the ratio of 18 to 31·3. The hypothesis that the two phases represented the compressional and distortional waves led to the conclusion that the interior of the earth satisfied the uni-constant elastic theory associated with the names of Navier and Poisson. The curving of the rays within the crust of variable speed of propagation led to a concentration of the energy towards the immediate neighbourhood of the epicentre, a result which had important bearings upon the interpretation of seismograms from distant stations.

PARIS.

Academy of Sciences, January 27.—M. Henri Becquerel in the chair.—The emission spectra of varieties of fluor-spar: Henri **Becquerel.** The peculiarities recently pointed out by A. Dufour in the spectra of fluor-spar as regards the Zeeman effect are probably due to the presence of rare earths in the spar.—Concerning a hitherto unknown fragment of the "Opus tertium" of Roger Bacon: P. **Duhem.** This manuscript, No. 10,264 in the Bibliothèque nationale, is headed "Liber tertius Alpetragii." M. Duhem surmises that it is really a portion of the "Opus tertium" of Roger Bacon, and points out that it indicates a clear knowledge of the composition and explosive power of gunpowder before the middle of the thirteenth century.—The geological history and phylogeny of the Anthracotherideæ: Charles **Depéret.**—A class of surfaces: M. **Tzitzéica.**—The equation $\frac{\partial^2 z}{\partial x^2} - \frac{\partial z}{\partial y} = 0$: Eugenio Elia **Levi.**—The definition of the area of a portion of a curved surface: E. **Cartan.** The author points out that his note of December 30 last on this subject has been anticipated by M. Schwarz.—The theory of thin bodies: Eugène and François **Cosserat.**—The action of the X-rays on the photographic plate: M. **Chanoz.** These experimental results show a parallelism between the successive aspects presented for increasing irradiation by radiographic and photographic negatives. It furnishes an argument in favour of the luminous nature of the X-rays.—The abnormal mobility of the ions of some rare earths: Jules **Roux.** With the exception of the samarium ion, the mobility of which is of the order of the usual monovalent ions, the mobilities of the other earths studied (lanthanum, yttrium, cerium, and gadolinium) are greater than those of monovalent and divalent ions. This difference may be of use in the separation of these metals, pointing to a possibility of effecting their separation by diffusion or by electrolysis.—The radio-activity of the waters at Plombières: André **Brochet.** These researches confirm a point already established, that, contrary to a view very commonly expressed, there is no relation between the radio-activity of a water and its temperature.—The dissociation by water

of the double chlorides of dimercuriammonium and ammonium: H. **Gaudechon.** The compounds

$$NHg_2Cl.NH_4Cl, \qquad NHg_2Cl.3NH_4Cl,$$

in presence of water at the ordinary temperature behave as true double salts.—The establishment of the constitutional formula of fenone: L. **Bouveault** and M. **Levallois.** The authors regard their experimental work as definitely eliminating the formula suggested by Wallach, and giving great probability to that of Semmler.—The essence of *Magnolia kobus*: Eug. **Charabot** and G. **Laloue.** This essence consists chiefly of citral (15 per cent.) and anethol.—The volcano of Siroua, Moroccan Anti-Atlas: Louis **Gentil.**—Researches on the pulp called Netté flour: A. **Goris** and L. **Crété.** The name flour applied to this substance, which is obtained from the fruit of *Parkia biglobosa*, is a misnomer, as it contains no starch. It is rich in fatty matter, phosphates, and sugar (saccharose). As regards the latter, it contains about 25 per cent. of saccharose and 20 per cent. of glucose and levulose, and surpasses either the sugar beet or sugar cane.—The erythrolytic function of the spleen in fishes: Richard **Blumenthal.** In fish the spleen appears to be normally the place where the red corpuscles of the blood are destroyed.—Modifications of the blood caused by the injection of atropine or of peptone: MM. **Doyen** and Cl. **Gautier.**—Bovine bacilliform piroplasmosis observed in the neighbourhood of Algiers: H. **Soulié** and G. **Roig.**—An attempt at grafting articular tissues: Henri **Judet.** These experiments were made on rabbits, dogs, and cats, and show that it is possible to repair a loss of articular cartilage by the transplantation of fragments arising either from the costal cartilages of the same animal or the articular cartilages of an animal of closely allied species.—The nature of the urns of the Siphuncles: J. **Kunstler.**—*Bacillus endothrix*, a new bacterial parasite of the hair: Fernand **Guéguen.**—A Laboulbenacieæ, *Trenomyces histophtorus*, an endoparasite of the lice (*Menopon pallidum* and *Goniocotes abdominalis*) of the domestic fowl: Édouard **Chalton** and François **Picard.**—The middle Lias in the Seybouse basin (Algeria): J. Dareste **de la Chavanne.**—A neotype of *Pinus* (*Pseudostrobus*) *Defrancei* in the Lutetian of the Trocadero (Paris): Paul **Combes,** jun.—Characteristics of the foliar trace in genera Gyropteris and Tubicaulis: Paul **Bertrand.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 6.

ROYAL SOCIETY, at 4.30.—On the Weight of Precipitum obtainable in Precipitin Interactions with Small Weights of Homologous Protein: Prof. D. A. Welsh and H. G. Chapman.—Nitrification in Acid Soils: A. D. Hall, N. H. J. Miller, and C. T. Gimingham.—A Criticism of the Opsonic Theory based upon Studies carried out by Means of Melanin: S. G. Shattock and L. S. Dudgeon.—A Contribution to the Study of the Mechanism of Respiration, with Especial Reference to the Action of the Vertebral Column and Diaphragm: J. F. Halls-Dally.

ROYAL INSTITUTION, at 3.—The Story of the Spanish Armada: Major Martin Hume.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Protective Devices for High Tension Transmission Circuits: J. S. Peck.

LINNEAN SOCIETY, at 8.—Fruits and Seeds from the Pre-Glacial Beds of Britain and the Netherlands: Clement Reid, F.R.S.—On a Method of Disintegrating Peat and other Deposits containing Fossil Seeds: Mrs. Reid.—On a Botanical Expedition to Fokien: S. T. Dunn.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Some Devices for the Absorption of Shock on Wheeled Vehicles: F. G. Woollard.

CHEMICAL SOCIETY, at 8.30.—The Metallic Picrates: O. Silberrad and H. A. Phillips.—Organic Derivatives of Silicon. Part V., Benzylethylsilicone, Dibenzylsilicone and other Benzyl- and Benzylethyl-derivatives of Silicane: R. Robison and F. S. Kipping.—Some Physico-chemical Properties of Mixtures of Pyridine and Water: H. Hartley, N. G. Thomas, and M. P. Applebey.—The Constitution of Umbellulone, Part III.: F. Tutin.—The Residual Affinity of the Coumarins and Thiocoumarins as shown by their Additive Compounds: A. Clayton.—The Influence of Foreign Substances on Certain Transition Temperatures, and the Determination of Molecular Weights: H. M. Dawson and C. G. Jackson.—The Bromination of *p*-Hydroxydiphenylamine: Miss A. E. Smith and K. J. P. Orton.—Colour and Constitution of *as*-Methine Compounds, Part I.: F. G. Pope.—The Decomposition of Ammonium Bichromate by Heat. Preliminary Notice: W. M. Hooton.

FRIDAY, FEBRUARY 7.

ROYAL SOCIETY OF ARTS, at 8.—The Hygiene of the Pottery Trade: W. Burton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Hardening and Annealing Furnaces: P. T. Steinthal.

GEOLOGISTS' ASSOCIATION, at 8.—Presidential Address: The Centenary of the Geological Society: R. S. Herries.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Aërial Navigation: H. Chatley.

MONDAY, FEBRUARY 10.

ROYAL SOCIETY OF ARTS, at 8.—The Theory and Practice of Clock Making: H. H. Cunynghame, C.B.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Story of London Maps: Laurence Gomme.

TUESDAY, FEBRUARY 11.

ROYAL INSTITUTION, at 3.—Membranes: Their Structure, Uses, and Products: Prof. W. Stirling.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Additional Notes on New Guinea Games: Dr. A. C. Haddon, F.R.S.—Exhibition of a New Instrument for determining the Colour of the Hair, Skin, and Eyes: J. Gray.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Erection of the Pwll-y-Pant Viaduct on the Brecon and Merthyr Extension of the Barry Railway: A. L. Dickie.—Notes on the Erection of Cantilever Bridges: Prof. T. C. Fidler.

WEDNESDAY, FEBRUARY 12.

ROYAL SOCIETY OF ARTS, at 8.—The Application of Science to Foundry Work: R. Buchanan.

ROYAL SANITARY INSTITUTE, at 8.—Rivers Pollution, with Special Reference to the Board proposed by the Royal Commission: Sir William Ramsay, K.C.B., F.R.S.

THURSDAY, FEBRUARY 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—The Constitution of the Electric Spark: T. Royds.—On the Determination of Viscosity at High Temperatures: Dr. C. E. Fawsitt.—The Effect of Hydrogen on the Discharge of Negative Electricity from Hot Platinum: Prof. H. A. Wilson, F.R.S.—The Decomposition of Ozone by Heat: E. P. Perman and R. H. Greaves.

ROYAL SOCIETY OF ARTS, at 4.30.—The New Imperial Gazetteer of India: R. Burn.

MATHEMATICAL SOCIETY, at 5.30.—Proof that every Algebraic Equation has a Root: Dr. H. A. de S. Pittard.—On the Uniform Approach of a Continuous Function to its Limit: Dr. W. H. Young.—Note on *q*-differences: Rev. F. H. Jackson.

FRIDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 9.—Biology and History: Dr. C. W. Saleeby.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—President's Address: Malacology *versus* Palæoconchology: B. B. Woodward.

CONTENTS.