THURSDAY, DECEMBER 31, 1908.

ESSENTIAL OILS AND ESSENCES.

The Chemistry of Essential Oils and Artificial Perfumes. By Ernest J. Parry. Second edition, revised and enlarged. Pp. viii+546. (London: Scott, Greenwood and Son, 1908.) Price 12*s.* 6*d.* net.

THE chemistry of the essential oils is one of the most interesting, and at the same time one of the most complicated, sections of plant chemistry. To begin with, the true function of an essential oil in the economy and life-history of a plant is by no means clear. It might at first sight be thought to be connected with the reproductive agencies of the plant, and possibly as regards the flower this may be the case; a fragrant smell in the flower may be the means of attracting the insects which carry the fecundating pollen. But that the attraction of insects is not the sole function of an odoriferous oil must be obvious from the circumstance that many essential oils, as in the conifers, are to be met with in practically all parts of the plant; some are found in the fruits, and a few even in the roots. At the same time, there is much evidence to show that the occurrence of an essential oil in a plant is frequently directly related to processes which ensure the continuance of the species. The amount increases with the growth of inflorescence and decreases after the flowering period is past. But certain oils appear to be the result of metabolic changes which are not necessarily connected with reproductive processes. Thus the essential oil of almonds is a product of the decomposition of amygdalin under the influence of the ferment emulsin. Oil of mustard is similarly produced from a specific glucoside by the agency of myrosin.

The whole subject has hardly received that attention from plant physiologists that its importance and interest demand. Experimentally it is confessedly most difficult, owing to the imperfection and restricted character of the analytical methods at the investigator's disposal, especially quantitatively; and it is, of course, accurate quantitative methods which are most needed in correlating the life-history of the plant with the occurrence and distribution of the fragrant oil.

The volume before us is the second edition of a work which made its first appearance in 1899, and it differs from its predecessor in several important particulars, partly in omissions, but more especially in extensions. Thus as regards the chemical nature of the essential oils, a comparison of the present volume with that of the first edition will serve to show the striking developments that have taken place in the interval. It is true that we have had no substantial addition to the main groups to which the various proximate principles occurring in essential oils may be referred, but the number of such substances has been greatly increased, and their physical characteristics, constitution and mutual relations have been far more accurately determined. The general survey of the chemistry of the subject given by Mr. Parry in the second chapter is as full as the limitations of space in a book not primarily intended for theoretical chemists would allow. The chapter on the preparation of the essential oils is, however, disappointing, especially in a work which professes to deal with the technology of the subject. The author practically contents himself with a statement of the principles of the main processes—expression, distillation and extraction—in general use, and omits all detail on the ground that details could not yield the practical man nearly so much information as could be obtained during a short stay in a factory. No doubt, in general, practice is worth more than precept, but if every technologist treated the practical aspects of his subject in this way technology would cease to exist.

By far the largest, and indeed the most valuable, section of the work is concerned with the systematic study of the more commercially important essential oils. This section constitutes about half the entire work. Great pains have evidently been taken in its compilation, and, so far as we have been able to discover, nothing of material importance relating to the origin, mode of manufacture and properties of any particular oil would appear to have been omitted. It need hardly be said that the well-known contributions which Messrs. Schimmel and Co. periodically make to the literature of the subject have afforded the author much of his information. Indeed, it must be admitted that the amount of actual original matter other than analytical data which he has been able to contribute to his work is not very extensive, and he has to depend upon others for the greater part of what he has to say relating to the origin and mode of extraction of the products he describes.

Since Tiemann's discovery of vanillin, which he first obtained from the glucoside coniferin more than a third of a century ago, a considerable number of so-called synthetic perfumes have been prepared, notably coumarin, heliotropin, ionone, artificial musk, and neroli. Vanillin, which is methyl protocatechuic aldehyde, is now obtained on a considerable scale from eugenol, the main constituent of oil of cloves, and also from guaiacol, as well as by other methods, and is largely used in confectionery. Costing as much as 16*l.* per lb. in 1876, it is now quoted at about 18*s.* Coumarin, originally discovered in the tonka bean, is found in a great number of plants, and was first synthetically obtained by Perkin. The synthetic product is now employed to a considerable extent in place of the tonka bean, as, for example, in the preparation of the well-known perfume *foin-coupé*.

Heliotropin is the methylene ether of protocatechuic aldehyde, and was first obtained from piperine, the active principle of pepper, and is now prepared from safrol. When first discovered its price, in 1880, was 7*o*l. per lb.; it now costs about 8*s.* per lb.

Ionone, the artificial violet perfume, now largely employed in perfumery, was first obtained by Tiemann and Krüger in 1893. The preparation of these various substances artificially constitutes one of the triumphs of synthetic chemistry, and has given a great impetus to the manufacture of artificial perfumes. Practically all that has been up to the present made known on this subject is set out in detail in the last chapter of Mr.

Parry's book. Incidentally the question of what is brandy is elucidated by what is stated respecting the nature of artificial cognac oil, which, however, strictly speaking, is not an essential oil. There is, as the author says, an almost unlimited field of research in the synthetic production of perfumes. The field is still practically untilled, and a rich harvest awaits the successful cultivator.

It is, however, a moot point whether any individual synthetic perfume is the equal, from the perfumer's point of view, of the corresponding natural perfume. Some of these synthetic perfumes in the pure or concentrated state in no wise resemble the natural variety; in fact, in this state they are almost repellent, and it is only when judiciously blended and diluted that their fragrance becomes pleasurable.

The fragrance of a natural perfume is in all probability not wholly due to a single substance or a single stimulus. Some one substance may be there in relatively large proportion, but associated with it are other odoriferous substances, some of them, possibly, in minute amounts only, but all of them contributing to an olfactory sensation which gives pleasure. A perfume, in fact, is like a piece of music. There may be in the piece a dominant musical idea, but the pleasure it creates is largely dependent upon its association with tone-sensations which are not necessarily structural parts of the dominant idea. Synthetic perfumes, therefore, can only successfully replace natural perfumes when the greatest care and judgment are exercised in blending. This kind of blending rises to the level of a fine art. To be successful in its exercise the olfactory sense of the blender requires a training hardly less rigorous than that required by the auditory sense of the musician.

This work, with all its limitations, is still the most complete treatise on the subject in our language, and as such is indispensable to the pharmacist, the perfumer, as well as to the analytical chemist who may be concerned with the examination of a class of substances of varying character and peculiarly liable to sophistication.

A MONOGRAPH ON THE FROG.

Der Frosch. Monographien einheimischer Tiere. Band i. By Dr. F. Hempelmann. Pp. vi+201. (Leipzig: W. Klinkhardt, 1908.) Price 4.80 marks.

THIS monograph, the editor informs us, has arisen in connection with elementary biological teaching at Leipzig, and is intended to describe not only the habits, structure, and development of "the physiologist's domestic animal," but to form an introduction to physiology, psychology, the mechanics of development, classification, and distribution. It is in respect of its scope that this addition to the vast literature on the frog differs from its predecessors. At the same time it is written for beginners, and must be judged from its value as an introductory handbook to practical dissection and experiment.

We may say at once that taken as a whole it is a well-written and successful attempt to compress all that is important and well established concerning the frog into 200 pages. But that is far more than an elementary student can assimilate, and between what he is first to notice and what he will only notice after the primary difficulties are overcome there is no means of distinguishing.

We regret that no mention is made of Marshall's famous book, and also that figures taken from his works are borrowed merely from reproductions of them by other authors. This neglect of Marshall is, however, no isolated case of the omission of some of the most important English works on the frog, both educational and other. There is surely no more important work on the distribution and systematic aspect of Amphibia than Boulenger's "Tailless Batrachians," nor is there a more readable account of the various aspects of this very animal than that by Holmes, published some two years ago. Lister's classical researches on the pigmented cells are nowhere referred to, whilst a small and almost unknown compilation by St. John Mivart more than thirty years old is quoted.

The first section, that on anatomy, is based on Gaupp's well-known edition of Ecker's work. Histology begins on p. 6, and the student is plunged into a study of the structure of the integument before the terms "cell," "transverse section," and "gland" are made clear. The apparently inevitable and complicated nomenclature reaches its maximum in connection with the brain, where no fewer than four sets of terms are used for each region. The difficult and complicated question of how the heart distributes arterial and venous blood requires a fuller sketch of the heart itself than is given on p. 54; whilst the equally difficult problems of development, *e.g.* of what are meant by "pronephros" and "mesonephros," are scarcely alluded to. The writer does not seem to appreciate the difficulties of beginners in regard to these unfamiliar conceptions.

The second section—physiology—is much better done, and the general features of metabolism are clearly explained. Then follow sections on heat-production, colour-change, movements, and the elementary physiology of muscle and nerve, leading up to a discussion of psychology and the development of consciousness. Some account is given of the experimental side of development, in which, however, we miss any reference to Assheton's work on the growth of different regions; in fact, the phenomenon of growth does not appear to be treated anywhere in the book. The references to sex-determination (pp. 162–4) in our present ignorance are inconclusive, and might well have been omitted.

Lastly, we come to "Biologie" (it is difficult to see why this, the most interesting part of a treatise, is always put at the end by German writers) and classification. Here we must agree to differ from the author. The common brown grass frog has always been *Rana temporaria* to us, but to find it described as *Rana muta laurenti* is indeed a shock. There is really no good ground for this change. The tendency needlessly to upset well-established names is a most regrettable feature of systematists; but to introduce confusion without any right, explanation or apology into a book

intended for elementary students is really an offence. We recommend the remarks of Boulenger ("Tailless Batrachians of Europe," Ray Society, p. 301) to the author.

MODERN ORGANIC CHEMISTRY.

Recent Advances in Organic Chemistry. By Dr. A. W. Stewart. With an introduction by Prof. J. N. Collie. Pp. xv+296. (London: Longmans, Green and Co., 1908.) Price 7*s.* 6*d.* net.

UNLESS the chemist, and especially the organic chemist, adopts some elaborate system of grouping together new information as it appears, the mass of research which nowadays floods the journals makes it difficult for him to keep abreast of current investigations.

The reports of the British Association on organic chemistry have served a most useful purpose in giving summaries of recent work; but they are too few in number. It appears to us that if the Association's funds could be utilised in extending this part of its activities, they would be well spent. Three or four reports a year on different branches of chemistry would be invaluable. But until we have something of this kind we must rely on individual effort to supply the want. This, we take it, is the main object which Dr. Stewart had in view in writing his book, and we congratulate him on the result, which has taken the form of a compact, neatly bound and well-printed volume at a very moderate price. The compilation has been carried out with great discrimination. It is not an easy matter to discuss details of modern structural formulæ and at the same time to sustain the interest of the reader. But Dr. Stewart has an easy and pleasant style, and, if his criticisms are occasionally rather forcible, they only add piquancy to the subject under discussion.

We think the author takes too despondent a view of the present trend of organic chemistry. We are, it is true, deluged with new compounds, which seem destined to bear no fruit, but the worst that can be said of them is that they add to the bulk of our already ponderous journals.

Nor are we of the author's opinion in thinking that "we have accumulated an immense mass of data concerning the results of reactions, but very little indeed with regard to their causes." The very volume before us serves to negative the statement, for the book bristles with facts upon which theories are based.

We do, however, most heartily agree with him in emphasising the need for studying exceptions to general theories, and there is no doubt that therein lies a fruitful field of study. Our knowledge of the mechanism of most, even of the simplest, reactions is incomplete. We know the end result, but not the intermediate steps. Moreover, there is scarcely any general reaction which is not modified to some extent in its individual applications, whereby we are forced more and more to recognise reactivity as a function of environment. But surely this is no cause for discouragement. There are still new worlds to conquer, and perhaps Dr. Stewart's book may induce chemists to give their attention to these neglected problems.

That the author appears a little impatient of those whose attitude towards new theories is hesitating, and perhaps conservative, is perhaps natural. But it must be remembered that our mechanical concepts of atomic relations are not easy of proof, and dynamical concepts much less than statical ones. Van 't Hoff's theory has afforded overwhelming evidence of the value of the statical idea, for it is the very essence of stereochemistry, and fits in admirably with the theory of atomic linking and the existence of dynamic isomers. The foundations of organic chemistry are laid on a statical basis. It is only natural, therefore, that the explanation of the physical properties of compounds should bear a direct relation to this fundamental idea. No one doubts that the statical concept is an incomplete one. It is equally certain that the whole story of molecular forces will only be known when physical and chemical properties are grouped under one comprehensive idea. But there is no reason why new theories should not be grafted on the old, deep-rooted stock, until it may be safely transplanted. We must only be sure that any theoretical development is capable of experimental study, and in this connection it is doubtful if electrons and Faraday tubes, whatever theoretical value the physicist may attach to them, will prove more serviceable to the organic chemist than vortex atoms.

The book is divided into chapters or essays dealing with those topics which have attracted special attention during the last decade. It opens with a good general account of Grignard's reaction and asymmetric synthesis. Then follows a chapter on polyketides, that is, bodies containing the $CH_2.CO$ or ketene group or its multiple, which is illustrated from the work of Collie, Staudinger, and Wilsmore. This is followed by a chapter on recent synthetic preparations of *cyclo*paraffins, which the author terms "polymethylenes." There are essays on recent work on the terpenes, alkaloids, and polypeptides. An interesting, though a very brief, account is given on the action of light on organic compounds which embodies much of the work of Ciamician and Silber, and there are chapters on addition reactions and unsaturation, in which the author has something to say about his own investigations. The volume closes with a chapter touching on modern views and the inadequate nature of structural formulæ, and there is, finally, an excellent bibliography of organic chemical literature, which affords convincing testimony of the utility, if not necessity, to all organic chemists of an adequate knowledge of the German language.

J. B. C.

THE CURVATURE METHOD OF TEACHING GEOMETRICAL OPTICS.

Geometrical Optics. By V. H. Mackinney and H. L. Taylor. Pp. iii+128. (Birmingham: J. and H. Taylor.)

THE preface to this little book is somewhat misleading. We there read:—"The growing demand for a book on Geometrical Optics based upon the Curvature system has led to the production of this small volume. . . ." If the use of the curvature

method constituted the chief characteristic of the book, we should have but little to say in its favour. The curvature method undoubtedly possesses many obvious advantages, but the loose and in places quite inaccurate manner in which the elementary theory of mirrors and lenses is here set forth does much to obscure the merits of the system.

The definition "The curvature of a circle is the angle through which a curve turns per unit length" gives an early suggestion of the lack of logical clearness which is throughout apparent. As an instance of more serious inaccuracy the following attempt at an explanation of the formation of an image by a concave mirror may be quoted (p. 18):—

"To explain the formation of the virtual erect image we may imagine the mirror to consist of an infinite number of plane surfaces (Fig.). Each of these is capable of producing a virtual and erect image (as previously explained) identical in position behind the mirror with the object in front. As the object is moved from the mirror more of these supposed innumerable facets take up the reflection for the eye to view, and so the image increases rapidly in size. . . ."

The attempt at a formal proof, for the spherical mirror, of the relation connecting conjugate foci is given later (p. 38). With no guidance as to the conditions limiting the truth of the statements made, and with a misleading figure, we venture to think that the intelligent student would find this hopelessly bewildering.

In fact, however, no real attempt is made to establish, by the curvature method, the principles of elementary geometrical optics. Apart from the statement in the preface one would have judged the aim of the book to be quite different from this. It would appear clearly to be intended for the use of those actually engaged in optical workshops, and especially those concerned with the practice of spectacle making and of sight testing. It would seem to aim, not at providing a logical exposition of elementary principles on any system, curvature or other, but at furnishing a reader of the kind suggested with a sufficient modicum of information about many points likely to be brought under his attention in the course of his practice, to enable him to deal with these not unintelligently. From this point of view it may fairly be held to have achieved some measure of success. Evidently written by practising opticians, it does contain, in small compass, a good deal of practically useful and important information not to be found in the ordinary elementary text-book, more especially in regard to the characteristics of the eye as an optical instrument and the problems involved in the correction of its defects. The fact that the discussion of such questions is more readily carried on in terms of curvatures and focal powers than of radii of curvature and focal lengths may, perhaps, be held to account in some measure for the sentence quoted from the preface.

The book has some features of value to those for whom quick reference is essential: a useful summary at the end of each chapter; a few tables and data, including a table of aberrations in lenses and their remedies, from a paper read by Prof. Silvanus Thompson before the Optical Society; a list of optical works; and, following the index, a list of articles useful in spectacle work and sight testing, with approximate prices.

As a text-book on elementary optics the book needs much careful revision. We think well enough of it to express the hope that it may receive this treatment without delay.

ECONOMIC ZOOLOGY.

Economic Zoology, an Introductory Text-book in Zoology, with Special Reference to its Applications in Agriculture, Commerce and Medicine. By Prof. Herbert Osborn. Pp. xv+490; 269 figures. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1908.) Price 8*s.* 6*d.* net.

A Manual of Elementary Forest Zoology for India. By E. P. Stebbing. Pp. xxiii+230+xxxiv; 422 figures. (Calcutta: Superintendent Government Printing, 1908.) Price 15*s.*

THE teacher of zoology to students whose chief interest in the science depends upon its relations to some branch of human industry has often to decide whether he shall give the more prominent place to general principles or to special and technical applications. The rival points of view are well illustrated in these two works. Prof. Osborn, in the introduction to his handy "text-book," rightly advocates the claims of sound general principles.

"Inasmuch," he writes, "as economic zoology is simply an application of our knowledge of animals which affect human interests, it is easy to see that almost any phase of the study will have some bearing on the problems that concern us. Economic zoology, if studied thoroughly, must of necessity be based on accurate knowledge . . . so that it involves a study of the whole animal and all that can be learned regarding its activities."

In agreement with these principles, the author has, in the work before us, neglected no groups of the animal kingdom, even though, like the Echinoderms and the lower Chordata, they have little or no "economic" importance, so far as we know at present. A knowledge of the structure of these groups is essential to any real training in zoology; and who, a dozen years ago, could have foreseen the vast economic importance of such groups as the Hæmosporidia, the Culicidæ, and Ixodidæ? The students now in our colleges require training not only for the known needs of the present; they are entitled to be equipped so that they can grapple practically with the unknown problems of the future.

But while the principles that have guided Prof. Osborn are thoroughly sound, it is doubtful if he has made the best possible use of the space at his disposal in thus applying them. He has given clear descriptions of the great animal phyla from Protozoa to Vertebrata, and the leading classes and orders, illustrated by well-chosen figures culled from trustworthy sources. Such descriptions are, however, already available in many zoological text-books. The special text-book for the student of economic zoology should

contain summaries of those detailed accounts of families and species, injurious or useful to man and his domesticated plants and animals, at present to be found only in scattered original papers or in expensive advanced treatises. In this respect the book must be pronounced disappointing. Prof. Osborn is well known for his original work on insects parasitic on domestic animals, yet here he dismisses the Anoplura in seven lines, the Mallophaga in a single short page, and refers to the Oestridæ only by reproducing two figures of horse bot-fly and its larvæ, not even mentioning this most important family in his text. Similarly, in the section on the Hymenoptera there is no special account of the saw-flies. Such omissions are not compensated for by outlines of morphology and classification, which, though the economic student ought indeed to know them, and know them well, he can find in half-a-dozen good elementary manuals.

There is another branch of zoological inquiry which, though most fundamental and important to the economic student, is superficially dealt with in most elementary text-books—the branch that deals with the factors of evolution. A fairly full and critical summary of modern developments of the theory of descent would be of vast benefit to the scientific agriculturist, for example. Prof. Osborn discusses these questions in eight pages, and the summary is necessarily so condensed as to be practically useless to a beginner. It were surely better to make no mention at all of the Darwinian and Mendelian theories than to describe them in ten and fourteen lines respectively.

A word of praise is due to the clear printing of the book and to the illustrations, which, with a few exceptions—printed so darkly as to be almost unrecognisable—are very well reproduced.

While Prof. Osborn's book is written mainly from the standpoint of the North American worker, Mr. Stebbing's deals almost exclusively with Indian forest zoology. After a general introduction, in which the principles of structure are illustrated mainly from the Vertebrata, the invertebrate phyla—except the Arthropoda—are dismissed in six pages. The Arthropoda are described in 148 pages, and of these 136 are devoted to an account of the Insecta. The chapters included in this section form the original and valuable part of the book. The author states in his preface that it could not have been written seven years ago, and the number of life-histories of forest insects, especially among the Curculionidæ and Scolytidæ, described and figured bears testimony to the industry and power of observation displayed by Mr. Stebbing. Unfortunately, many of his drawings have been very coarsely reproduced; our Government publishing departments—both at home and "beyond the seas"—have much to learn, for the heavy, unattractive appearance of too many scientific works marks their "official" origin at a glance. In some cases, however, Mr. Stebbing's photographs and figures have been treated with full justice; for example, the stages of Hoplocerambyx in a sal tree (Figs. 193, 194) form a beautiful and instructive picture. In following Dr. Sharp's volumes of the "Cambridge Natural History," it is unfortunate that Mr. Stebbing should have copied the antiquated arrangement of insectan orders now abandoned by Dr. Sharp himself. It is disappointing also to find that both Mr. Stebbing and Prof. Osborn retain the unnatural "Class Myriapoda."

The concluding section of Mr. Stebbing's book comprises short accounts of the classes, orders, and leading families of Vertebrata, with special reference to the Indian fauna, illustrated with cuts mostly reproduced from the volumes of the "Fauna of British India." The most valuable feature of these summaries is in the accounts of damage done to forests by various mammals and birds. Indeed, in Mr. Stebbing's book, as a whole, we have prominence given to the practical and technical aspects of zoology rather than to those general facts and principles on which Prof. Osborn lays the greater stress. G. H. CARPENTER.

OBSERVATION, STUDY, AND NAMING OF PLANTS.

Nature Rambles in London. By Miss K. M. Hall. Pp. xviii+325. (London: Hodder and Stoughton, n.d.) Price 3*s.* 6*d.* net.

Life Histories of Common Plants. By Dr. F. Cavers. Pp. xvi+363. (Cambridge: University Tutorial Press, Ltd., 1908.) Price 3*s.*

The Young Botanist. By W. Percival Westell and C. S. Cooper. Pp. xxxix+199. (London: Methuen and Co., n.d.) Price 3*s.* 6*d.* net.

PUBLIC gardens and parks provide better facilities for the observation of trees and shrubs than it is possible to obtain on rambles in the country, so that dwellers in London have full opportunity for pursuing the study of these objects. Unfortunately, many of the numerous visitors who frequent the parks have not the necessary knowledge or lack the training required to make the best use of their opportunities. For these Miss Hall has prepared the notes on nature rambles, written in non-technical language, and arranged according to the seasons' changes. Apart from the discourses on trees, a considerable amount of space is devoted to the descriptions of the birds that reside in or frequent the parks, and not the least interesting pages tell of the bee-hive that is located under Miss Hall's charge in the Stepney Gardens. The descriptive text is set off by the illustrations supplied by Mr. H. Irving, who has established a reputation for his photographs of natural history specimens.

The title of Dr. Cavers's book may suggest a series of short monographs on selected types; it furnishes, however, a compendium of the morphology and physiology of the flowering plants, followed by chapters on special orders or allied groups of plants. For the study of elementary botany the course delineated is both natural and practicable. The early portion of the book follows somewhat similar lines to the author's "Plant Biology," but is not so full, and is written in a more direct, *i.e.* less interrogative, form. Physiology provides the fundaments of the training, and a full set of experiments is outlined to enable the student to gather his principles from personal observation or from attempted experiments, as some are too uncertain for the student to manipulate.

The notes on the different plants supply the opportunities for considering accessory problems; thus the scarlet runner introduces twining, the marsh marigold leads up to a discourse on marsh plants, and so on. The volume concludes with a short epitome of ecological principles, while at the end of each chapter searching questions are proposed for solution. The author is to be congratulated on the excellent features of his book, which may be summarised as a clear diction, a logical sequence, and a recognition of the essentials.

The volume prepared by Mr. Percival Westell and Mr. Cooper does not present any very unique features. It is a systematic book containing a few coloured and numerous illustrations that are quite good, especially those in colour. A preliminary chapter furnishes hints on collecting, after which an explanation of general systematic and morphological terms leads to the enumeration of species. The salient distinctions of each order are given, and the specific characters are scheduled at the expense of much space. The book is somewhat simpler than a flora, but less complete, as only about 200 species are described.

ELEMENTARY PHYSICS.

(1) *First Year Physics.* By Charles E. Jackson. Pp. vii+112. (London: Methuen and Co., n.d.) Price 1*s.* 6*d.*

(2) *Einführung in die Elektrochemie.* By Prof. W. Bermbach. Pp. iv+140. (Leipzig: Quelle and Meyer, 1907.)

(3) *Magnetism and Electricity and the Principles of Electrical Measurement.* By S. S. Richardson. Pp. viii+596. (London: Blackie and Son, Ltd., 1908.) Price 5*s.* net.

(1) THIS small manual is intended as a first-year text-book for schools where three or four hours per week are devoted to the subject. The book is divided into two portions; the first, theoretical, and consisting of about 100 pages, deals with units of measurement, length, area, volume, density, pressure, and force. The second part consists of 76 laboratory exercises bearing on the subject-matter of the first portion. In addition, examples for home work are given at the ends of each chapter. The book is written in clear and simple language, and the illustrations are good. The section on "Mixtures," p. 51, is ill-chosen. A theoretical calculation of the density of a mixture as there indicated will most probably differ from that obtained practically by the pupil, owing to change in volume on mixing. Again, good practical results cannot be obtained from the pendulum experiments if carried out according to the directions indicated on p. 85, viz.:—

"Allow the pendulum to swing through an arc of about 3 in. long and measure the time of 10 *complete swings*, using a watch with a seconds' hand for this purpose. . . . Repeat taking 20, 30, &c., swings, and from each measurement calculate the time of one swing. The result in each case should be the same."

Again, in section 136 we are told to time 20 swings when investigating the variation of period with length, and as an example 1.42 sec. is given as a period calculated from such an observation.

(2) The title of this book is somewhat misleading, as it does not deal with the applications of electrical methods to chemical industries, but is intended as an introduction to the study of physical chemistry. Although the treatment is of an elementary nature, the book may be profitably read by students of physics and chemistry. The first chapter is devoted by the author to a *résumé* of the laws and principles of electricity; the second chapter contains the fundamental conceptions and definitions on which the science of physical chemistry is based. The remainder of the book deals with such subjects as the electrolytic dissociation theory of Arrhenius, osmotic pressure, conductivity of electrolytes, migration of ions, and the theory of the voltaic cell. References to more advanced works on the subject are given at the end of the book.

(3) This text-book assumes a knowledge of the elementary descriptive portions of magnetism and electricity, and is intended for those students who are pursuing the subject further, either as a branch of pure physics or in preparation for a course of applied electricity. The author does not assume more than an elementary knowledge of the principles of trigonometry and mechanics in dealing with the subject. The treatment, on the whole, is very clear and concise, and the book contains considerably more matter than is usually found in books of this standard. Solutions of many questions set in recent examinations are included in the text, or given as examples to illustrate the subject-matter. These will, no doubt, commend the book to many students preparing for examinations. The statement on p. 27, "When the lines of force are parallel the field is of uniform strength," is not a very intelligible way of defining a uniform magnetic field for an elementary student. Again, on p. 97, "If a conductor carrying an electric current is placed in a magnetic field it is subject to a mechanical force which depends on the length of the conductor, the current strength, and on a measure of the field," is a somewhat loose statement, there being no mention of the direction of the field with respect to the conductor. In Fig. 204, on p. 446, "Measurement of Thermoelectric Force," the connections are apparently wrong, although the author gives no explanation of the various parts of this figure.

OUR BOOK SHELF.

Text-book of Physiological Chemistry, in Thirty Lectures. By Emil Abderhalden. Translated by William T. Hall and George Defren. Pp. xiii+722. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 21*s.* net.

WHEN Prof. Abderhalden's book was published in German about two years ago, its general excellence was at once noted, and it stepped immediately into the front rank of text-books which deal with this important and rapidly growing branch of physiology. Its author had already made for himself a great reputation as an original investigator, and as Prof. Emil Fischer's chief lieutenant had done much to elucidate the fundamental question which lies at the root of biochemistry, namely, the constitution of the protein molecule. In spite of

being a prolific worker, he has found time to write a text-book, and in so doing has established for himself another reputation as a clear and thoughtful exponent of the things the student should know. Copious references to the bibliography of the subject enhance the value of the work.

Books on physiological chemistry, or biochemistry, as it is the fashion just now to term it, have been very numerous of late. This merely indicates how assiduous are the disciples of this department of science at the present day. It was inevitable, however, that Prof. Abderhalden's book should receive the honour of translation into other tongues, and all will welcome its appearance in English dress. The translators have carried out their task with great skill, and have successfully preserved the lucid style of the original. The difficulty of international nomenclature in science is always with us, but is perhaps nowhere so conspicuous as in chemistry. Even in the English language there are no fixed rules, and such rules as do exist are often more honoured in the breach than in the observance. The Chemical Society of London has formulated laws on this question, and we believe that the American Chemical Society has acquiesced in them. There is therefore some hope for uniformity in the future, and it is gratifying to find in the present translation that these rules are observed.

In reference to protein nomenclature, a joint committee of the Chemical and Physiological Societies recently issued a report, and as the main recommendations have been also adopted by the corresponding American societies there is again some hope that authors may see their way to adopt them also, and so do something to bring order out of chaos. The translation of Prof. Abderhalden's book, however, had gone to press before this report was issued, so that in certain points (for instance, the retention of the term nucleo-albumin) the old confusion is perpetuated.

But, as the translators wisely say in their preface, it seems probable that in view of the rapid progress which is being made in this branch of chemistry, before long we shall be able to adopt a chemical classification of the proteins which will be better than any yet proposed. W. D. H.

Double Star Astronomy. Containing the History of Double-star Work; Computation of Orbits and Position of Orbit Planes; Formulæ in Connection with Mass, Parallax, Magnitude, &c. By T. Lewis. Pp. 46. (London: Taylor and Francis, 1908.) Price 2*s*.

WE doubt if Mr. Lewis has done himself justice in this little work, by which is meant that anyone might read the pamphlet and fail to recognise that he was in presence of a master. Within the small limits to which he has confined himself, it was impossible for the author to discuss the subject with the fulness it demands or the completeness that his experience would approve. He is our authority on double-star work. His familiarity with the subject has been abundantly demonstrated, his researches have been thorough and minute, and his success has been pronounced. We do not forget that here he is writing for amateur astronomers, who particularly affect double-star observation, and to many of whom the past history of astronomy is a blank. These will welcome the historical notes showing what has been accomplished, and by what means our knowledge has been enriched.

From history the author passes to computation, and we can sincerely hope that, guided by the excellent practical methods clearly set out, and illuminated by examples, many observers will be tempted to advance a step beyond mere observation. Of course, the information necessary for computing a new or correcting an approximate orbit increases but slowly, and opportunities may not very readily offer. It is perhaps more desirable that an observer should be able to compare his measures of position angle and distance with the places deduced from known elements. These means are provided and illustrated here, and by using them the observer will learn whether it is worth while to continue his measures of a particular star or to remove it from his working list, because he will see not only whether there is a wide discrepancy between the measures and the computed places, pointing to the necessity of correcting the elements, but whether the position of the companion is moving so rapidly as to demand frequent measures. In a word, the student of this little book will be able to observe more intelligently, more usefully, and with greater delight to himself.

The Threshold of Music. By Dr. William Wallace. Pp. xii+267. (London: Macmillan and Co., Ltd., 1908.) Price 5*s*. net.

DR. WALLACE has endeavoured in these pages to trace the development of the musical sense in the human race from the earliest ages up to the present time, and to trace its relation to the development of thought in other directions. In the chronological chart which is appended he "represents graphically in a diagram" the lifetimes of the principal composers on the scale of one millimetre to the year, side by side with those of men eminent in science, literature, and art. No one will doubt the author's main contention that the development of modern music has taken place according to the natural laws of evolution, and a book written with this object, though admittedly touching only the fringe of the subject, opens up a highly interesting field of study.

Dr. Wallace clearly shows how the old classical ideal found its culminating point in the works of Beethoven, and that the demand for "more expression," or, as we should say, a closer connection between music and other phases of thought, led to the development of the modern school. In our opinion the two schools stand in somewhat the same relation to one another as pure and applied mathematics. Dr. Wallace considers that still higher musical ideals may be attained in the future. But we would suggest that the transition from pure to applied music has been rather the outcome of causes which have involved degeneration from the perfection of form of the older school, just in the same way that the requirements of the practical man involve the use of approximate methods which represent a sacrifice of the perfection of form of the theories of the pure mathematician. It is little to be wondered at that in an age when men's sense of sound is deadened by the perpetual din of electric trams, motor-cars, and typewriters they should be able to endure and appreciate complex minor chords and discords blasted out "fff" or even "fffff" by an orchestra the overtones of the instruments of which afford no approximation to harmonic series, and the chaotic effect of which is further intensified by the acoustic properties of the concert hall.

Vorlesungen über technische Mechanik. By Dr. August Föppl. Vol. v. Pp. xii+391. (Leipzig: B. G. Teubner, 1907.) Price 10 marks.

THE point which strikes an English reader most forcibly on opening this book is that "technical mechanics" in Germany means something much more thorough and scientific than it does in England. Here we have a highly mathematical treatise on the theory of elasticity dealing with the flexure and vibrations of plates, the bending and torsion of beams, including Saint Venant's problem and its solutions for the ellipse, equilateral triangle and rectangle, the latter involving the usual application of Fourier's series,

solutions of the equations of elasticity for cylinders and solids bounded by planes, and numerous other important problems, selected, however, with a view mainly to practical applications. The volume forms a sequel to the third volume of the series, in which the elements of the theory of elasticity are dealt with.

Problems are every day occurring in engineering and naval architecture which require for their solution a knowledge of the subject-matter contained in this book. Very often such problems lead to differential equations, the solution of which, subject to the given boundary conditions, would keep a pure mathematician occupied for years. It is gratifying to learn from the preface that in Germany, at any rate, the larger industrial works are attaching importance to including on their engineering staffs specialists possessing theoretical knowledge of the kind here treated.

A further stimulus in the same direction has been afforded by the somewhat recently instituted degree of Doctor of Engineering. In these circumstances engineering science is bound to progress in Germany, and important new developments and improvements may be anticipated. In England not one man in a hundred who graduates at our universities in mathematics attains the standard of this book, and the majority of engineering students consider that their education in mathematics has reached a very high standard if they *really* understand the meaning of a differential coefficient and a moment of inertia. They practically never get beyond EI divided by R*o*.

Fads and Feeding. By Dr. C. Stanford Read. Pp. viii+163. (London: Methuen and Co., n.d.) Price 2*s*. 6*d*. net.

THIS is an admirably clear, well reasoned, and sensible little book. One can only hope that it may be widely read and may do something to counteract the ridiculous views on diet which are the result of the cogitation of that dangerous class of people who, having a little knowledge, supply the remainder from their own imagination. In spite of the importance of a suitable diet for health, there is perhaps no other subject which breeds so many fads. These are disseminated without discrimination by the cheap Press, and are assimilated by certain sections of the public who are always on the look-out for the latest new thing in the way of being different from their neighbours.

The key-word of Dr. Read's book is moderation; moderation in meat-eating, in tea-drinking, in the use of alcoholic drinks and the like. He is also moderate in the way he deals with the faddists, the vegetarians, the uric-acid-free dietists, the teetotalers, and the rest. Perhaps this method of dealing with them is the most effectual with the public, who, taken as a whole, are moderate, and temperate too. A reader is always apt to distrust the hammer-and-tongs argument, and to label those who adopt it among the faddists also.

Dr. Read does not concern himself with prescribing diets in disease, that is properly left to the medical attendant; he deals merely with the underlying scientific principles which regulate, or ought to regulate, the diet in health. There are, however, a few useful general hints laid down regarding the foods suitable in dyspepsia and in obesity. The golden rule for diet is to take in moderation the kind of food which experience has shown can be easily digested. The enthusiast who cannot see beyond his one idea is never a safe person to trust in any sphere of life. The accumulated knowledge which is the offspring of experience and physiological experiment is the only sort of knowledge which is trustworthy. It is impossible for every member of the public to wade through physiological treatises; the least one can expect the non-scientific man in the street to do is to study such a book as the one under review, in which this mass of facts is boiled down and presented in a non-technical and palatable form. W. D. H.

Uber Nervöse Dyspepsie. By Georges L. Dreyfus. Pp. iv+102. (Jena: Gustav Fischer, 1908). Price 2.50 marks.

ALTHOUGH this work of 100 pages claims to be a collection of psychiatric researches from the Medizinische Klinik at Heidelberg, it is of the nature rather of a critical digest than an attempt to add much to our knowledge of the subject with which it deals. The researches consist of careful investigation of twelve patients suffering from nervous dyspepsia, including the chemical analysis of the gastric contents after the administration of test-breakfasts. The cases are carefully recorded.

After a historical introduction the author proceeds to consider cases of dyspepsia in which mental disease, nervousness, hysteria and acquired neurasthenia are to be regarded as the primary cause and he rightly insists that the nervous disorder in these patients is not due to the dyspepsia; but he does not point out, as he should have done, that some rare cases of nervous disorder occur as the direct result of chronic dyspepsia of stomachic origin, and that in other cases dyspepsia and nervous disease have a common cause and are not dependent on one another. This view ought to be considered in dealing with acquired neurasthenia which is, according to some writers, probably due to the accumulation of fatigue products. The dyspepsias of Addison's disease and of exophthalmic goitre are mentioned, as well as cases in which degeneration of the plexus of Meissner was found *post mortem*.

In his summary Dr. Dreyfus maintains with justice that nervous dyspepsia is a symptom and not a disease, and that, although we are ignorant of the intimate physiology of the condition, we are in a position to assert that local treatment of the stomach by modifications of diet and other means is useless. In other words, the disease, and not the symptom, must be treated.

The bibliography of 10 pages is very full, so far as German work on the subject is concerned, and contains some references to papers in other tongues.

The volume, which is well written and easy of reference, will be welcomed by future workers on dyspepsia due to disease of the nervous system.

The Metaphysics of Nature. By Prof. Carveth Read. Second edition, with appendices. Pp. xiii+372. (London: A. and C. Black, 1908.) Price 7*s*. 6*d*. net.

AMONG the ways in which this edition differs from the first issue may be mentioned the fact that a preface has now been provided, and this introduction is of special interest as revealing the way in which Prof. Read himself regards his book, and his opinion of the reviews of the first edition. Referring to the nature of the work, the preface states:—"It is not a deductive system from principles, advancing from the simple to the complex, from the general to the particular, or according to some such formula; but is everywhere a reflection upon experience in the light of common-sense. It starts everywhere from the facts, and these may not have a necessary order." To elucidate further the more important doctrines of the book, the author has added in this edition appendices on truth, consciousness, transcendent being, and moral freedom. Unfortunately, no index is provided.

The Reliquary and Illustrated Archaeologist. Edited by Rev. Dr. J. Charles Cox. New series, Vol. xiv. Pp. 302. (London: Bemrose and Sons, Ltd., 1908.) Price 12*s.* net.

THE quarterly numbers of this review are often noticed separately in these columns on their appearance. The *Reliquary* is devoted to the study of the early pagan and Christian antiquities of Great Britain, mediæval architecture and ecclesiology, the development of the arts and industries of man in the past ages, and the survivals of ancient usages and appliances in the present. The volume for the present year contains an abundance of interesting text and excellent illustrations, and should appeal to a wide circle of readers interested in antiquities.

The Class-room Atlas of Physical, Political, Biblical, and Classical Geography. Edited by E. F. Elton. Third edition, revised. Pp. vii + 48, plates + 11. (Edinburgh and London: W. and A. K. Johnston, Ltd., 1908.) Price 5*s.* net.

THIS widely known atlas has undergone a thorough revision, and may be recommended to the careful attention of teachers in schools where geography is regarded as a school subject of great educational value. The editor has been successful in his aim of providing clear maps, a full treatment of physical features, and a series of climate charts which will meet school requirements adequately.

Flashes from the Orient, or a Thousand and One Mornings with Poesy. In Four Books: Spring, Summer, Autumn and Winter. Book second—Summer. By John Hazelhurst. (London: Hazell, Watson and Viney, Ltd., 1908.) Price 1*s.* 6*d.*

MR. HAZELHURST draws the inspiration for most of his verse from natural objects and phenomena, but occasionally current events, incidents relating to people of the day, and moral questions form the subjects of his sonnets. There are many evidences of the author's versatility in the 295 pieces the book includes, and his imagination and grace will please many readers.

The Country Home. Vol. i., May to October, 1908. Pp. ii+380. (London: Archibald Constable and Co., Ltd., 1908.) Price 5*s.* net.

THE first volume of this very attractive magazine, containing the monthly numbers one to six, is likely to become a popular book in country houses. Nature-study takes a prominent place in the comprehensive table of contents, and much attention is given to horticulture and other suitable pursuits for country dwellers. The illustrations are numerous and good.

LETTER 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 Objective Demonstration of the Rotation of the Plane of Polarisation of Light by Optically Active Liquids

SOME years ago a method was described by N. Umow (*Zeitschrift für physikalische Chemie*, 1899, xxx., 711) for demonstrating objectively the rotation of the plane of polarisation of light by an optically active liquid such as a solution of sugar. The method was an ingenious application of Tyndall's experiment on the effect of an opalescent liquid on a beam of polarised light. It consisted in rendering a concentrated solution of sugar somewhat turbid by adding to it a small quantity of an alcoholic solution of resin; on passing an intense beam of plane polarised light into this solution spirals of light of the spectrum colours were seen round the walls of the tube, the colours being, of course, due to rotation dispersion.

Some time ago, in order to show this phenomenon, I made a slight modification of Umow's method in regard to the solution, which appeared to be advantageous. A concentrated solution of sugar was mixed with arsenious oxide, and when as much of the latter had dissolved as possible, the liquid was filtered, and sulphuretted hydrogen gas passed through the filtrate. This gave a clear solution of sugar and colloidal arsenious sulphide, and when an intense beam of plane polarised light was passed into such a solution the phenomenon described by Umow was very clearly seen, although some of the colours were slightly interfered with by the yellow colour of the solution.

For the purposes of a popular lecture I recently prepared a colloidal solution in water of arsenious sulphide alone—to exhibit the Tyndall effect—and another as above described, but I also filled a third tube with a solution of sugar in water (made with tap-water and filtered through ordinary filter paper). I proposed to point out that a beam of plane polarised light passed through this last tube should produce no effect, as the tube contained a true solution.

On trying the experiment beforehand, however, I was surprised to find that the colours were nearly as distinct as, and certainly purer than, in the case of the solution which contained arsenic sulphide. It thus appears that in order objectively to demonstrate optical rotation nothing further than a clear aqueous solution of sugar is necessary, and that Umow's addition of resin and mine of arsenious sulphide were superfluous.

It seems highly probable that the simple experiment of passing a beam of plane polarised light sufficiently intense to show the phenomenon can never have been made before, otherwise the experimenter could not have failed to be struck by the colours produced.

As regards explanation, there seem to be two possibilities:—(1) there may be in the solution containing sugar and water a small quantity of foreign matter, either in the colloid form or in such a fine state of subdivision as to pass through the filter paper, these particles, as in Tyndall's and in Umow's experiment, scattering light and thus showing up the rotation; or (2) the spirals may be due to scattering of light by the sugar molecules themselves, which thus serve to show up their own rotation. The decision must be left to those competent to discuss the question. I will only mention in support of the first suggestion that when a beam of ordinary light is passed through the aqueous sugar solution slight scattering of the light certainly occurs, as is shown by examination of the light coming from the sides of the tube, by means of a Nicol prism. On the other hand, however, the colours seen in the tube containing sugar and water alone are but little inferior in intensity to those seen in the tube containing arsenious sulphide.

I have also passed a beam of plane polarised light through a tube containing a very pure specimen of menthyl acetate ($[\alpha]_D^{16\cdot6} = -79°\cdot5$) which had been carefully distilled. The colours were quite apparent in this case also, being purer, but not so intense as with the sugar solution. The scattering of ordinary light by the menthyl acetate was very slight indeed.

Whatever the cause of the phenomenon may be, it is a very simple matter to demonstrate objectively to a large audience the rotation of the plane of polarisation of light.

T. S. PATTERSON.

Organic Chemistry Laboratory, University of Glasgow, December 18.

THE FINANCIAL STATUS OF THE UNIVERSITY PROFESSOR.[1]

THE Carnegie Foundation for the Advancement of Teaching was instituted for the betterment of the calling of the teacher in the United States, the Dominion of Canada, and Newfoundland. Its first

1 "The Financial Status of the Professor in America and in Germany." Bulletin No. 2 (New York: The Carnegie Foundation for the Advancement of Teaching, 1908.)

"The Relations of Christian Denominations to Colleges." An Address before the Conference on Education of the Methodist Episcopal Church, South, at Atlanta, Ga., May 20, 1908. By Henry Pritchett, President of the Carnegie Foundation. (Printed at Nashville, Tennessee, 1908.)

purpose has been to establish an efficient system of retiring pensions for professors in the higher centres of learning. Up to May, 1908, sixty colleges and universities had been admitted to the benefits of its retiring allowance system, and one hundred and six professors and eighteen widows of professors are already receiving allowances amounting in the aggregate to more than 37,000*l*.

A natural sequel to this first important task has been the collection of statistics relating to the salaries of the American professors, and a comparison of the figures with those prevailing in Germany. The report which has been drawn up contains an introduction by Mr. Henry S. Pritchett, president of the foundation, while the arrangement and analysis are due to Prof. E. L. Thorndike, of Teachers' College, and Messrs. John G. Bowman and Monell Sayre, representing the Carnegie Foundation. For the data concerning the German professor, Dr. A. A. Snowden is responsible.

We learn from the report that there are about 1000 institutions in the United States and Canada bearing the title "college" or "university." A great many of these, however, do not rise above the rank of indifferent high schools; roughly speaking, nearly one-half of them are not colleges in any true sense, and the pay of their teachers is proportionately small. As it would be unfair to draw conclusions from these institutions regarding the average pay of the teacher of real distinction, the committee has based its conclusions mainly on information derived from the 102 institutions in the United States and Canada which appropriate annually more than 9000*l*. for the total payment of the salaries of their instructing staffs. The tables indicate that in these institutions the salary of a full professor ranges generally from about 270*l*. to 960*l*. per annum, and that the average is about 500*l*. It is pointed out that the variations in salary correspond to some extent with differences in cost of living, and that while a salary of 400*l*. may be a comfortable one in a small town in the middle west of America, double that salary may not secure equal advantages in New York. It appears that all the salaries below 300*l*. are paid either at colleges where living is comparatively inexpensive, or they are paid under exceptional conditions, in addition to free rooms and board.

From an examination of the corresponding figures for associate professors and assistants, Mr. Pritchett concludes that an American who has taken a post-graduate course and prepared himself for the profession of higher teaching may hope to obtain 250*l*. at the age of twenty-eight, 270*l*. at thirty-one, 450*l*. at thirty-three, and 500*l*. at thirty-five. The report also discusses the details at fifty-four of the most important institutions, where the total annual expenditure varies between 2000*l*. and 9000*l*. It is found that though several of these institutions are doing excellent work as "colleges," it is practically impossible for a "university" to exist and do good work under 9000*l*. a year. The scholarly atmosphere maintained at some of the smaller institutions is in direct relation to the relatively high salaries they pay their teachers.

There are very few large prizes in the teaching profession. In only two or three colleges does the salary rise above 1000*l*., and it would appear that in several instances those drawing this salary have been appointed under conditions which have since been modified.

Mr. Pritchett is keenly alive to the need for bettering the position of the university teacher. It is pointed out that the professor can never expect to earn the large income which is the reward of enterprise and ability in such learned professions as medicine and law. The attraction which leads able men into the teacher's calling springs from two sources, first, the sense of power and responsibility which the true teacher feels; secondly, the love of study and of the scholar's life. Held in a position of highest dignity by those about him, he lives a life of frugality, of simplicity, of influence, and, above all, of happiness. He lives, as Mr. Lowell observed, in the only recognised aristocracy in America. A man who chooses this calling should be freed from financial worries. A salary below the line of comfort means a struggle to live and educate the children of the family. Probably there are very few professors in any country who do not utilise their salaries to the best advantage by living the simple life, so that when the financial worries come the sacrifice takes the form of abandonment of research and the undertaking of outside work, often remunerated at a rate which makes but a poor return for the demands it imposes on the professor's time. The need of opportunity for research is strongly emphasised by Mr. Pritchett. Another cause which is detrimental to scholarly productiveness is the large amount of administrative and routine work frequently devolving on the teachers.

The second part of the report deals with Germany. The committee finds that the German professor may expect in time a far greater financial and social reward than comes to his American colleague. He has, furthermore, a place of far greater security, and with full protection for his old age and for his wife and children. On the other hand, he has to go through a longer period of probation than the American before attaining the coveted chair. A German who possesses such ability that he may expect in due time to become a full professor, and who prepares himself for university teaching, must expect to study until the age of thirty with no financial return, to study and teach as a privat-docent until nearly thirty-six, with an annual remuneration of less than 40*l*., and to teach from thirty-six to forty-one with an annual remuneration of from 120*l*. to 400*l*., by which time he may become a full professor and will continue to receive his salary until his death.

The committee is very strongly of opinion that the low scale of salaries of American professors is in no small measure due to the multiplication of weak and unnecessary colleges, and also to the tendency to expand the curriculum over an enormous variety of subjects without regard to thoroughness. A college of ten professors who are strong teachers, commanding fair compensation and teaching only such subjects as they can teach thoroughly, is, as Mr. Pritchett points out, a far better centre of intellectual life than a college which seeks with the same income to double the number of professors and to expand the curriculum to include in a superficial way the whole field of human knowledge. In many instances given in this bulletin the low grade of college salaries is due to the attempt to maintain a university with an income which is adequate only to the maintenance of a good college.

In regard to the multiplication of classes, it is pointed out, in so many words, that as a rule neither the professors nor the president of a university college are fighting business men. When it comes to a question of asking for more money, they are by nature diffident of placing their own personal claims in the foremost position, and they adopt the "path of least resistance" by associating their demand with some desirable extension of the teaching work of their institution. They hope all along that their own candle will be relieved from the pressure of the bushel which dims its luminosity. But, unfortunately, they

too often adopt a course which has the reverse effect by exhausting the funds which might be theirs if they only asserted themselves with a little more push. It is this fact which has led to a result, not peculiar in any way to American universities, that the salaries of professors often decrease in direct measure as the success of their college or university increases. If Mr. Pritchett had carefully studied the universities of Great Britain he might have found some notable instances in our own country. Meanwhile the professor himself makes strenuous efforts to reduce his butcher's or tailor's bill, and if he succeeds it too often happens that his influence as a leader of thought is impaired in consequence. As the committee puts the matter, he does not feel quite justified in demanding a greater salary for himself, even though he is wasting the university's energy in copying quotations, building fires, and hunting about the town for a cheap tailor. A course is given, though only five out of a thousand students take it, and though these five would probably be as much profited by some other course already offered. Yet to give that course is to withhold an increase of twenty or twenty-five per cent. to some individual's salary. It is pointed out that in many things institutions might profitably cooperate. There does not seem, for example, any necessity for two universities in the same city to give courses in Syriac.

The problem which this consideration presents is thus stated on p. 52 of the Bulletin. "Given a certain sum for salaries for a university or college of a given size, how much must be sacrificed in the quality of the teachers in order to have enough teachers? If all the conditions of the problem were capable of exact numerical representation, this would be a simple problem in maxima and minima, but in view of the difficulty of translating the data into mathematical language, we may be at least satisfied with the committee's recommendation that one 600*l.* man teaching a class of thirty-six students probably means better progress than two 300*l.* men each teaching eighteen of the thirty-six.

Turning to the question of multiplication of colleges, an important factor in America has been the foundation of a large number of educational institutions associated more or less directly with certain Christian denominations. These colleges form the subject of Mr. Pritchett's address before the Methodist Episcopal Conference at Atlanta. Colleges which are under the control of a sect, or which require their trustees, officers, or teachers to belong to a specified denomination, are excluded from the benefits of the Carnegie Foundation. Mr. Pritchett pays a high tribute to the work which many of these institutions have done in the pioneer days of American education, but points out the great increase which has taken place in recent years in the expense of maintaining a genuine college on efficient lines, and finds that during the last two decades Christian denominations have found increasing difficulty in meeting those obligations, and the colleges controlled by them have with few exceptions received a meagre and inadequate support. There are three positions which a Christian denomination may take up in regard to education. First, it may say that the maintenance of colleges is necessary for extending and continuing the influence and power of the Church in question. Under this view the responsibility of providing the funds rests with the Church itself. From the statistics given in the paper it is shown that the salaries which denominational colleges provide for their teachers even in the most favourable cases compare very badly with those prevailing in institutions under State or independent control. A further objection to the system is the burden which it imposes on the ministry of begging money for the Church college. It is clear that under such a system burdens have been imposed on the churches which they cannot efficiently bear at the present time. The second view is that a church may claim the right and duty to control educational institutions on the ground of religious fitness. But it is pointed out that the maintenance of sectarian tests does not, as a rule, conduce to the religious fitness of a college; indeed, it has often resulted in a serious lowering of standard, brought about by competition between colleges of rival denominations. The third method is for a religious body to accept openly the view that colleges and universities are furthering the cause of religion generally, and that the cause can best be advanced by a Church if it exerts its best influences on higher institutions in general without reference to sectarian control. Mr. Pritchett considers that such a solution is not only theoretically but practically possible, and that the abandonment of the spirit of partisanship will strengthen the churches by enabling them to appropriate to their own use in the training of their own men the facilities for general education provided in colleges.

On reading these publications we naturally wish that there was some body in England corresponding to the American Carnegie Foundation, the more so as the operations of that body extend to Canada as well as to the United States. The very success of the higher educational movement in Great Britain has too often resulted in a lowering of the professors' salaries. This is particularly unfortunate in a country where a continual struggle for the upper hand occurs between the scholarly ideal and the examination (shall we say?) ordeal. Examinations are not altogether bad in themselves; they test the student's powers of English composition, of expressing lucidly and intelligibly in writing the ideas which he has learnt. They should also test his resourcefulness in dealing at short notice with difficulties which have not been anticipated by the teacher. But the teacher whose tenure of office is at all insecure cannot but feel that in many instances his means of livelihood are more or less dependent on the outside show which his classes make when the numerical results of examinations are compared with those of other institutions. Thus, instead of devoting his spare hours to research, he is often led voluntarily to give private tuition to those members of his classes whose prospects of passing their examinations are doubtful. In other words, a premium is placed upon inferior scholarship. We have known of professors whose careers have been ruined by their too rigid insistence on high scholarship in contradistinction to high records of examination passes. Again, the need of retiring allowances for professors was never and nowhere more acutely felt than it is in Great Britain at the present day. That it should be possible for a Fellow of the Royal Society to be reduced to extreme poverty without even a Civil List Pension, after devoting the best years of his lifetime to the interests of a college, doing the work of perhaps five professors in a German university for a salary far below the line of comfort, is an occurrence of which our country cannot feel proud. To make things worse, this sad misfortune may not improbably have been the result of overwork in undertaking additional administrative duties for the college in a period of emergency. If the Carnegie Foundation does no more for America than prevent the occurrence of such cases its existence will be fully justified, but it would be a great relief to some of us on this side of the Atlantic if a similar institution could be charged with the interests of the higher teachers in Great Britain. G. H. B.

THE VACATIONS OF A NATURALIST.

THOSE who have read "In Northern Spain," published some years ago, will welcome another book of travel by the same author. In the years 1902 and 1904 he spent the long vacation in the south of Mexico in search of zoological specimens, and the present volume not only gives us an entertaining account of the experiences of himself and his wife in localities which are still but little known, but it is a collection of scientific observations and speculations of considerable value, in which, though zoology naturally takes the first place, other branches of research are by no means neglected. He spent a considerable portion of his time in the *tierra caliente*, the hot tropical lowlands, at a season—from June to September—when vegetable and animal life exhibits the greatest luxuriance and activity. It is, however, a period of excessive heat, and in most places heavy rainfall, so that readers of the book will obtain an unduly unfavourable impression of life in tropical America. At other times he was at work on the invigorating table-land of Mexico or the slopes of its lofty volcanoes.

Everywhere he was successful in obtaining specimens of new or rare forms of life, and to those who know the difficulties of carrying through a programme where the bridle-path and mule-train are the only means of transport, the amount that he was able to accomplish in the limited time at his disposal will seem marvellous.

The book commences with a description of the environs of the capital, and gives an interesting account of Lake Xochimilco, famous for its floating gardens and the axolotl that inhabits its waters, the questions which arise in connection with the life-history of the latter being discussed in some detail.

The travellers spent some time on Citlaltepetl, el Volcan de Orizaba, where the author was struck by the abrupt character of the upper limits of plants on the mountain-side. "*Tillandsia tricolor* disappears quite suddenly from the southern slopes at about 9600 feet; the last specimens are just as large and flourishing as those lower down, whilst the conifers upon which they grow, continue without the slightest change. The *Pinus liophylla* and the *Abies religiosa* cease at their upper level as very big trees."

The author obtained five species of the land-newt, Spelerpes, one of which, *S. variegatus*, was ultimately found to extend from an altitude of 9000 feet to the tropical lowlands. He states that "a boxful of *S. variegatus* that he collected in a day's excursion in a tropical region south of Cordoba lived very well on Citlaltepetl in spite of the low temperature, but those brought from that mountain died within a few days when taken into the tropics; and he considers this to corroborate "the fact that most creatures can endure a temporary change into cooler surroundings, even though they may not flourish under it, while the reverse of such conditions prostrates and kills them." It is, however, doubtful whether this is true of warm-blooded animals. On the other hand, he contends that there are many more species of animals and plants, which have their "probable centre of origin in temperate climates, and now extend into the tropics and yet remain apparently unaltered, than there are hot country species which have spread into cool climates."

From Orizaba the travellers passed to the low-lying forests of the Rio Tonto, on the northern side of the Isthmus of Tehuantepec, where a goods van shunted on to a siding formed their headquarters. The author's description of a tropical forest is so true to nature that part of it may be quoted here:—"It does not begin gradually. On its outskirts it is fringed by an impenetrable wall of luxuriant herbage, shrubs and creepers. . . . It can be entered only by hacking and slashing a path through the tangled growth, which closes up again within a few weeks, except where traffic may have produced a narrow, meandering track, from which it is impossible to deviate either to right or left. Once inside, we are in a gloomy, stuffy forest consisting of tall, straight trees, which branch out at a great height above us, there interlacing and forming a dense canopy of green through which passes little or no sunlight. The absence of direct light effectively prevents the growth of underwood, and there are no green, luxuriant plants, no flowers or grass. The ground is brown and black, covered with many inches of rotting leaves and twigs, all turning into a steaming mould. From our point of view below the canopy the leaves, branches, and even bright-coloured birds look black, and this is still more the case where, by contrast, such objects are seen through a rift in the canopy against the glaring sky."

The "Chinampas" or Floating Gardens of Lake Xochimilco. From "Through Southern Mexico."

Prof. Gadow describes in detail the adaptation of different groups of animals to forest life, and lays stress on the fact that, given the same conditions, the outward characters of different forms become almost identical. Speaking of the arboreal Anura, he tells us that "the forests have succeeded so well that it is, for in-

[1] "Through Southern Mexico. Being an Account of the Travels of a Naturalist." By Hans Gadow, F.R.S. Pp. xvi+527. (London: Witherby and Co., 1908.) Price 18*s.* net.

stance, impossible to distinguish certain green tree-frogs of the African genus Rappia from a Hyla unless we cut them open. If they lived side by side, which they do not, this close resemblance would be extolled as an example of mimicry. In reality, it is a case of heterogeneous convergence brought about by identical environmental conditions. One might almost say that tropical, moist forests must have tree-frogs, and that these are made out of whatever suitable material happens to be available."

Continuing their journey by rail, the travellers reached Tehuantepec, on the Pacific coast, where the lower rainfall is evidenced by less luxuriant vegetation, and thence travelled on horseback north-westward on to the southern plateau. On the way we learn a great deal about a variety of topics, including "white ants"; *Anableps dowei*, the "four-eyed" fish; the weaver bird and the method it has devised of suspending its nests from telegraph wires; humming-birds; rattlesnakes, and how they got their rattle, and the exemplary Chontal Indians, who never steal "porque no es costumbre."

In some places the vegetation consists mainly of cacti. After describing the armament of spines that affords them effectual protection, the author reminds us that "cattle and horses, sheep and goats, were all introduced by the Spaniards, and none of the indigenous vegetable-feeders of the plateau, such as stags, squirrels, hares, and mice, can claim to have helped in the evolution of these plants. Are we reduced for an explanation to go back to the extinct fauna? More likely it is one of those cases in which imagination has run away from a more sober and matter-of-fact judgment. It is, no doubt, the case that the conditions prevailing on a high table-land of this kind, subject to prolonged drought, a fierce sun, great and quickly-succeeding changes of temperature, and dust-storms, have produced the characteristics of this family of plants without regard to the animals." We must remember, however, that the Camelidæ and Equidæ must in all probability have formed part of the fauna of Mexico as late as the Pleistocene, as they are found in deposits referred to that period both in North and South America. Some means of defence against these animals would have been absolutely necessary for the preservation of succulent plants in a dry climate where vegetable food was far from plentiful, and it is only reasonable to suppose that the destruction of unprotected forms contributed to the extraordinary development of spines which now characterises the group.

In the second expedition the author and his wife travelled south from the capital by way of Cuernavaca to the terminus of the railway at Balsas. Thence they made their way on horseback over the mountains to a densely wooded portion of the Pacific coast, where they camped on a narrow strip of dry land between a lagoon and the sea. There is a fine description of the nightly thunderstorm which came up from over the sea, a phenomenon of considerable meteorological interest. Unfortunately, in this and many other cases we are not given the date or even the month when the observations recorded were made, though this information would have added considerably to their value.

The illustrations are plentiful and usually clearly reproduced, though one would have wished for more photographs of the phases of animal life which form such an important feature of the text; but with so much compressed into such a brief period it is easy to understand that there was no time for telephotographic work.

J. W. E.

THE HEADMASTERS' CONFERENCE.

AFTER a school career prolonged to the age of eighteen in one of the great public schools, a youth should possess certain minima of endowment —moral, physical and intellectual. His intellectual assets should include a reasonable proficiency in the use of the English language, the ability to read intelligently at least one other language, a notion of what the study of history really means (with some sense of historical perspective), and acquaintance with some fundamental scientific discoveries, together with an inkling of the importance of the advancement of man's control over his environment. He should have an intellectual interest in at least one subject, not necessarily, nor even preferably, included in his school studies. A charge has been preferred against the schools of failing to equip the majority of the young men who leave their ranks with even this modest minimum of mental endowment, and the authors of this charge include men whose experience and ability lend weight to their indictment. Interest in the headmasters' debates concerning curricula should not at this juncture be confined to the ranks of the scholastic profession.

There were fifty-two headmasters present at the meetings of the conference, which took place at the Merchant Taylors' School, London, on December 22 and 23. The Rev. Dr. Nairn presided, and the larger schools were well represented. It may be well to remind our readers that by its constitution the conference limits its membership to headmasters of schools where a considerable number of boys remain until the age of eighteen or nineteen. A discussion of the proceedings of the annual congress should throw light on the progress being made towards an improved curriculum.

Special interest attaches to the resolutions relating to the age at which the study of Greek should begin. Two years ago the conference declared that this study should be postponed to the age of thirteen or fourteen, and that Greek should not be a subject of the entrance examination at the schools represented in the conference. Forty-two of the leading schools regulate the admission of boys from the preparatory schools by an examination entitled "Common Examination for Entrance to Public Schools." We find that only five of the forty-two schools have definitely dropped Greek, the remaining thirty-seven disregarding the 1906 resolution. On the other hand, seventeen schools exclude science, and the remainder make science optional, usually as an alternative to Latin verse. The practical result is that many little boys in preparatory schools are specialising in classics, and their general education is impossible. In other cases we find (to quote Mr. R. C. Gilson, of Birmingham) "the present stupid method of trying to teach three foreign languages together to little boys in knickerbockers." At the age when the observation of nature and education of motor-centres are of special importance, the public schools insist on the pursuit of Latin and Greek to the practical exclusion of manual and observational training. It is hardly to be wondered at that, to quote Mr. Gilson again, "in the name of teaching Greek the schools were turning out men who could not observe nature." This state of affairs will be remedied to some extent if and when practical effect is given to the resolutions of the conference, which affirmed (1) that the average boy cannot undertake the study of more than two languages besides English before the age of thirteen years without detriment to his general education; (2) it is the duty of public schools to provide classes in which the study

of Greek can be *begun*. There is the more reason for hope that the opinions of the conference will not again be ignored in practice, since the meeting further resolved, on the motion of Dr. Lyttelton, to appoint a committee to confer with the preparatory schoolmasters as to a scheme of studies for schoolboys from the age of nine until about sixteen.

A report presented to the Leicester meeting of the British Association contained recommendations which have been endorsed during the last fifteen months by various meetings of teachers. Without undue precipitancy or rash precision, the meeting decided, "That this conference, while withholding its assent to many details, and in particular to the proposal to postpone the study of Latin to the age of twelve, approves of the main conclusions of the report of the committee of the British Association Education section." It may be hoped that influential headmasters will find some means of translating this approval into action, especially the much-needed improvement of the position of teachers.

Several administrative problems were discussed. The Board of Education was asked to proceed at an early date with the registration of teachers, the suggestion being made that the Registration Council should include representatives of various types of schools. A resolution welcoming the inspection of non-local schools by the Board failed to pass, the previous question being voted by a small majority. Some headmasters desired inspection as a means of bringing the authorities of the schools into closer touch with the Board, in order that the great public schools might take their place in a coordinated system of national education. On the other side, fear was expressed lest compulsory inspection should make the headmaster responsible to two masters, the governors and the Board; any action was deprecated which would diminish or destroy the variety of type of the secondary schools of England. As opinion on this matter appears to be uncrystallised, we may hope that there may be a gradual growth in the number of schools which seek inspection by the Board on their individual initiative. The conference appointed committees to confer with (*a*) the Army Council, (*b*) the Oxford and Cambridge joint board. The neglect of German was deplored, and a resolution was carried in favour of dividing the emoluments of entrance scholarships so that the bulk of the money should be reserved to those in need of financial assistance.

Reviewing the deliberations of the conference as a whole, it can hardly be asserted that the need for far-reaching reform of the public-school curriculum has been sufficiently impressed upon headmasters. Reform of the common examination for entrance to public schools is a necessary preliminary. In its present organisation this examination discourages manual training, ignores the æsthetic side of education, and penalises nature-study and experimental science. The plain teaching of physiology concerning the development of the brain and of neuro-muscular systems receives contemptuous disregard. There is a widespread belief that the position attained by a boy on entry to the public school depends almost entirely on his knowledge of the rudiments of Latin and Greek. We do not know of how many schools this is true, but we are certain that proficiency in natural history or physics should be no bar to a boy's efforts to win a good position, and that no implication of intellectual inferiority should attach to the science side of the school. With great earnestness we urge the joint committee of the conference and the masters of preparatory schools to re-model the conditions of the entrance examination, so that young boys may pursue a broad general course, comprising literary, scientific, mathematical, artistic and manual training. The terms of reference assigned to the committee encourage us to hope for a curriculum containing the studies we have enumerated up to sixteen years of age. If schemes founded on such a basis were adopted by the schools, a partial specialisation during the last two years at school would be compatible with the aim which headmasters no less than their critics have in view, viz. to ensure that the majority of boys should receive during school-life a general education in harmony with the ideas and requirements of the present century. G. F. D.

BIRDS IN RELATION TO AGRICULTURE.[1]

DURING the past few years birds have received an increased amount of attention, for it has become more generally recognised that the whole question of their food supply is of great importance to British agriculture—using this term in its widest sense. There are plenty of individuals who rightly recognise that many of our avian fauna are of much economic value, while there are also, unfortunately, a far greater number who thoughtlessly stigmatise the majority of birds,—or at least birds of a certain class, *e.g.* owls—as useless and harmful. These less enlightened sons of the soil need showing that the majority of British birds are useful, but the showing is far from easy. It has been demonstrated over and over again that the sparrow, or "the avian rat," as Mr. Tegetmeier terms it, is entirely harmful; Yarrell has stated that the kestrel principally subsists on mice; a case is mentioned by Macgillivray in which food was brought to the nestlings by a pair of fly-catchers no fewer than 537 times in a day; and the writer has himself observed a single starling carry food to its young from a grass paddock 18 times in 15 minutes; and hundreds of similar records have served to demonstrate in some sense that many birds are useful, and confer an immense benefit on mankind.

Although individual records are very valuable, they are not of the same importance as a coordinated and duplicated set of records, and the latter has been sorely needed. Mr. Robert Newstead has just made a most important contribution to our knowledge of the food of birds, his memoir on the subject being published as a supplement to the December issue of the *Journal of the Board of Agriculture*. As curator of the Grosvenor Museum, Chester, a large number of birds passed through Mr. Newstead's hands, and he was wise enough to tabulate carefully the contents of stomachs, &c. No special effort was made to collect material, and for this reason the records are, perhaps, the more valuable, since no selection of birds "caught red-handed" was made

Full notes were also made as to sex, locality, date, &c., and the records are based on 871 *post-mortem* examinations of the stomach contents and the "pellets" or "castings" of 128 species of birds. Field observations bring the records up to more than 1100. The contents of stomachs, "pellets," &c., are arranged under several heads, including insects, divided into beneficial and harmful in their respective orders; animals other than insects, *e.g.* slugs, birds, fish and other "small deer"; and vegetable food, which includes fruit, weed seeds, grain, &c. The birds themselves are finally divided, on the results of their partiality for given foods, into seven classes, from wholly innoxious and more or less strictly

[1] "The Food of Some British Birds." By Robert Newstead. *Journal of the Board of Agriculture*, December supplement. (Board of Agriculture and Fisheries, 4 Whitehall Place, S.W.) Price 4*d*. post free.

beneficial, through other grades to wholly destructive and useless species.

Coming now to the results, it is shown that insects were found in 41 per cent. of the total *post-mortem* records and pellets, while if certain birds—*e.g.* finches, owls, hawks, and water birds—are omitted "the insects forming the whole or part of the dietary of the remaining birds amount to between 70 and 75 per cent."

Large numbers of injurious insects were taken by all kinds of birds, click beetles and their larvæ (wireworms), weevils, crane flies and their larvæ (leather jackets), surface caterpillars and winter moth caterpillars being numerous; for example, five specimens of the rook contained between them 213 surface caterpillars, and 120 winter moth larvæ were found in a jay's stomach.

Grain occurred in about 77 cases, but in almost negligible quantities, and, except in the case of the blackbird and of fruit buds damaged by the bullfinch and blue titmouse, cultivated fruit was scarcely represented. Noxious weed seeds were taken by many birds.

Of the birds themselves, the majority come under the "useful" class; the song thrush, great and blue tits, greenfinch, chaffinch *and rook* have the balance of utility in their favour; the blackbird, bullfinch, sparrow-hawk and raven are destructive and doubtfully of any utility; while it is noteworthy that those species regarded as "wholly destructive and useless" number but three—the carrion crow, house sparrow and wood pigeon, the food of the two latter, however, not being considered.

Mr. Newstead's paper should be widely read, for it may certainly be held as a vindication of the bird world, and it is easy to understand the author's emphasis of the great value of the majority of birds. As hinted in the official preface, it is to be hoped that further reports will be forthcoming at a later date.

NOTES.

THE most disastrous earthquake in Europe for many years was experienced in Calabria and the district of Messina, in Sicily, on Monday, December 28. The shock occurred at 5.20 a.m., and was followed by a great sea-wave, which appears to have destroyed Messina and Reggio, and also the greater part of the villages on each side of the Straits of Messina. Reports from Catanzaro state that the first intimation of the disturbance was a prolonged, thunderous noise followed by a vivid flash of lightning, and at the same time by a series of violent shocks which seemed interminable. Heavy torrential rain then fell, and continued to fall during Tuesday. According to reports from *Times* correspondents, so complete has been the destruction of Messina that it is almost impossible to obtain any connected account of the character of the earthquake. The centre of the disturbance seems to have been in the Straits, and it is greatly feared that the whole conformation of the neighbouring coast-line has been changed. On Tuesday, the officer of a torpedo-boat who left Messina for Reggio sent after a few hours the following message:—"I cannot find Reggio; if it exists, it is no longer where it was." The lighthouses in the Straits have been rendered useless by the earthquake, and it is rumoured that the configuration of the bottom of the Straits has been altered greatly. It is estimated that the number of deaths will reach the terrible total of 100,000, for in Messina alone 50,000 lives are said to have been lost. It will be recalled that the province of Calabria was visited with like disasters in September, 1905, and October, 1907.

A TOUCH of real winter has set in over Great Britain since Christmas, and the closing days of December will be remembered for the heavy falls of snow and the severe frosts which have occurred. At Christmas a cold but dry easterly wind was blowing over the whole country, but on December 27 a shallow disturbance traversed the northern portion of the kingdom, and a fall of snow was generally experienced. The heaviest fall occurred in Scotland, but the amounts were fairly large over England, the fall being generally augmented on the following days, and much inconvenience was occasioned on our railways and to other traffic. The frost was exceptionally keen in all parts of Great Britain, and unusually low temperatures occurred in many places. The lowest thermometer readings were mostly experienced on the night of December 28 and on the following day. At Oxford the thermometer on the grass registered 14°, and at Greenwich a similar thermometer read 17° on the early morning of December 29. Much snow has fallen in London and the suburbs, and in St. James's Park, the observing station of the Meteorological Office, the sheltered thermometer stood at 22° at mid-day on December 29. The Greenwich records for the past sixty-eight years only show three instances of the highest day temperature below 25° in December; these occurred in 1855, 1874, and 1890, the lowest previous record being 23°·2, in 1855. Intense cold has occurred generally over western Europe, the minimum thermometer in the screen registering 3° at Berlin and 5° at Brussels on the night of December 28. This severe weather was accompanied by high easterly winds in many places.

WE learn with deep regret of the death of Dr. J. M. Pernter, director of the Zentralanstalt für Meteorologie und Geodynamik in Vienna, and professor of terrestrial physics in the university there. Dr. Pernter died on December 20 at Arco, in South Tyrol, at sixty years of age.

THE Weekly Weather Report just issued by the Meteorological Office gives a summary of the observations for the past year. The highest shade temperatures for the several districts range from 91° in the west of Scotland to 81° in the north of Scotland and in the north of Ireland. The lowest temperatures range from 10° in the east of Scotland and in the Midland counties to 19° in the north of Scotland and 24° in the English Channel. The mean temperature was not generally very different from the average, but there was mostly a slight excess. The number of rainy days ranged from 252 in the north of Scotland to 167 in the south-east of England, and they were mostly in fair agreement with the normal. The largest aggregate rainfall for the year was 51·14 inches, in the north of Scotland, which is 1·17 inches less than the average; the next largest measurement was 46·85 inches, in the west of Scotland. The largest total in the English districts was 36·36 inches, in the north-west, and the least 20·14 inches, in the north-east. The rainfall was nearly everywhere in defect of the average; in the south-west of England the deficiency was 6·93 inches. The duration of bright sunshine varied considerably in different parts of the kingdom, the largest amount being 1897 hours, in the English Channel district. In the south-east of England there was the greatest excess, the total duration being 1737 hours, which is 140 hours more than usual.

WE regret to see the announcement of the death of Dr. George Gore, F.R.S., at eighty-two years of age.

ACCORDING to a Reuter message, the newspapers of Burgos report that five meteoritic stones, weighing from

one to seven kilograms, fell a few days ago in the village of Jubilla del Agua, setting fire to a farm.

DR. HAROLD R. D. SPITTA, assistant lecturer on bacteriology and lecturer on clinical pathology at St. George's Hospital, has been appointed to the newly created post of bacteriologist to the Royal Household.

ACCORDING to the *Scientific American*, the U.S. War Department has considered the advisability of immunising soldiers against typhoid fever by vaccination. It has decided that inoculation as a preventive against typhoid has been demonstrated so thoroughly, and its efficacy so well established, that the vaccination method is to be adopted in the United States Army.

WE learn from *Science* that an investigation into the cause of cancer, and its possible prevention and cure, has been begun in the College of Physicians and Surgeons, Columbia University, under the direction of a committee consisting of Dr. S. W. Lambert, dean; Prof. W. J. Gies, professor of biological chemistry; Prof. P. H. Hiss, jun., professor of bacteriology; Prof. F. C. Wood, professor of clinical pathology; Prof. G. N. Calkins, professor of protozoology; and Dr. Eugene H. Pool, instructor in the department of surgery.

THE American National Association of Audubon Societies is organising a complete census of the game and forest birds of the country. This work will be superintended by a committee consisting of Mr. W. Dutcher, president of the association; Mr. E. H. Forbush, ornithologist of the Massachusetts State Board; Mr. T. Gilbert Pearson; Mr. Frank M. Chapman, assistant curator at the American Museum of Natural History; and Dr. T. S. Palmer, of the U.S. Biological Survey. Thousands of question forms are to be sent to friends of the association throughout America, as well as to all wardens and officials who have opportunities of observing the bird life of their own neighbourhoods. The object of the census is to collect cogent evidence of the need of greater protection for the nation's birds, especially in the interests of the crops and the trees.

THE following are among the prizes awarded by the Paris Academy of Medicine for 1908, announced in the *British Medical Journal*:—the Laborde prize (200*l*.), for the most notable advancement of surgery, to Prof. Monprofit, of Angers, for his work on the operative surgery of the stomach; the Theodore Herpin prize (120*l*.) to Dr. Albert Deschamps, of Riom, for an essay on the diseases of energy—general asthenias; the Amussat prize (40*l*.) to Dr. Destot, of Lyons, for a radiographic and clinical study of the wrist and industrial accidents; the Orfila prize (160*l*.) to Prof. Calmette, MM. Boullanger, E. Rolants, F. Constant and L. Massol, and Prof. Buisine, for researches on the purification of water that has been used in towns and of the residual water of factories. The Roger prize (100*l*.) to Dr. Marfan, for his treatise on the feeding of infants; the Saintour prize (176*l*.) to Dr. Émile Sergent, for his work on syphilis and tuberculosis; the Campbell-Dupierris prize (92*l*.) to Dr. Morris Nicloux, for his work on general anæsthetics from the chemico-physiological point of view; the Ernest Godard prize (40*l*.) to Dr. F. W. Pavy, of London, for his work on carbohydrates and their transformation—a physiologico-pathological study with considerations on diabetes and its treatment.

WE regret to announce the death of M. E. Stuyvaert, who for many years occupied a prominent position in the Royal Observatory of Belgium. For nearly thirty years he rendered loyal and efficient service to that institution, both at Brussels and in its more recent installation at Uccle. He was one of the Belgian astronomers who took part in the observation of the transit of Venus in 1882, and from that time onward he took the greatest interest in extra-meridional work. He was in charge of one of the equatorials, and was indefatigable in his observation of comets and planets, as well as of eclipses and occultations. The physical appearance of the larger planets was a subject which engaged his attention, and he published several memoirs on the surface markings of Jupiter and Mars. His micrometrical measures of double stars from 1878–96 is a well-known work. In addition to instrumental observation, he paid considerable attention to the subject of meteors and the appearance of the zodiacal light. For some time previous to his death he had been engaged in constructing a large-scale model of the moon, which, unfortunately, is left unfinished.

MR. H. ST. JOHN GRAY contributes to the *Times* of December 26 a full account of excavations in the Maumbury Rings Circle, of which he was in charge. This has long been regarded as the site of a Roman amphitheatre, and this view is corroborated by the fact that one of the most interesting discoveries made was that of a stratum of shell fragments, quartz, flint, land-shells, &c., similar to that used by the Romans in other places to fill up uneven patches, to prevent the slipping of the gladiators, and to absorb the blood of combatants. Fragments of pottery also indicate Roman occupation, and one portion of the site seems to have been fortified, holes for stakes cut in slabs of Purbeck limestone having been found at the point where the entrance of the arena was situated. It is interesting to find that this place was occupied by the Neolithic people as a flint workshop. Flint flakes, cores, and hammer-stones were found scattered on part of the site, and the picks made of deer's antlers were obviously the implements by which this early race excavated the remarkable pit whence the rough flints were obtained. This pit is at least 30 feet deep, one of the deepest archæological excavations on record, one of those at Grime's Grave being a few feet deeper. It is much to be desired that a site which seems to have been almost continuously occupied since Neolithic times by various peoples should be fully investigated, and it may be hoped that the appeal for help issued by Mr. Gray from Taunton Castle, Somerset, may meet with a liberal response.

A SHORT time ago Dr. O. P. Hay's memoir on the fossil chelonians of North America was reviewed in our columns. The author has supplemented this in No. 1640 of the Proceedings of the U.S. National Museum with an account of four new species, together with a note on a fifth named by Cope.

TO No. 5 of vol. viii. of the *Museums Journal* Dr. A. Fairbank, the director, contributes an account, illustrated with plans, of the new building for the Museum of Fine Arts in Boston, U.S.A., which, it is hoped, will be completed early in the new year. Great care appears to have been exercised in the planning of the building, which, it is stated, will be admirably adapted for the display of the treasures with which it is to be filled.

SOME time ago Dr. E. Fraas published an account of bones of sauropod dinosaurs obtained by himself in German East Africa. The remains were found lying on the surface of the ground in considerable numbers, and only a portion of those seen appears to have been brought home. With the view of securing additional specimens, Dr. Fraas

we are given to understand, is about to make another expedition to East Africa.

A BEAUTIFULLY coloured plate, in addition to several others in black and white, illustrates a further report, by Mr. R. W. Sharpe, on the ostracods in the United States National Museum, published as No. 1651 of the Proceedings of the Museum. No. 1654 of the same publication is devoted to amphipods collected off the west coast of North America, which include a new family, together with several new genera and species. Mr. S. J. Holmes is the author of this communication.

A FURTHER account of fishes of the Irish Atlantic slope forms the subject of Irish Fisheries, Scientific Investigations, 1906, part v. (1908). The authors, Messrs. Holt and Byrne, commence in this issue an illustrated account of the more uncommon deep-water fishes of the Atlantic coast, with the object of rendering the species easily identifiable by fishermen, and commence with the families Scorpænidæ and Alepocephalidæ, of which a number of representatives are figured. This is followed by an account of recent additions to the marine fish-fauna of the British Isles, these including a new species of ray.

THE greater portion of vol. xii., part ii., of the Transactions of the Leicester Literary and Philosophical Society is devoted to an illustrated account, by Mr. A. B. Harwood, of the town museum, of the fossil flora of the Leicestershire and South Derbyshire Coalfield, with especial reference to the evidence it affords with regard to the age of the local Coal-measures. It is concluded that the Coal-measures of the Ashby, or central, district are lower in the series than those of the eastern and western districts, which belong mainly or wholly to the middle portion of the series.

THE opening article in the November issue (vol. ii., No. 8) of the *Anatomical Record* is devoted to the methods of teaching anatomy in the medical schools of the United States, more especially at Johns Hopkins University. The importance of concentrating elementary teaching is strongly insisted upon by the author of the paper, Mr. F. P. Mall, this, as applied to anatomy, meaning that the elementary work should be given during the student's first year, the schedule being so arranged that the greater part of the time of each pupil is devoted to this subject until the elementary portion is completed. "It has been the aim of American anatomists," concludes the author, "to elevate the status of our profession, for it has been resting as a compressed buffer between surgery on the one hand and zoology on the other."

REGENERATION at the two extremities of the body in the annelid *Spirographis spallanzanii* forms the subject of the first article, by Mr. P. Ivanov, in vol. xci., part iv., of the *Zeitschrift für wissenschaftliche Zoologie*. It is stated that in this and allied polychætous annelids, living a sedentary life in tubes constructed by themselves, the phenomenon of regeneration presents a special interest on account of the fact that the bodily structure of these creatures shows several peculiarities, such, for instance, as the abnormally large size of the nephridia in the anterior segments. The regenerated extremities are described in detail in the text, and fully illustrated, both from the external aspect and by means of sections, in the plates.

LIKE many other British birds, the scaup-duck seems to be extending its breeding-range in our islands. According to an account relating to Scotland, given by Mr. P. H. Bahr in the December number of Witherby's *British Birds*, the species was recorded as breeding near Loch Hope in 1834; in 1867 a clutch of ducks' eggs, believed to be those of a scaup, were taken, while in the following year a drake was shot in Sutherland in circumstances suggesting that it was breeding. The first definitely authenticated nest and eggs were obtained in Speyside in 1899, and in 1897, 1898, 1899, and 1900, as well as probably in the two following years, the species bred in the islands south of the Sound of Harris. In 1906 two other nests were discovered in these islands, one of which is figured in Mr. Bahr's paper.

AMONG a number of articles in vol. xxx., No. 1, of Notes from the Leyden Museum, we select for mention one by Mr. E. Jacobson on the construction of the nests of the Javanese ant *Polyrhachis bicolor*. In common with a few other species, these ants spin nests in the leaves of palms and other trees. The example described and figured takes the form of a long and slender tube, slightly expanded at the two extremities, and with a minute entrance at the lower end, its total length being 25 cm. It was constructed in a palm-leaf, and when examined was found to contain one winged female, twenty-five males, twenty-four workers, and a number of pupæ and larvæ in various stages of development. The note concludes with a description of a somewhat more complicated spun nest constructed by the West African *Polyrhachis laboriosa*.

THE embryology and anatomy of hyperdactylism in Houdan domesticated fowls is discussed in great detail by Marie Kaufmann-Wolff in vol. xxxviii., part iv., of *Gegenbaur's Morphologisches Jahrbuch*. The abnormality usually takes the form of an extra digit on the inner side of the hallux or great toe, but in some instances assumes a more complicated type. In the plates and text-figures the structure of the foot is displayed by means of sciographs, dissections, and embryo specimens. Embryology decisively shows that the additional digit or digits arises as a bud from the metatarsal or phalangeals of the hallux, which, in the course of its development, becomes segmented, and eventually appears as a duplication or triplication of the latter. The hyperphalangism is therefore essentially a neomorphic, and in no wise an atavistic, condition, its evidence thus being altogether opposed to the theory of the existence in vertebrates of a prepollex or prehallux.

No. 27 of the "North American Fauna" (U.S. Department of Agriculture) is devoted to an account of the natural history of the Athabasca-Mackenzie region, by Mr. E. H. Preble, based on a recent biological survey of that area. The region is of considerable importance from a commercial point of view on account of the number of valuable fur-bearing animals by which it is inhabited, while it is of special interest to the naturalist as being the one in which the last remnants of the American bison survive in a truly wild state, and it is also the home of the Canadian race of the musk-ox. In the spring, when its springs and rivers are released from the icy grip of the long Arctic winter, the region is likewise the resort of countless flocks of birds of various kinds which breed within its limits, these including representatives, and in some cases the great majority, of most of the migratory game-birds of North America. The monograph, which comprises 564 pages, deals chiefly with the vertebrates, although it likewise contains a section on the trees and shrubs of the district. The explorers were unable to obtain any definite information with regard to the present numbers of the bison, but the herds are stated to be much

harassed by wolves, and the opinion is expressed that unless something is speedily done to reduce the number of the latter, the bison is doomed ere long to complete extermination. Two parties, comprising respectively eight and sixteen head, were reported by the Indians to include no yearlings or two-year-olds, all the calves having been killed by wolves.

In the December number of *Man* Mr. A. Lang returns to the well-worn controversy on the subject of totemism by a criticism of Dr. Seligmann's paper in the previous number on the subject of "linked totems." He rightly questions the admissibility of the term, and remarks on the confusion between the words "tribe" and "clan" in dealing with the subject. It seems clear that until a recognised terminology comes to be adopted by all writers, the origin and meaning of totemism must remain to a large degree uncertain, and the important problems of its relation to exogamous marriage and prohibited forms of food will continue to be incapable of solution. It may be hoped that in his great forthcoming work on totemism Prof. J. G. Frazer will finally settle the nomenclature of the subject, and thus dispose of difficulties which have led to much wearisome and embittered controversy.

Mr. W. K. Moorhead, of the Phillips Academy, Andover, Massachusetts, which claims to be "the only preparatory school in the world that possesses a fine museum and department of archæology," has issued two fresh Bulletins, Nos. 3 and 4. The second and more important contains an elaborate monograph on the famous site of Fort Ancient, the great prehistoric earthwork of Warren County, Ohio. It is satisfactory to learn that the State Legislature has now completed the purchase of this important site, which will be preserved as a public park. Needless to say, the age of this monument and its relation to the immense aboriginal cemetery at Madisonville have long formed a subject of controversy among American anthropologists. Mr. Moorhead, who has done much work on the spot, thinks that Fort Ancient may be some eight or nine centuries old, and he dismisses the modern articles found in a grave at Madisonville as "intrusive." It is clear, however, that this *résumé* of the facts at present available will not close the discussion. The writer admits that "we have but begun the right study of the Ohio Mounds," and that it will take many years to complete the field work which is necessary before the problem of their origin and age can be finally solved.

Although the rules and recommendations regarding botanical nomenclature at the Vienna Congress were framed primarily for the guidance of systematic botanists, it is important that they should be generally known. A pamphlet, reprinted from the Transactions of the New Zealand Institute (vol. xl.), gives the substance of an address on the subject read by Mr. T. F. Cheeseman at the Auckland Institute. It provides a good epitome of the salient points, and contains a list of changes caused in the nomenclature of New Zealand ferns. A second contribution to the fuller knowledge of the flora of New Zealand, by the same authority, is concerned mainly with the record of new localities.

Intending visitors to Connemara in search of botanical rarities will find it profitable to consult the account of an excursion published in the Transactions and Proceedings of the Botanical Society of Edinburgh (vol. xxiii., part iii.). The two plants, *Erica Stuarti* and *Erica Mackaiana*, that formed the immediate object of the expedition, were obtained. In the same part Mr. W. W. Smith describes a remarkable tussock formation observed in the Scilly Isles, where plants of *Arundo phragmites*, *Pteris aquilina*, and *Carex paniculata* were growing together in clumps, rising as high as 8 feet above the marshy substratum. A short note on the collection of five species of Riccia in the Edinburgh district is contributed by Mr. W. Evans.

Among the systematic articles published in the latest part (No. 9) of the *Kew Bulletin*, special interest attaches to the description of a new species of the Burmanniaceæ, *Bagnisia Hillii*, reported from New Zealand by Mr. T. F. Cheeseman. Species of the subfamily to which Bagnisia belongs have been hitherto collected in Ceylon, Samoa, and New Guinea, so that the discovery in New Zealand extends the range considerably further south. Another contribution of considerable interest, more especially to the small cultivator, is the account of a Lancashire willow farm furnished by Mr. W. Dallimore. The willows are grown on dry land under similar conditions to ordinary farm crops; the best twigs are obtained from special varieties of the species *purpurea*, *viminalis*, *rubra*, and *Smithiana*.

We are in receipt of the recent issues of the *Agricultural News*, a fortnightly paper issued by the West Indian Department of Agriculture dealing with matters of interest to tropical agriculturists. The subject-matter consists mainly of excerpts from various agricultural journals and bulletins, the selection being carefully and intelligently made. Altogether the paper must be ranked among the most useful of our agricultural publications.

The determination of total solids in sugar-mill products has usually been rather a tedious and uncertain business by reason of the instability of certain compounds in the molasses. Mr. Peck finds that the Abbe refractometer can be used conveniently, and describes the method of working in Bulletin No. 27 of the Hawaiian Sugar-planters' Association. He gives also a set of tables to show the percentage of total solids corresponding with each refractive index. The agreement between the results obtained in this way, and by the older method of drying, is satisfactory, and the method promises to be very useful to sugar chemists.

We have received from the Board of Agriculture leaflets dealing with gooseberry black-knot (*Plowrightia ribesia*, Sacc.), grain weevils (*Calandra granaria* and *C. oryzae*), and the apple saw-fly (*Hoplocampa* [*Tenthredo*] *testudinea*). They give illustrations showing the pest in its various stages, and the kind of damage it does; there is also a description, in simple language, which will help the practical man in his identification. Schemes of treatment are suggested.

Increasing attention is being devoted in South Australia to fruit production and to the best methods of placing the products on the market. The *Journal of Agriculture of South Australia* has recently described at some length how fruit-drying is practised in California, where this practice has been developed to a high degree of perfection. The fresh fruit is first fumigated by means of sulphur, then spread on trays and exposed to the sun until dry; but as the weather conditions may become unfavourable, the larger drying grounds are also provided with elaborate drying plant, so arranged that the fruit shall be exposed to a gradually increasing temperature. The tray of fruit is placed in a gently sloping tunnel up which a stream of hot air from a furnace passes, and is gradually pushed downwards as fresh trays are put on behind. This slow

drying is found to give much better results, and to yield a finer product, than more rapid drying would do.

HYDROCYANIC acid is fast becoming a recognised agent for the destruction of various insect pests that infest greenhouses, trees, &c., although the conditions for success are not yet fully known. It is used in combating citrus scales in South Africa, New South Wales, Florida, and elsewhere, with results which, on the whole, are very satisfactory. The fumigation of trees growing in the open air is made possible by covering the tree with a tent. Dr. Morrill recently described in Bulletin No. 76, Bureau of Entomology, U.S. Department of Agriculture, an ingenious graduated tent that not only covers the tree, but also indicates the volume enclosed, thus enabling the operator to use a definite quantity of hydrocyanic acid for each cubic foot of air. The tent is shown in the illustration; it is a large sheet with numbers painted on it in two directions at right angles, starting from the middle. A table has been drawn up showing the proper amount of potassium cyanide to use when any particular numbers mark the base of the tent. The method marks a distinct advance in outdoor fumigation by enabling the operator to avoid an excess of hydrocyanic acid, which would injure the tree, whilst ensuring a sufficiency to kill the pest.

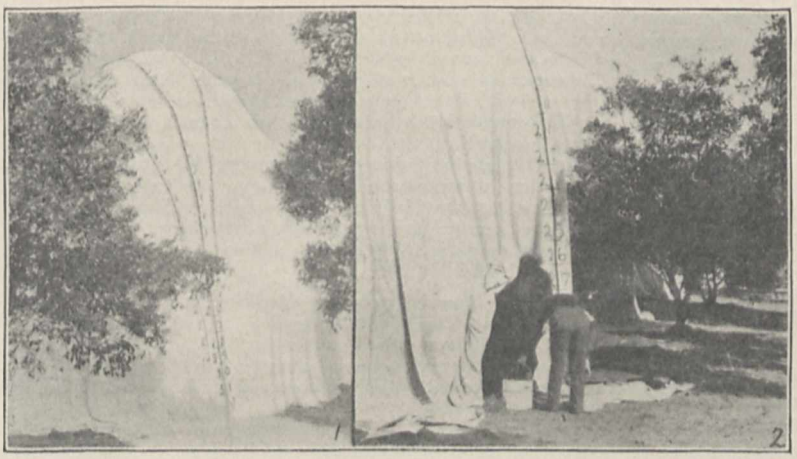

FIG. 1.—Eighty-foot tent covering large seedling orange tree, showing tent graduated for the purpose of enabling operators to use the proper amount of potassium cyanide.
FIG. 2.—Carrying 5-gallon crocks containing acid and water under the tent, preparatory to introducing the cyanide.

THE *Philippine Journal of Science* for September (iii., No. 4) contains several papers of medical interest. Mr. Old reports several cases with unusually severe symptoms caused by stings of an unknown variety of jelly-fish, and Mr. Ruediger describes filtration experiments with the virus of cattle plague which show that the virus is small enough to pass through the pores of the Berkefeld filters V, N, or W, but not through a Chamberland B filter.

IN a second report on research work issued by the Metropolitan Water Board, Dr. Houston, the director of water examinations, details the methods employed and the results obtained in experiments planned with a view to the detection of the typhoid bacillus in *raw* Thames, Lee, and New River waters. The result is that the typhoid bacillus was not once detected. Dr. Houston says, "the most recent tests for *B. typhosus*, applied to a considerable volume of raw river water, at weekly intervals, during a period of twelve months, and involving the study of 7329 samples, failed to reveal the presence of a single typhoid bacillus. It would, however, be altogether presumptuous to infer from these observations that the typhoid bacillus is never present in the raw river waters, or to conclude that any relaxation in the processes of purifying the raw river waters, by storage and filtration, before delivery to consumer, is justifiable."

WE have received No. 1 of the weekly report of the seismological stations established by Messrs. Nobel at Baku and Balakhany, the instruments in each station being a pair of Zöllner light horizontal pendula with photographic registration. We may take this as an indication of the growing interest in the study of earthquakes and of the recognition of its economic applicability by a firm which has always been remarkable for enlightenment and progressiveness.

IN the *U.S. Monthly Weather Review* for August last Prof. C. Abbe, in a note entitled "The Duty of the Government to Protect the People from Swindlers," says, with reference to rain-making and other experiments:—"It is the duty of the editor to call attention to the fact that the folly of any human attempt to make rain or to alter the weather in any way has been so abundantly demonstrated in this country, in Europe, in Australia, in New Zealand, and elsewhere, that it is high time our law givers made it a penal offence to do this or to secure money under such false pretences as these promises are." No special mention is made of the dispersion of fog; would Prof. Abbe include this under altering the weather in any way?

THE current number of the Journal of the Scottish Meteorological Society (vol. xiv., No. 25) contains an important discussion of the climate of Orkney, by Mr. M. Spence. From 1827 to 1885 observations were made at Sandwick by the Rev. Dr. Clouston; since that time they have been continued first by Dr. Fortescue at Swanbister, and afterwards by Mr. Spence at Deerness. Dividing the mean temperatures into two periods of forty years, the first, 1827–66, gives 46°·1; the second, 1867–1906, gives 45°·6; difference, 0°·5. A comparatively small range is natural, from the insular position; the lowest mean for any month is 31°·3 (February, 1838), and the highest 61°·4 (July, 1852); the mean difference between day and night temperature is very small. The mean annual rainfall (1841–1907) was 36·7 inches; the driest month is May, the wettest October. The Orkneys surpass any other district in Great Britain in the number of gales, the yearly average being about ninety-seven. Winds from S. and S.E. are much more frequent than from S.W. and W. Mr. Spence remarks that the Orkney statistics "entirely dispose of the belief that is almost universal, at least in these islands, that there are equinoctial gales." Excepting that it avoids extremes, the climate as a whole does not vary greatly from that of the north of Scotland.

FROM a reprint that we have recently received of Prof. L. Palazzo's presidential address to the International Seismological Association at its meeting at the Hague in September, 1907, we observe that he attributes more par-

ticularly the great interest now generally taken in seismological studies to the hope that these may aid in solving the problems inherent to the constitution of the interior of the globe. In the course of his remarks he said that the great improvement in self-recording instruments has enabled us to determine the trajectories of the seismic waves, to study their reflection, refraction, dispersion, and absorption; but he remarks that we shall never be able to avoid the terrible scourge of the earthquake, nor even to foretell it. Modern discoveries, however, have led us to consider the interior of the globe to be formed of a solid nucleus, with a density and rigidity greater than that of steel. This nucleus is enveloped by a rocky crust, but between this crust and the metallic nucleus lies, at a great depth, the layer of plastic matter, of high temperature, which explains volcanic phenomena and their localisation.

We have received from the Royal Observatory of Belgium the results of recent balloon ascents made at Uccle, including those arranged for by the International Commission for Scientific Aëronautics, from July 27 to August 1. The observatory was very unfortunate during this period; the records of two ascents were wilfully destroyed, and only one ascent, that of July 30, reached a considerable altitude, 15·2 kilometres, where the temperature by M. Hergesell's metallic thermometer was −59°·7 C. The minimum reading of the up trace was −69°·2 C. at 13·2 kilometres. In the British Isles twenty-eight ascents were made during the above period, twelve of which were on account of the Meteorological Office. The preliminary results of the British series were communicated to the Royal Meteorological Society by Mr. C. J. P. Cave on December 16. The average height reached was 16·4 kilometres, the highest being 23 kilometres, at Pyrton Hill, Oxfordshire. The records of all the balloons recovered, except one, showed the existence of the isothermal layer.

Prof. Larmor pointed out several years ago in his "Æther and Matter" that the fundamental facts of optics and electrodynamics, those of aberration in particular, require us to assume that the æther does not partake to any sensible extent in the motion of matter through it. On this hypothesis there should, however, be certain modifications in the optical or electrical actions of bodies on each other according to the direction in which the æther is sweeping past them. Such effects have been sought for and not found, and the negative results led Profs. Lorentz and Fitzgerald to suggest as explanation that the bodies themselves undergo changes of shape when they move through the æther which accurately compensate these effects. More recently Prof. Einstein has shown that the "principle of relativity," according to which only relative motions of bodies with respect to each other can produce observable effects, leads to the same law of change of shape, and Prof. H. A. Bumstead, in an interesting article in the November number of the *American Journal of Science*, is disposed to accord it a position analogous to that of the second law of thermodynamics. He applies it in succession to the torsion pendulum, the gravitation pendulum, and to several problems of gravitation, and shows that it leads to a slight modification of the law of gravitation and to consequences which ought to be capable of detection astronomically.

As a supplement to *Rivista Marittima* (Rome) for November are published two papers, by Prof. Guido Cora, on geography and oceanography during the nineteenth century. In the second paper Prof. Cora gives a short, but comprehensive, review of the chief problems of oceanography from its foundation to the present time. The papers should be valuable as guides to work accomplished in geography and oceanography during last century.

Mr. C. Baker, of High Holborn, London, has forwarded a copy of the 1909 issue of section iv. of his catalogue. The catalogue is divided into four parts, dealing respectively with aids to vision, prismatic and other optical appliances, projection apparatus, and meteorological and allied instruments. We have also received the current issue of Mr. Baker's classified quarterly list of second-hand instruments which he has on sale or hire.

OUR ASTRONOMICAL COLUMN.

Search for an Ultra-Neptunian Planet.—Following the recent interesting discussion by Prof. Forbes at the Royal Astronomical Society, of the probable existence of a planet beyond the orbit of Neptune, there is an interesting note by Prof. E. C. Pickering in No. 4292 of the *Astronomische Nachrichten* (p. 323, December 18).

In this note Prof. Pickering mentions that as the result of an investigation, an abstract of which was read at the American Academy of Arts and Sciences on November 11, Prof. W. H. Pickering finds evidence of the existence of an ultra-Neptunian planet, which at the epoch 1909·0 will be located approximately in R.A. 7h. 47m., dec. +21°. Photographs of this region have already been taken with the 24-inch Bruce telescope at Arequipa, and the Rev. J. H. Metcalf is also employing his 12-inch doublet for the same research.

As this region is now easily accessible, Prof. Pickering asks that other astronomers, having the use of suitable instruments, should join in the search. Should the proposal be accepted by any number of workers, it is proposed that a systematic study of this portion of the ecliptic might be organised.

Further Observations of Morehouse's Comet, 1908c.—In No. 24 of the *Comptes rendus* (p. 1263, December 14) M. J. Guillaume gives some further interesting details concerning the remarkable changes which took place in the form of comet 1908c as observed at the Lyons Observatory.

On October 24 the nucleus was seen to be elongated and to have a granular appearance with a small stellar condensation, of about the thirteenth magnitude, towards the eastern extremity of the head. The light of a star, of the tenth or eleventh magnitude, appeared to be augmented as the head of the comet passed before it until it reached the eastern edge, when sudden diminutions of brightness occurred at intervals of several seconds.

Remarkable oscillations of the brightness of various parts of the coma were also observed, and on November 17, when the field of the telescope was artificially illuminated, the comet disappeared with a star of the ninth magnitude.

The same number of the *Comptes rendus* also contains the results of observations of the comet's position, made at the Toulouse Observatory between October 2 and 13.

The Figure of the Sun.—In No. 26 of the Contributions from the Observatory of Columbia University, New York, Prof. Charles Lane Poor brings together in a general discussion the results hitherto obtained from investigations dealing with the figure of the sun, and its possible variations.

Some of the earlier results were directly contradictory in their statements as to whether the equatorial or the polar diameter was the longer, whilst later results indicate that although there may be a fluctuating difference, its magnitude is insufficient to show definitely.

Prof. Poor, summing up the general results of the present investigation of meridian, heliometer, and photographic measures, concludes that the exact shape of the sun is not known, but the generally accepted idea that it is a sphere is at least open to question. All the measures show a departure from the spherical form, but the difference between the various radii probably does not exceed 0″·25.

The available heliometer measures indicate a fluctuation of the sun's shape corresponding with the 11·3-year sun-spot period, but probably not exceeding 0″·10, whilst the observations of Ambronn and Schur possibly indicate another, shorter, period, of about twenty-eight days.

To determine this question, a long, homogeneous series of observations is necessary, and a photographic heliometer would probably furnish the best results. Experiments in this direction have already been made.

A REMARKABLE METEOR.—In No. 4287 of the *Astronomische Nachrichten* Prof. Kopff describes a remarkable meteor which left a persistent, drifting train for about half an hour. The meteor was first seen at 12h. 55m. (M.T. Königstuhl) at Heidelberg, and was brighter than Venus, its colour being a yellowish white. It appeared about 2° east of α Ursæ Majoris, and travelled along a path parallel to the line joining α and γ Ursæ. The luminous trail changed its shape and position, and was finally observed at 13h. 25m.

SUN-SPOTS IN 1907.—The frequency and heliographic distribution of sun-spots in 1907 are discussed by Dr. Rudolf Wolf in No. 99 of the *Astronomische Mitteilungen*. The monthly relative numbers show maxima in February and September, the daily relative number between February 9–14 exceeding 170; for the year the mean monthly number was 62·0. Some interesting tables and curves show the relations between the variations in sun-spot numbers and terrestrial magnetism.

THE PARALLAX OF 61 CYGNI.—The results of a new determination of the parallax of 61 Cygni, carried out by Prof. G. Abetti at Heidelberg 1906–8, are published in No. 9, vol. xxxvii., of the *Memorie della Società degli Spettroscopisti Italiani*. About 7000 observations were made, and their reduction, in three series, gives the following figures for the parallaxes of the components of the star:—61 Cygni pr. $\pi = +0''\cdot24$, mean error, $\pm 0''\cdot05$; 61 Cygni f. $\pi = +0''\cdot22$, mean error, $\pm 0''\cdot05$.

ADVANCE IN KNOWLEDGE OF CANCER.

IN conformity with a scheme of inquiry embarked upon in October, 1902, the third scientific report of the Imperial Cancer Research Fund, recently issued, treats, like its predecessors, of cancer as a problem of general and experimental biology. It contains no definite answer to the questions, What is the nature and what the cause of cancer? and beyond demonstrating that systematic experiment justifies the early surgical removal of a tumour as the only possible treatment at the present time, the report is silent as to remedial and preventive measures. These shortcomings will almost certainly arouse misgivings on the part of those who cannot appreciate how progress is made in any field of knowledge. They will also, no doubt, be seized upon by persons who, in their ignorance, assert that all scientific efforts should be concentrated on utilitarian ends, and they will be exploited by the charlatan, to whom for a space a free field is still left for his nostrums. The sustained efforts of the past six years to penetrate the mysteries of cancer have been accompanied by a corresponding activity on the part of faddists and quacks who advertise themselves by proclaiming the failure of scientific investigation to yield "practical fruits." The danger of their literary activity is but enhanced by the powers of diction and of exposition possessed by some of the writers. They could profitably devote their literary ability to expounding to the public the true facts and difficulties of the cancer problem instead of the ridiculous causes they maintain before a jury of the credulous and the suffering. In the absence of this enlightened attitude on their part it is my duty, since the second scientific report was followed by volumes of nonsense on the part of such persons, bluntly to inform the general reader of the folly of ignoring the necessity for the early surgical removal of cancer, and of running from one faddist or quack to another yet more ignorantly sanguine. If, in the future, the progress of scientific investigation provides a substitute for or an adjunct to surgical treatment, there will be no needless delay in placing it within the reach of the cancer patient.

Meantime, the importance of the investigation of cancer is only too grimly emphasised by its frequency as a cause of death. The number of deaths *recorded* from cancer increases from year to year throughout the world, civilised and uncivilised, human and animal. Taking England and Wales as an example, in 1889, on an average, the chance of a man above thirty-five years ultimately dying of cancer was one in twenty-one, and for a woman above the same age one in twelve. The increase in the number of deaths *recorded* from cancer makes the corresponding chances to-day one in eleven for men and one in seven for women. Scarcely a family of large size escapes attack. There is no circle of acquaintances, no chance assemblage of persons at a *table d'hôte* or in a tube lift, but contains prospective victims. But is cancer really increasing? The accurate use of statistics, and the careful scrutiny of the scientific value of the data upon which they are based, still withhold an affirmative answer. If it be further asked, Is not cancer much more frequent in races living under European civilisation than in the rest of mankind? recent investigation has disposed of the fiction that many races of mankind are exempt. Where the disease was said to be rare, *e.g.* in Japan, there are excellent statistics of which Europeans were previously ignorant proving the great frequency of cancer among the Japanese, and, taking another example, investigations in Indian hospitals show that certain forms of cancer very common in London hospitals are probably not less common in hospitals throughout Hindustan. In the case of most other races there are insurmountable difficulties in the way of even thus roughly estimating its frequency among them. Therefore it is idle to affirm or to deny that cancer may be more common in some races than in others. The disease occurs throughout the human race, and its association with forms of chronic irritation having nothing in common beyond this association is a fact of more moment than any futile discussion of the relative liability of different races. The additions, during six years, to our knowledge of its occurrence in man, as well as in tame and wild animals, tell hard against those who, at the close of the nineteenth century, argued that the increase in the number of deaths attributed to cancer was real, and merely a penalty for living under the influences of European civilisation.

Much additional evidence has been obtained of the extent to which cancer pervades the vertebrate scale. The similarity of the disease throughout vertebrates is illustrated most diagrammatically by a series of preparations of skin-cancers from mammals to marine fish living in a state of nature. Wherever data are available, for animals as for man, the liability to cancer is shown to be greatest in the last third of the span of life, whether it be short or long; the "age-incidence" of cancer in man has acquired enhanced significance by the establishment of this generalisation.

The widening of our knowledge of the occurrence of cancer is only one example of how revived interest in mere observation has put an end to the era of unverified, and often unverifiable, speculation which characterised the last twenty years of the nineteenth century, when exact methods of studying the clinical course, the anatomy, and the microscopical structure of tumours had reached their natural limitations. The study of cancer solely from the standpoint of its being an infective disease had yielded equivocal and self-contradictory results. Statistical methods had become barren from want of data to work on. No point vulnerable to an attack in the rear by the experimental method could be discerned.[1] In short, there was a standstill in the advance of knowledge. As is usual in all similar epochs in the progress of science, observation, hypothesis, and experiment had ceased to advance hand in hand. The arm-chair speculator had the field to himself. With only the knowledge derived from the bedside, the study of the structure of tumours in man, imper-

[1] As a matter of fact, such a point of attack had existed since the time when Hanau and Morau had successfully inoculated cancer from one animal to another, but those engaged in cancer research had either failed to realise the significance of this imperfect work or had been baffled by the difficulties which had to be overcome in attempting to imitate it.

fect data of its incidence in Europeans, and hearsay statements of its absence elsewhere to guide him, he little comprehended the futility of the explanations he so lightly advanced, and others of his kind equally lightly refuted. A general feeling of the hopelessness of penetrating to the truth was abroad, both among the public and the medical profession, who, the limits of surgical aid having been reached, were despondent in the extreme. The universality of this conviction led to the spontaneous and independent formation of "cancer research committees" in different countries at the end of the nineteenth century.

The whole outlook of the cancer question has been changed by the successful application of the comparative biological and experimental methods to its study, and by the restoration of the legitimate relations of observation, speculation, and experimental verification. In this revival the committees formed in different centres have played very unequal shares, according as their proceedings have conformed to the methods which advance natural knowledge. To demonstrate fully the adequate evidence upon which the claim—cautiously advanced in the first and second scientific reports and earlier papers—is based that a new and rational era of investigation has been inaugurated, and to urge continued confidence in the investigation of cancer, are the primary objects and the main justifications of the third scientific report of the Imperial Cancer Research. The time has not come when practical applications of the additions to knowledge are to be expected, nor has accident yet yielded any.

Although the rapid accumulation of new facts forbids the premature formulation of a generalisation attempting a unification of the mass of new and old knowledge, many results of far-reaching importance have been attained. The work of recent years has made it more certain than it ever was before that cancer contains no virus or other parasite foreign to the living organism. One is often asked if a relative suffering from cancer is dangerous to others, *e.g.* a grandmother to her grandchild—the chief solace of her old age—or if an historic family mansion should be burnt down because many progenitors inheriting it had died of cancer. During six years many tens of thousands of mice suffering from cancer have been under the most stringent observation. If cancer were communicable in the sense in which infective diseases are communicable, animals housed along with those naturally suffering from, or inoculated with, cancer would be the first to suffer. In an experience extending over six years, *i.e.* almost three times the average length of a mouse's life, exhaustive investigation has shown that this risk does not exist. This fact of itself satisfies those handling the animals. They incur still less risk in passing many hours daily dealing with cancerous animals in a room in which 10,000 of such mice and rats are usually housed at one time. If such a "cancer house" as never before existed has no dangers to human beings who spend their days in it, *a fortiori* other persons have no ground for apprehension. These results are of great practical value. They reinforce opinions often expressed in the past for other reasons. The presence, every day in the year, of some 50,000 persons suffering from cancer in England and Wales constitutes no menace to the health of those near and dear to them, nor to the health of the population generally, as would a smaller number of people suffering from small-pox. Notwithstanding the unwise assertions irresponsible enthusiasts will continue to make from time to time, what was a justifiable cause of public alarm has been removed by experiments on the transference of cancer from one animal to another, and on the housing of large numbers of cancerous with sound animals over a prolonged period. It has been demonstrated completely that artificial transference from animal to animal is due to the implantation of living cells. This is a factor which does not come in at all in reference to the frequency of spontaneous cancer in man or animals. In corresponding observations on mice suffering from spontaneous cancer no case of transference has occurred.

In this respect cancer presents a marked contrast to other diseases, *e.g.* tuberculosis, equally widely disseminated and common to man and the whole vertebrate phylum, for although no race of mankind is exempt, and cancer extends down the vertebrate scale to marine fish living in a state of nature, there are the most striking limitations to its communication from one individual to another. There is no connecting link, as it were, between the disease as it presents itself in nearly allied species nor yet even in individuals of the same species. There is nothing which, while foreign to the animal body, is nevertheless common to cancer wherever it occurs. There is nothing equivalent, *e.g.*, to the characteristics of tuberculous tissues which, no matter what the species of animal, are stamped with unmistakable common features by the presence of the tubercle bacillus. The properties of the tubercle bacillus obscure all the natural properties of the tissue containing it, and they confer upon such tissue new properties essentially the same in all species of animals. Tubercular tissue has common properties in all animals; the distinctions of species, and of individual tissues of one and the same species, are submerged in their acquirement of a new property, conferring on them the power of conveying the disease to previously healthy tissues, not only from one animal to another of the same species, but also to others of different species. The tuberculous *tissues* themselves, however, die when transferred to a new animal; they do not grow, they merely hand on the cause of the disease, viz. the bacteria, which continue to grow in new soil. How, then, is the pervasion of the animal kingdom by cancer explicable? It is intelligible because experiment has proved that cancerous tissues retain, not only the characters of the species of animal, but also those features distinguishing the several normal tissues of an individual and because the general conclusion from comparative and experimental investigation is that cancer arises *de novo* in each individual attacked, by a transformation of healthy tissue, one case of cancer having no relation to any other. This general conclusion is based upon observations and experiments of very varied but confirmatory nature.

When a piece of cancer-tissue of a mouse is implanted into another mouse, certain of the cells continue to grow in the new animal and others die. The cells which continue to grow are the cancer cells proper. The other cells which die, formed the scaffolding of supporting connective tissues and blood-vessels. The process of transference can be repeated *ad infinitum*, the powers of growth of the cancer cell being inexhaustible; they set at defiance the laws determining the specific sizes of the bodies and the organs of vertebrates, and determining the specific duration of the lives of different vertebrates. The cancer cells retain their characters unaltered in the course of artificial propagation, and the connective tissue scaffolding, supplied afresh by each successive host, remains identical with that which the cancer cells had in the animal where they originated. This scaffolding is called forth by the cancer cells themselves, and is of the nature of a specific reaction on the part of the ordinary connective tissues and blood-vessels of the host. The scaffolding is characteristically different for different tumours, and as will be stated below, the cancer cell is unable to continue to live and grow without it. The propagation of cancer is only possible in animals of the same species, *e.g.* from mouse to mouse or rat to rat, but not from mouse to rat or *vice versâ*.

Since the limits to transplantation are the same as those which limit the transplantation of normal tissues, *e.g.* the grafting of skin, the facts are of themselves evidence that cancer tissue contains nothing extraneous to the animal in which it appears. The distinctive differences in the new scaffolding which different tumours even of the same organ, *e.g.* the mamma, re-acquire after every transplantation are inexplicable on the assumption that the tumour cells contain a common virus endowing them with their peculiar properties. Thorough investigation of questions of metabolism has shown the relations of a tumour to its host to be merely those of nutrition, similar to those of the fœtus *in utero* to its mother. More than seventy transplantable tumours of very varied nature have been studied in the laboratory, and the above facts hold for them all.

The features of growth and of histology exhibited by different spontaneous tumours remain distinctive in the course of continued propagation, and they give weighty indications of the nature of the changes responsible for the acquisition of cancerous properties, since there is neither

progress to a uniform histological structure nor a gradual advance to the exhibition of uniform biological behaviour, nor acquisition of a uniform rate of growth. The transformation of normal into cancer cells really covers a scale of changes which do not pass into one another. Permanent features are stamped upon cancer cells at the outset. There is no transition from one degree of the cancerous change to another.

In the transplantation of a tumour into a new host success or failure is determined primarily by two factors. These are the qualities of the tumour cells and the nature of the "soil" the new animal offers. During continued propagation the cells of the tumours of a single organ, *e.g.* the mamma, exhibit other differences corresponding to those mentioned above with reference to the "supporting" scaffolding, and together with them pointing still more strongly to primary qualitative differences in the cells of different tumours. Although cancer occurs spontaneously mostly in old animals, young animals are more suitable for growth. The introduction of a minute particle of cancerous tissue into a normal animal leads to all the consequences which accompany the growth of a spontaneous tumour. Thus the adequacy of the assumption with regard to man, that the origin of cancer is primarily circumscribed, is demonstrated. A consideration of all the results proves that the genesis of a tumour and the growth of a tumour are two different things.

The "soil" which different races of mice offer, as it were, for the growth of cancer varies naturally in suitability; but tumours can gradually or rapidly adapt themselves to a soil which was unsuitable, *e.g.* when a Danish tumour was first transplanted in England it grew in only 5 per cent. of the mice inoculated, but later the success rose to 90 per cent. There are natural constitutional conditions which are favourable, and others which are unfavourable, to the growth of a tumour. The unfavourable conditions act as sieves, permitting certain kinds of cells to pass, and once they have passed they can multiply beyond our powers of measurement.

The "soil" can, however, also be modified experimentally. It can be made absolutely unsuitable for growth or rendered more suitable than normal. Mice and rats can be rendered unsuitable for growth only by vaccinating them with malignant new growths of their own species and by vaccinating with *normal* tissues of their own species. In the latter case the degree of "resistance" normal tissues produce directly corresponds to the closeness of the relationship between the normal tissue vaccinated and the tumour subsequently inoculated, *e.g.* skin protects best against skin cancer. These facts refer us back again to the limitations to the transplantation of tumours, and together with them demonstrate the retention by malignant new growths, not only of the tissue characters of a species, but also of the biochemical as well as of the histological characters distinctive of the several species. A sarcoma of a rat or cat, vaccinated into a mouse, lacks the power of protecting it against subsequent inoculation of a mouse sarcoma; this fact shows, as clearly as the method permits, the absence of any extraneous agent common to the growths of these different species. The growths of different species of animal resemble one another just as much, and differ just as much, as their respective organs and tissues do. As differences exist in certain properties of tumours already alluded to above, so corresponding other differences are revealed by the extent to which tumours, when vaccinated, induce protection against one another. A tumour does not vaccinate so well against other tumours as it does against itself or against those of its own kind. A lesser degree of protection which one kind of mouse-tumour induces against other kinds is due, probably, not to cancer-tissue as such, but to its properties *quâ* mouse-tissue.

Animals which are absolutely protected against inoculation do not yield a serum which, when introduced into new animals, has a power of protecting them against inoculation, still less is there any evidence of immune sera having a power to cure animals of tumours already growing. Highly immune mothers do not transfer immunity to their offspring as do animals immune to diphtheria or other poison of infective disease. Indeed, the mechanism of the protection which can be induced against cancer is of a kind quite unknown before. Most painstaking observations have been necessary to penetrate somewhat into its nature. Artificially protected animals do not supply the cancer cell with the peculiar scaffolding of supporting tissues it requires in order to grow into a tumour. It dies because it cannot grow into an organised tissue, and hence cannot nourish itself; being damaged, it falls a prey to the natural guardians—the phagocytes—of the body. The process is the same whether vaccination has been made with cancer or with normal tissue. The way in which this protection becomes general in the body fluids or tissues has not yet been fully ascertained; nevertheless, so far as it is known, it helps to elucidate the spontaneous healing of primary and secondary growths in man, and its further study gives promise of our being able ultimately to enhance the powers of resistance of the body to a degree which will prevent the dissemination of a primary growth.

Before so much can be attained there are many difficulties to be overcome, not the least of which is the discovery of the fact mentioned above, that the soil may be rendered more than normally suitable for the growth of cancer. Hypersensitiveness can be induced by many different agencies; indeed, as contrasted with the induction of protection, it is not specifically induced.[1] The growth of one tumour does at times make the "soil" of an animal more favourable for the growth of a second tumour, and therefore, presumably, for dissemination. It is much more difficult to protect an animal already bearing a tumour against the transplantation of a second tumour than it is to protect an animal which has not already got one.

Animals spontaneously attacked with cancer make efforts, which are sometimes successful, to cure themselves both of primary and of disseminated growths, *e.g.* in the vessels of the lungs. There is no longer room for scepticism regarding the statements which have been made from time to time of similar occurrences in man. The process of spontaneous healing is much more common in animals bearing transplanted tumours. In their case it can be studied in great detail, and it has been found to follow the same course as in man. A weighty factor contributing to its occurrence resides in the properties of the cancer cells themselves, for it has been discovered that they multiply with unequal rapidity at different times. They alternate regularly between positive and negative phases of growth. They are much more vulnerable to attack in the negative phase, *e.g.* through the heightened unsuitability or resistance which can be induced in the soil as described above. The further study of the relations obtaining here will ultimately assist us to prevent a primary tumour from disseminating and establishing offshoots in remote parts of the body.

A startling phenomenon has been stumbled upon during the artificial propagation of epithelial malignant new growths (carcinomata). In the course of time some of these tumours have been replaced by connective tissue new growths (sarcomata). There is no question of the conversion of epithelial into connective tissue cells. All the facts point to the acquisition of cancerous properties by what were previously normal connective tissues, viz. cells of the supporting scaffolding or "stroma." It appears probable that in this way malignant new growths have been produced for the first time experimentally. The development of sarcoma in this way occurs in circumstances throwing much light upon why cancer in man is so frequently associated with chronic irritation, as referred to above, and resulting continuous or intermittent attempts at regeneration and repair in man. Together with other facts, notably the differences in incidence of cancer in different races of mankind as determined by the application of irritants to different parts of the body, it gives the *coup de grâce* to the generalisation of the idea that cancer is of congenital origin.

Many new facts recorded above are of fundamental importance in enabling us better to comprehend the nature of cancer. Two factors have been proved to be of prime importance in its development; one is the alteration within

[1] The variety of the agents which render an animal hypersensitive for the growth of cancer acquires added interest when regarded in association with the variety of causes of chronic irritation related to the development of cancer in mankind, as referred to above.

a circumscribed area of what were normal into cancerous cells, either under the influence of unknown causes in the body itself or through the mediate intervention of diverse external chronic irritants, which may be actinic, chemical, bacterial, mechanical, in short, are legion; the other factor is the constitutional condition of the living body, which may favour or hinder growth of the limited number of altered cells into a tumour. Extensive observations on in-breeding stocks of cancerous mice show that in-born predisposition plays only a very subsidiary, if any, part in determining both the one and the other; both are acquired. Cancer is a foe to all men, and the liability to it being in all probability acquired may ultimately be found to be avoidable.

A sudden revolution of all former views on the nature and treatment of cancer has not been effected. Much of the knowledge inherited can be utilised, much of it must be discarded. I have not dwelt on the initiative, the sacrifices, and the patient toil of my colleagues Bowen, Cramer, Gierke, Haaland, Murray, and Russell, nor on the enlightened and generous encouragement of the executive committee of the Imperial Cancer Research. It will be evident to all who read my colleagues' papers in the report how much they have contributed to raise the British national investigations of cancer to the premier position among similar institutions abroad. I have not made reference to work by other distinguished investigators, but full credit is given to them in the report itself. Slowly feeling the way from one certain step to another has often simply meant being met by new and unsuspected difficulties. Each hitherto unsuspected difficulty when overcome has, however, brought us more nearly face to face with the realities of cancer genesis, cancer growth, and the natural means by which the body protects itself against them; they all are better comprehended and nearer solution to-day than ever before. E. F. B.

STUDIES IN ANTHROPOLOGY.

THE growing interest in the study of anthropology as a branch of university teaching is illustrated by the publication of the Proceedings of the Anatomical and Anthropological Society of Aberdeen, of which Prof. R. W. Reid is chairman, for the years 1906–8. The most important contribution in the volume is a report by Dr. G. A. Turner on the natives of Portuguese East Africa south of latitude 22°. The habits, customs, and mode of life of the three chief races in this territory, the Myambaams, Mtyopis, Shangaans, and Lourenço Marques Boys, are described chiefly with reference to the principal forms of disease which appear in their kraals. Incidentally, some remarkable customs of much interest to the anthropologist are discussed. Thus, if a man dies of a disease like consumption, which causes constant gasping for breath, the officiant at the burial has to open the thorax of the deceased in the middle line and remove both the lungs and heart. These are so placed in the grave that they will not slip back into the thorax when they are laid upon it. The rite is obviously a piece of sympathetic magic intended to save the person conducting the interment from contracting the disease.

Full details are given of the remarkable habit of the Mtyopi women, who produce, by means of cicatrisation, lumps varying in size from that of a walnut to a pea along the breast, abdomen, and legs. The males of the same tribe file their teeth in the form of pegs, of which the rather doubtful explanation is suggested that it is a mark of primitive cannibalism, because they would be better able to tear human flesh if their teeth were filed. The existence of the practice, however, among tribes who are not cannibals seems to indicate that it is more probably one of the savage's misguided attempts at personal ornamentation. Witchcraft is common among these races, and the witch is much dreaded and often shamefully treated. Some natives, we are told, were in the habit of bringing suspected women for examination by the Portuguese commandant, who was asked to report on their alleged possession of supernatural powers. Finally, to put an end to such proceedings, he shrewdly gave as his verdict that while he was unable to detect anything extraordinary in the women, he could not speak with such confidence of their male companions. This opinion abruptly brought the investigation to a close. The methods of circumcision are fully described, the most remarkable feature in the operation being the extreme cleanliness enforced upon the performer of the rite, a precaution which usually obviates the risk of septic poisoning.

Local anthropology is represented by a paper by Dr. W. R. Macdonell on the physical characteristics of the medical students at the University, a summary of a long series of measurements which have been taken with the utmost care. For the purpose of comparison the subjects were divided into two groups, those of pure Scotch descent on both sides and those where one or both parents were foreign to Scotland. The general result is that in physical characteristics the two groups are practically identical. They closely resemble Cambridge students and graduates in length and breadth of head, but they are slightly lower in stature. In all three characters they are uniform with the rural population of Aberdeenshire. The average growth between the nineteenth and twenty-third year of age is about 1¼ per cent. in all characters except auricular height, in which it is about 3 per cent. There is practically no difference between honours and pass men in length and breadth of head, and the Aberdeen head is not larger than that of other classes of the community.

HYGIENE—PERSONAL AND ENVIRONMENTAL.[1]

THREE well-printed and well-filled volumes containing all the addresses and papers read at last year's School Hygiene Congress in London, and a summary of many of the important discussions, have been published recently. On a more leisurely and comprehensive review than was possible at the congress itself, one cannot but be struck with the small amount of irrelevant matter. School hygiene, involving, directly or indirectly, the whole series of systems of modern education, lends itself to the fanatic, the crank, and every other type of abstractionist. It is, however, with agreeable surprise that one finds here a large number of papers full of concrete experience, presented in a well-ordered way. Like the four volumes of the first congress (Nuremberg), these three form a most convenient conspectus of school hygiene at the present day. There are signs that the movement has become more mature, for the studies are in many respects more detailed. It is difficult to select papers for special observation, but there are many that will repay reading and re-reading. The general address by Bishop Welldon on "The Effect of School Training on Mental Discipline" contains many well-loaded aphorisms, but it is disconcerting to read:—"But, at whatever cost, the habit of unquestioned obedience must be created in the young. When I was headmaster of Harrow School, I used to say to my young colleagues, 'Begin by making the boys feel that you are prepared, if need be, to grind them to powder; then you may safely grant them as much liberty as you will.'" This is one ideal, but it is not the ideal of Froebel, of Pestalozzi, of Herbert Spencer, of Earl Barnes, of Stanley Hall.

The discussion on duration of lessons, sequence of subjects, and seasons of the year as affecting school work, contains good papers by W. H. Burnham (Clark University, Mass.), by M. Chabot (Lyons), who enters into much exact detail, and by Dr. L. Burgerstein (Vienna), whose well-known handbook on school hygiene is a standard. Another "set discussion on the lighting and ventilation of class rooms" contains a careful paper by MM. Courtois and Dinet. The general conclusion is that class rooms in France have too little cubic space, and that the air should be slightly warmed and free from dust.

Griesbach's method of estimating fatigue by the æsthesiometer was discussed by Dr. Altschul and others. Obviously, the method needs to be applied with skill, but, on the

[1] Second International Congress on School Hygiene. London, 1907. Transactions, Vols. i., ii., iii. Edited and arranged by the Ordinary General Secretaries, Dr. James Kerr and E. White Wallis. Price 5s. each volume; complete in three volumes, 12s. 6d.; bound 15s. net. Vol. i., pp. xxiv+331; vol. ii., pp. xv+401–848; vol. iii., pp. vi+849–1038. (London: Royal Sanitary Institute.)

whole, the conclusion was favourable. Dr. M. C. Schuyten (Antwerp) gives some favourable evidence, so does Dr. H. Baur (Württemberg), who used Scheiner's experiment as a test of fatigue. The question of suicide at school elicited a very full and detailed paper from Dr. G. W. Chlopin (St. Petersburg). It is obvious that national temperament, as well as school pressure, counts for much in the percentages. In Russia the suicide occurs three times as often in the middle schools for boys as among the general population of all ages. In the middle schools for girls the tendency to suicide is about three times weaker than at the gymnasium or real schools, and not more than in the general Russian population. No general solution is offered.

These papers are enough to indicate the large variety of material contained in these transactions. One general feature is obvious—personal hygiene distinctly predominates over environmental hygiene, although the latter is far from neglected. We have no space to note the papers on residential schools, school epidemics, administration questions, medical inspection, special schools, &c. The editors are to be congratulated on the practical nature of the volumes.

It is only right to direct attention to the elaborate address prepared by Prof. Griesbach on the relations between medicine and pædagogy; the tables are of great value.

PREHISTORIC POTTERY IN AMERICA.

THE Academy of Natural Sciences, Philadelphia, has issued as part of the thirteenth volume of its Proceedings another of its great monographs, finely illustrated with coloured and process plates, on a group of mounds in Arkansas and Mississippi, prepared by Mr.

Vessel of the "teapot" variety. Near Menard Mound. Height 6·25 inches.

C. B. Moore, who has made a speciality of this line of investigation. These mounds fall into three groups:—those of the Lower Arkansas, the Yazoo and Lower Sunflower Rivers, and those at Blum. A number of interments, many of which are of the "bunched" or contracted type, has been examined, and a large collection of objects, such as pottery, bone pins, shell and copper ornaments, has been made. Some bones showing marks of specific disease have been unearthed, but there is some doubt whether these belong to the pre-Columbian period, and the sites may have been used for interments after Europeans reached the country.

The most important examples are those of pottery, which, though inferior to specimens found in other sites, is still highly artistic, well baked, and carefully wrought. It consists of pots, bowls, and bottles, of the last the long-necked or carafe type being comparatively abundant. An interesting variety is the "teapot" class, a vessel with a more or less globular body, a circular opening at the top surrounded by a low neck, with a spout and small knob at opposite sides of the body. This class, for the United States at least, seems to be peculiar to the Arkansas region. The pigments used are generally clays, white or tinted with iron oxides, of which careful analyses have been made by Dr. H. F. Keller. In decoration the scroll pattern is predominant; but in one very beautiful bottle the spaces in the yellow ware are defined on the body in white pigment, the interior being occupied by five-pointed stars and figures resembling an arrow-head, somewhat analogous to the copper pendants found at Moundville, the circular portions of which contain Swastikas or stars.

On the base of another vessel the Swastika reappears, and the same emblem is common on shells and stamped ware from the southern States. Prof. Holmes, in a contribution to this report, interprets this well-known symbol as a representation of the world, the division into four quarters being a convenient mode of marking the groups of guardian deities to whom it was necessary to make offerings or appeals. This explanation, however, hardly accounts for the symbol in other parts of the world. On the whole, these discoveries are of the highest value as opening up a comparatively novel chapter in the art development of prehistoric America, while the forms and schemes of ornamentation deserve the attention of designers in our day, who may find much interesting suggestion in the work of this early school of artistic pottery.

INHERITANCE IN SILKWORMS.[1]

IT is not surprising that animals which breed so fast and occupy so little room as silkworms should have afforded the material for the experimental investigation of heredity. The publication before us is the outcome of the third considerable series of breeding experiments with this moth. The first to appear was that of Coutagne ("Recherches experimentales sur l'Hérédité chez les Vers à Soie"). This work was done without a knowledge of Mendel's observations, a fact which only increases the value of the work in the eyes of those who are not familiar with this author's other writings. The experiments, on the other hand, of Kametaro Toyama were carried out with the full knowledge of Mendelian principles, and were, indeed, set on foot with the object of testing them.

Mr. Kellogg's experiments were started a year later than Toyama's—in 1901. Mr. Toyama, who published his results before Mr. Kellogg, obtained results confirmatory of Mendelian hypotheses. But Mr. Kellogg does not find this to be the case with all his characters; in fact, he finds that the characters of the larvæ behave in Mendelian fashion in inheritance, whilst those of the cocoon exhibit considerable exceptions to this rule. The author suggests that the cause of this is that the cocoon characters have arisen by the selection of fluctuating variations, whilst those of the larvæ have arisen as discontinuous variations.

Mr. Kellogg's position with regard to the application of Mendelian principles to his results may be stated in his own words:—"Toyama finds the larval variation of colour-pattern and the cocoon differences of colour to follow Mendel's law. I do not. By the use of many repetition or check lots I find the larval characters to exhibit a great fidelity to Mendelian principles in their mode of inheritance, but with the cocoon colours I find exceptions so numerous, so varied, and so pronounced as to lead me to lay great stress on the potency or influence of individual or strain idiosyncrasies."

The chief criticism we are inclined to make is that far too little numerical evidence is given for the generalisations which are made. In an experiment in which nearly everything turns on the numerical proportion in which individuals with particular characters occur, we look for a far more detailed account of the results obtained. For example, Mr. Kellogg whets our appetite by telling of his experiments with a character of the egg, or rather of the female which lays it. Most races lay eggs which stick to the box in which they are laid, whilst some strains of the Bagdad race lay "non-adhesive" eggs. "The one race in my possession whose eggs are regularly (this regularity is not absolute) non-adhesive is the Bagdad

[1] "Inheritance in Silkworms." By Vernon L. Kellogg. Leland Stanford Junior University Publications. University Series, No. 1. Pp. 89. (California: Stanford University, 1908.)

race. . . .” Well, we want to know exactly how many have laid adhesive eggs. The author tells us that the egg-character is non-Mendelian, and that, though of course a character of the female, it is transmitted through the female. We want the details of the evidence on which this statement is based, in the form of a table preferably. In no case is the probable error of his results worked out.

THE OLDEST EUROPEAN SEDIMENTS.

MR. J. J. SEDERHOLM, director of the Geological Survey of Finland, has issued in English his “Explanatory Notes to accompany a Geological Sketch-map of Fenno-Scandia” (Helsingfors: Frenckellska Tryckeri-aktiebolaget, 1908). The beautifully coloured map of Norway, Sweden, and Finland (Prof. W. Ramsay's “Fenno-Scandia”) that accompanies this memoir was originally issued in Bulletin No. 23 of the Commission géologique de Finlande. Photographs are given of critical rock-specimens, such as the conglomerates that mark unconformities between the Archæan systems in Finland, and the early pre-Cambrian (Bottnian) banded sediment of the shores of Näsijärvi. This rock indicates seasonal stratification, strangely like that of the adjacent Glacial clays of Pleistocene age.

Those who have seen the actual specimens, or, better still, the beds in the field, cannot deny the existence of an immense series of pre-Cambrian sediments in Fenno-Scandia. The gneisses, such as those of the Hangö islets, are by no means the oldest or fundamental rocks, but result from the intrusion of granite into various series and at various times. Some of the granites in the north of Finland appear to be post-Silurian, as in Scandinavia. Sederholm's admirable summary is, of course, written from a Finnish point of view, and some of the results may meet with criticism when applied to Scandinavia; but they deserve the keen attention of geologists in our own islands, where post-Silurian movements have masked much of the older sequence, but where patches of ungranitised pre-Cambrian sediments may remain amid metamorphic areas.

A visit to Finland healthily counteracts the tendency, still apparent in some quarters, towards bringing all our clearly stratified rocks somehow into the Palæozoic era. Dr. A. Mickwitz has recently proposed (*Bulletin de l'Académie impériale des Sciences de St. Pétersbourg*, 1907, p. 699) to correlate the results of deep borings on the south side of the Gulf of Finland, in the hope of ascertaining the relations of the lower Cambrian strata of Russia to the pre-Cambrian beds that appear across the sea in Finland. Perhaps the areas still unexplored by the Finnish Survey may include some Palæozoic strata. For the present, the “Jatulian” dolomites, sandstones, and true bedded anthracites are sufficiently fascinating. What forms of vegetable life in pre-Cambrian times furnished the bed of coal 7 feet thick in Olonetz?

G. A. J. C.

METEORIC SHOWER OF JANUARY.

THE Quadrantids, or Boötids as they are sometimes called, the former constellation being modern and not fully recognised, ought to reappear under favourable auspices on the nights of Saturday, January 2, and Sunday, January 3; but the shower is a very fugitive one, and its more abundant phase will probably be confined to a few hours on one of the nights mentioned.

These January meteors really form a very rich stream, and I believe that, next to the Perseids, Leonids, and Andromedids, they are entitled to take precedence as regards numbers; but the annual returns are seldom well observed in this country owing to cloudy weather, moonlight, and other causes. Moreover, the radiant is only at a satisfactory height for the plentiful display of its meteors just before sunrise. At 9 p.m. in the latitude of Greenwich the point of radiation is only fourteen degrees above the northern horizon. Observations are best made, therefore, in the early evening between 5 p.m. and 6 p.m., or during the few hours before sunrise.

The meteors are generally fairly bright, with long, rather swift flights and flaky trains. They are decidedly conspicuous objects, and easily identified from members of the secondary showers of the epoch, which are not abundant or individually rich. This year the gibbous moon will slightly interfere with observations before midnight, but the morning hours, if atmospheric conditions allow, ought to provide a very suitable time for witnessing the spectacle.

W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE annual meeting of the Mathematical Association will be held on January 12, 1909, at King's College, London. Addresses will be delivered by Dr. H. T. Bovey, F.R.S., rector of the Imperial College of Science and Technology, on the mathematical preparation for students who propose to take up technical work; by Mr. Alfred Lodge, on the introduction of the idea of cross-ratio and homography, and its connection with involution; and by Prof. G. H. Bryan, F.R.S., on a proposal for the unknown digit.

THE annual meeting of the Geographical Association will be held on January 6, 1909, at the London School of Economics. In the morning, at 11.30, short papers on practical problems will be read. Mr. J. Fairgrieve will deal with the weather report and the teaching of geography, Dr. A. J. Herbertson will give hints on hanging and storing maps, and Mr. J. A. McMichael will give a demonstration of the method of making models by serial sections. In the afternoon, after a business meeting, the president, Mr. Douglas W. Freshfield, will deliver his address, Dr. H. R. Mill will lecture on the rainfall of the British Isles, and a lantern exhibition will be given of the set of views of the Dora Baltea, which has been prepared for the association by Mr. G. W. Palmer. The Geographical Association is, we are glad to find, continuing its excellent work in the direction of encouraging more scientific methods of teaching geography in schools. Monthly meetings for teachers and others are to be held on the last Friday evenings of January, February, and March next for the discussion of problems likely to assist teachers in their work, and in other ways the association is endeavouring to assist improved methods of geographical instruction. The honorary correspondence secretary, Mr. J. F. Unstead, 39 Greenholm Road, Eltham, is willing to give full particulars of the work of the association.

THE annual meeting of the recently formed American Federation of Teachers of the Mathematical and Natural Sciences was held at the Johns Hopkins University, Baltimore, on December 28 and 29. On the second day a joint meeting was held with the American Association for the Advancement of Science, at which numerous problems of science teaching were discussed. From Bulletin No. 1 of the federation, which has been received, we learn that seven associations have formally joined the federation. Fourteen others have the matter under consideration, and are expected to take action on it at their next meetings. Among pieces of work of obvious interest and importance which the federation proposes to undertake may be mentioned investigations and reports on such matters as the bibliography of science teaching and the history of science; the best means of publication for new material of interest to teachers of science; the best means of securing the most favourable conditions for science teaching, including a share in the shaping of college entrance requirements. It is important to notice that the articles of the federation provide, not for the formation of a new national society of teachers of mathematics and science, but for a collective representation of existing local societies in matters of broad general interest. Each local society, of which there are many in the United States, preserves its independent identity and methods of work. Already the federation has begun work by undertaking the compilation of a bibliography of the literature on the teaching of science and mathematics. The work is being done by cooperative effort, part having been assigned to each of the federated associations. A committee on bibliography has been appointed, with Prof. Richard E. Dodge, of Teachers' College, New York, as chairman. The list to be prepared is to “include books, articles in periodicals, scientific journals or association reports, including foreign contribu-

tions, if any." The object is to prepare a bibliography of contributions to science teaching in the last decade "that will be a working basis for any teacher of science, and especially for any in an institution with limited library facilities." Since reviews of recent publications on science teaching are valuable in making up programmes of study, this bibliography should be an aid in this way, and should encourage the study of the literature of the subject. For convenience and effectiveness in covering the whole field of science teaching, specialists have been appointed to undertake the work in six subdivisions. The federation has already a membership of more than 1600, and is the most representative body of teachers of science in America.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 25.—"Note on the Instability of Tubes subjected to End Pressure, and on the Folds in a Flexible Material." By A. **Mallock**, F.R.S.

When a straight rod is subjected to end compression it is stable for small lateral displacements unless the compressing force exceeds a definite limit, depending on the elastic constants of the material of the rod and its length and cross-section dimensions.

If this limit is exceeded the rod is unstable, and the least departure from straightness grows under the action of the force, the axis of the rod then taking the form of one of the well-known elastic curves, and this is the only form which a solid rod can take in the circumstances.

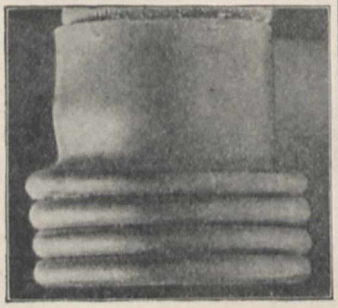

FIG. 1.

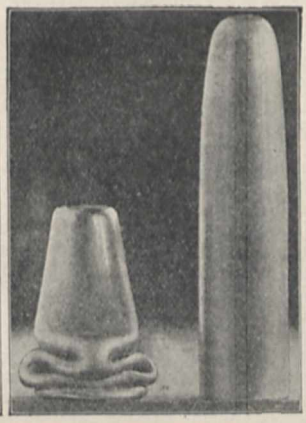

FIG. 2.

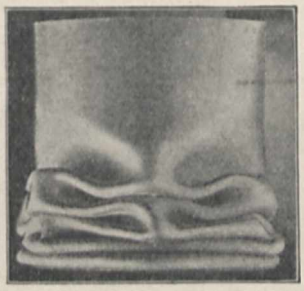

FIG. 3.

With tubes and plates, however, the case is different, for with the tube the ratio of the thickness of the walls to the diameter of the tube has to be considered as well as the ratio of the diameter to the length. Thus a tube the length of which is insufficient to produce instability involving a bending of the axis may become unstable by the crumpling up of the walls, the axis itself remaining straight.

In the case of solid rods the governing condition is the constancy (to the first order) of the length of the axis; with tubes and plates it is the constancy to the same order of the area of the mid-wall surface. Considering the case of tubes in rather more detail, take the axis of the tube as z and let its unstrained radius be r_0.

Under end compression the surface may become unstable by deformation into any of the cylindrical harmonics of the type

$$r = r_0 + a \cos n\theta \cos \frac{2\pi}{\lambda} z,$$

where θ is the angle which r makes with a fixed diameter of the tube and λ the length of the fold parallel to the axis. The order of the harmonic which will naturally be assumed by the deformed tube depends on the ratio (h/r) of the thickness of the walls to the diameter, and will be such that the potential energy of the combined bending and shearing involved may be a maximum.

If the crushing is continued until the tube is greatly reduced in length the folds are seen to develop into the symmetrical shapes shown in the photographs (Figs. 1, 2, 3), for which $n=1$, 2, and 3 respectively. For $n=1$ the folds are circular in plan and independent of θ; when $n=2$ the plan of the folds is a square, and when $n=3$ the plan is hexagonal.

It may be noticed that the instability always shows itself first at one end, and that since the reaction against end pressure decreases as the deformation goes on, each fold is completed in succession, the next not becoming marked until the reaction is increased by the previous fold resting against the last but one.

November 5.—"Note on Tidal Bores." By Lord **Rayleigh**, O.M., Pres.R.S.

It was shown long ago by Airy that when waves advance over shallow water of depth originally uniform, the crests tend to gain upon the hollows (see also "Scientific Papers," vol. i., p. 253, 1899), so that the anterior slopes become steeper and steeper. Ultimately, if the conditions are favourable, there may be formed what is called a *bore*. Ordinary breakers upon a shelving beach are of this character, but the name is usually reserved for tidal bores advancing up rivers or estuaries. Interesting descriptions of some of these are given in Sir G. Darwin's "Tides" (Murray, 1898).

Although the real bore advances up the channel, we may for theoretical purposes "reduce it to rest" by superposing an equal and opposite motion upon the whole water system. We have then merely to investigate the transition from a relatively rapid and shallow stream of depth l and velocity u, to a deeper and slower stream of depth l' and velocity u' (Fig. 1). The places where these velocities and depths are reckoned are supposed to be situated on the two sides of the bore, and at such distances from it that the motions are there sensibly uniform. The problem being taken as in two dimensions, two relations may at once be formulated connecting the depths and velocities. By conservation of matter ("continuity") we have

$$lu = l'u'; \qquad (1)$$

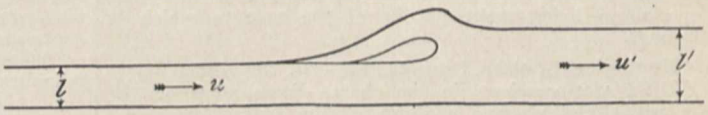

FIG. 1.

and since the mean pressures at the two sections are $\frac{1}{2}gl$, $\frac{1}{2}gl'$, the equation of momentum is

$$lu(u-u') = \tfrac{1}{2}g(l'^2 - l^2); \qquad (2)$$

whence

$$u^2 = \tfrac{1}{2}g(l+l').l'/l, \qquad u'^2 = \tfrac{1}{2}g(l+l').l/l'. \qquad (3)$$

The loss of energy per unit time at the bore is thus

$$lu\,(\tfrac{1}{2}u^2 + \tfrac{1}{2}gl) - lu\,(\tfrac{1}{2}u'^2 + \tfrac{1}{2}gl') = lu\,.g(l'-l)\frac{l^2+l'^2}{4ll'}. \qquad (4)$$

That there should be a loss of energy constitutes no

difficulty, at least in the presence of viscosity; but the impossibility of a gain of energy shows that the motions here contemplated cannot be reversed.

In order to recur to the natural condition of things where the shallow water is at rest, we have to superpose the velocity u taken negatively upon the above motion. The velocity of the bore is then u, and that of the stream above the bore $u-u'$. If l is relatively small, u is much greater than u'.

The reasoning just used is very similar to that applied by Stokes (*Phil. Mag.*, vol. xxxiii., p. 349, 1848) and by Riemann (*Göttingen Abh.*, vol. viii., 1860) to sound waves of expansion moving in one dimension. The matter is discussed in "Theory of Sound," § 253, where it is shown that the discontinuous solution, obtained from the principles of conservation of mass and momentum, violates the condition of energy. When this was pointed out to Stokes by Kelvin, and later by myself (Stokes, "Math. and Phys. Papers," vol. ii., p. 55), he abandoned his solution, which is, however, maintained by a competent German authority (private correspondence). It is clear, at least, that when the motion is such as to involve a gain of energy, the solution cannot be admitted. The opposite case stands upon a different footing, and we may, perhaps, imagine the redundant mechanical energy to be got rid of somehow at the surface of discontinuity. Even then we should have to face the complication entailed by the development of heat. In the present case of liquid, the heat is of little consequence, and since the motion is not entirely in one dimension, we escape the necessity of dealing with a single plane of discontinuity.

November 12.—"Further Observations on Welwitschia." By Dr. H. H. W. **Pearson.** Communicated by Prof. A. C. Seward, F.R.S.

The material which forms the subject of this investigation was collected at Welwitsch and Haikamchab, in Damaraland, in January and February, 1907. Macrospores and embryo-sacs are frequently present in the pith region of the female cone-axis. This confirms the view, already adopted by most authors, that the ovule of Welwitschia is cauline. Sporogenous cells have not been found in a similar position in the male cone.

The female cone and the male flower are probably derived by reduction and specialisation from an amphisporangiate strobilus of a type similar to that of Bennettites.

At the end of the free nuclear division the embryo-sac contains about 1024 nuclei which are equivalent in all visible characters. Cleavage of the cytoplasm occurs, resulting in the septation of the whole sac into compartments. In respect of the morphological character of the endosperm, Gnetum and Welwitschia are widely separated from Ephedra, in which the endosperm is a prothallus of the normal gymnosperm type. It is suggested that the endosperm of the primitive angiosperms was homologous with that of Welwitschia.

It appears that (1) the Gnetum-Welwitschia alliance has its origin in the same stock as the angiosperms, but separated from the angiosperm line before the carpel became the pollen-receiver; (2) Welwitschia is the most specialised living representative of the race to which it belongs.

Zoological Society, December 15.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Some notes on the muscular and visceral anatomy of the batrachian genus Hemisus, with notes on the lymph hearts of this and other genera: F. E. **Beddard.**—New species of Lacerta from Persia: G. A. **Boulenger.**—Some wart-hog skulls in the British Museum: Dr. Einar **Lönnberg.**—Two Chinese Serow skulls: R. **Lydekker.**—Warning coloration in the musteline Carnivora: R. I. **Pocock.**—A new river-crab of the genus Gecarcinucus, from New Guinea: Dr. W. T. **Calman.**—Mammals collected in the provinces of Shan-si and Shen-si, northern China, by Mr. M. P. Anderson, for the Duke of Bedford's zoological exploration of eastern Asia: Oldfield **Thomas.** Thirty-three species were included, represented by 335 specimens, presented, as before, to the National Museum by the Duke of Bedford.

Linnean Society, December 17.—Dr. D. H. Scott, F.R.S., president, in the chair.—The Anomura of the Sudanese Red Sea: W. **Riddell.**—Forms of flowers in *Valeriana dioica*: R. P. **Gregory.** In 1877 Hermann Müller described four forms of *Valeriana dioica*, distinguished from one another by the size of the flower and by the relative development of the male and female reproductive organs. The phenomenon appears to be very similar to that which was described by Darwin in *Rhamnus catharticus*. It has been found that the individuals of *Valeriana dioica* may be conveniently arranged in four groups, which are distinguished as, respectively, "female," "hermaphrodite," "long-styled male," and "short-styled male"; but while the central types of each group are readily distinguishable, it must be distinctly recognised that they are connected by a series of intermediate forms, and that there is no discontinuity between successive groups. The precise structure of the flowers of each plant varies considerably, as regards the relative development of the reproductive organs, with the age of the flower examined; but in addition to this there is, in some cases, a very wide range of variation in this respect, quite independent of the age of the flower.—Études sur les Cirrhipèdes du Musée de Cambridge: Prof. **Gruvel.**—The Rhynchota obtained on the *Sealark* Expedition: W. L. **Distant.** The author stated that the collection made by Mr. Gardiner in the Seychelles comprises forty species, viz. twenty-eight species of Heteroptera and twelve of Homoptera. Walker was the first to write on the Heteroptera of these islands, and in 1872 he described three species collected by Dr. Perceval Wright, one of which was found by Mr. Gardiner. In 1893 Bergroth and Reuter worked out the collections made by M. Ch. Alluaud and Père Philibert so far as the Heteroptera was concerned, and were able to enumerate thirty-seven species.

Geological Society, December 16.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The igneous and associated sedimentary rocks of the Tourmakeady district (County Mayo): C. I. **Gardiner** and Prof. Sidney H. **Reynolds,** with a palæontological appendix by F. R. C. **Reed.** The succession of the Ordovician rocks of the district appears to be as follows:—? Bala beds; Llandeilo beds: (*c*) Shangort beds; (*b*) Tourmakeady beds; (*a*) red felsite or rhyolite; Arenig beds—Mount Partry beds: (*d*) variable tuffs, grits, and cherts; (*c*) coarse quartzose and felspathic grits; (*b*) grits, graptolitic black slates, and radiolarian cherts; (*a*) coarse conglomerates. A series of graptolites from the Mount Partry beds prove to be of Upper Arenig age—about the zone of *Didymograptus hirundo*. The puzzling beds of the district are those of Llandeilo age. Although the limestones (Tourmakeady beds) occur in the main as disrupted blocks in the Shangort beds, the fossils indicate that there is little difference in the age of these deposits; probably, after the deposition of the limestone, but during the prevalence of the same faunal types as those of that deposit, the limestone was broken up by volcanic explosions, and its fragments were deposited as the peculiar limestone-breccias. The intrusive rocks are in the main felsites with quartz-crystals, and often contain augite. Interesting intrusions of olivine-dolerite, hornblende-lamprophyre, and fine-grained oligoclase-bearing rocks are scattered throughout the district. The appendix embodies a description of new species of brachiopods and trilobites.

PARIS.

Academy of Sciences, December 14.—M. Bouchard in the chair.—The approximate calculation of inequalities of a high order: Maurice **Hamy.** A calculation to the second degree of approximation of the disturbance of one planet by another.—Contribution to the study of *Haemogregarina lacertae* of Danilewsky and Chalachnikow: A. **Laveran** and A. **Pettit.** A detailed account of the appearances of this parasite in various stages of development, with nine illustrations.—Observations concerning the direct dehydration of certain alcohols: Louis **Henry.** In an earlier paper it has been shown that dimethyl-isopropyl-carbinol, heated with acetic anhydride and a few drops of sulphuric acid, gives, not the acetate, but a mixture of the hydrocarbons

tetramethyl-ethylene and isopropyl-methyl-ethylene. In this reaction the acetic anhydride was regarded as the true dehydrating agent, but in the present paper this view is shown to be incorrect. In the absence of the sulphuric acid the acetate is alone formed, and it is the presence of the very small amount of sulphuric acid which determines the formation of the ethylenic hydrocarbons. —Physical observations of the comet 1908*c*, made at the Observatory of Lyons: J. **Guillaume.** A detailed account of the changes of form undergone by the comet as observed between October 24 and November 28.—Observations of the Morehouse comet, 1908*c*, made with the Brünner-Henry equatorial of the Observatory of Toulouse: MM. **Saint-Blancat** and **Rossard.** Two tables giving the results of observations of the positions of the comet and of the comparison stars between October 2 and 14.—Geodesic lines: Jules **Drach.**—The number of double integrals of the second species of certain algebraic surfaces: L. **Remy.**—Description of the Voisin aëroplane used by MM. Farman and Delagrange: G. **Voisin.**—The compensation of compasses of great magnetic moment: Louis **Dunoyer.**—The magnetic dichroism of calcite and of dolomite in mixed liquids: Georges **Meslin.**—The influence of pressure on the phenomena of ionisation; curves of current and curves with constant field: E. **Rothé.**—Rotatory power at low temperatures and the connection between the absorption of light and rotatory polarisation in crystals of cinnabar: Jean **Becquerel.**—The theory of absorption in gases: L. **Bloch.** A modification of Lorentz's theory on the basis of Walker's hypotheses. The formulæ arrived at still await experimental verification.—The magnetism of the rare earths: B. **Urbain** and G. **Jantsch.** For groups of the rare earths, the salts of which possess nearly identical solubilities, and the atomic weights of which are nearly the same, the coefficients of magnetisation vary considerably, and hence may serve to determine the composition of mixtures which scarcely admit of analysis by other methods. Results are given of measurements of oxides of the type X_2O_3, in which X may be neodymium, samarium, europium, gadolinium, terbium, or dysprosium.—The variations of the composition of the colloids which are formed in a solution of ferric chloride according to the conditions of hydrolysis: L. **Michel.**—Remarks on the magnetic properties of the simple bodies: P. **Pascal.** The following law is enunciated:—the atomic susceptibility is an exponential function of the atomic weight for diamagnetic bodies of the same valency and of analogous chemical properties. Some of the experimental data in support of this are given.—The preparation of thorium chloride: Camille **Matignon.** The oxide is heated in a mixture of chlorine and the vapour of chloride of sulphur, the chloride being formed at a temperature sufficiently low to permit the use of glass tubes in the place of porcelain tubes required by other methods. Thorium chloride, if quite pure, is not so hygroscopic as has been stated by previous workers.—Studies on aluminium. The analysis of aluminium powder: E. **Kohn-Abrest.** Two methods of analysis are suggested, and the results given of their application to a sample of aluminium powder.—The dissociation of sodium bicarbonate: M. **Soury.**—The atomic weight of silver: Louis **Dubreuil.** A reply to some recent objections of A. Leduc.—The true atomic weight of silver: G. D. **Hinrichs.** The value 108 is maintained to be the true experimental atomic weight of silver.—The action of sulphur chloride (S_2Cl_2) on metals and metalloids: Paul **Nicolardot.** In all the actions described S_2Cl_2 acts like HCl, and not as a chlorinating agent.—The action of heat on iodic anhydride: Marcel **Guichard.** Iodine pentoxide is unchanged by heating until a temperature of 300° is reached. Above this temperature iodine and oxygen are given off. The non-decomposed portion becomes chestnut coloured. Comparative analyses of the white and brown anhydride gave similar results, all agreeing well with the composition of I_2O_5. The brown colour appears to be due to minute traces of iodine retained by the undecomposed anhydride, and no proof of the formation of a lower oxide could be obtained.—Research on the occluded gases contained in a complex brass containing manganese and filled with cavities: G. **Guillemin** and B. **Delachanal.** —The waxes of the Coniferæ: a new group of natural principles: J. **Bougault** and L. **Bourdier.**—Syntheses of derivatives of camphenylone: J. **Bouveault** and G. **Blanc.**—The action of sulphuric acid on aldehyde and paraldehyde: the preparation of crotonic aldehyde: Marcel **Delépine.** Acetaldehyde, carried as vapour in a current of air into pure sulphuric acid maintained at 10° C. to 15° C., is absorbed, and distillation of the diluted acid gives a 30 per cent. yield of crotonaldehyde, together with a new polymeride, $C_8H_{12}O_2$. The substitution of paraldehyde for aldehyde improves the yield.—The action of acids on diiodo-α-methylsparteine: Amand **Valeur.**—The action of ferments at varying temperatures: C. **Gerber.**—Attempts at the molecular analysis of protoplasmides: A. **Etard** and A. **Vila.** Anhydrous methyl alcohol is suggested as a suitable means of separation.—The influence of some mineral salts, especially stannous chloride, upon fermentation: G. **Gimel.** Two types of yeast (the elliptic wine yeast of Jacquemin and a distillery yeast of the Frohberg type) have been submitted to the action of salts of various metals. The results with tin and bismuth salts are the most striking. The addition of 0·01 per cent. of stannous chloride increases the yield of alcohol by 4 per cent., a property possessing obvious industrial applications. —The influence of light on the development of fruits and seeds: W. **Lubimenko.**—Contribution to the cytological study of the Endomyces: *Saccharomycopsis capsularis* and *Endomyces fibuliger*: A. **Guilliermond.**—The production of a new variety of spinach, *Spinacia oleracea*, var. *polygama*: M. **Blaringhem.**—The structure of the ciliary retina: J. **Mawas.**—An Acrasped without medusa: *Taeniolhydra Roscoffensis*: Edgard **Hérouard.**—The rhythmic appearance and stages in the experimental inversion of the chlorotropism of the Paguræ: Romuald **Minkiewicz.**—Studies on the cancer of mice: the histophysiology of certain cells of the conjunctival stroma of tumour B: L. **Cuénot** and L. **Mercier.**—The treatment of deep-seated tumours by a method allowing the action of radiant matter to proceed at close quarters with the tissues without altering the teguments: E. de Bourgade **la Dardye.** Zinc sulphide is injected, and this rendered phosphorescent by the X-rays. Cases are cited in which the method has been used with advantage.—The treatment of arterial hypertension by the high-frequency current: G. **Lemoine.** Good results have been obtained in five cases, full details of each being given.—The radiographic study of the articulation of the elbow and knee in a girl three and a half years of age: Maxime **Ménard.**—The fossil man found at Chapelle-aux-Saints (Corrèze): Marcellin **Boule.**—The white rhinoceros, re-found in the Soudan, is the unicorn of ancient times: E. L. **Trouessart.**—The Haleciidæ, Campanulariidæ, and Sertulariidæ of the *Challenger* collection: Armand **Billard.** —The appearance of males and hermaphrodites in parthenogenetic reproduction: J. **Pantel** and R. **de Sinéty.**—Microseisms of long duration: José Comas **Solá.**—The Phoridæ and Leptidæ of Baltic amber: Fernand **Meunier.**—The influence of deflation on the constitution of the ocean floor: J. **Thoulet.**

December 21.—M. Émile Picard in the chair.—Remarks on Fredholm's equation: H. **Poincaré.**—The action of lines of electric energy on hailstorms: J. **Violle.** In a previous note the author described the ravages caused by a hailstorm, the path of which followed exactly a wire carrying current at a high potential. Such a wire gives off torrents of ions carrying large electric charges, the effects of which are exactly comparable with those produced by the hail cannon. Although one electric transmission line is insufficient to protect a district, several might have a protective effect.—The mode of action of electricity in electric parthenogenesis: Yves **Delage.** It has been found that the condenser used in the experiments previously described permitted a leakage of current, the resistance being of the order of 20 megohms. It is conceivable that the acid and alkali produced by this current from the salt in the solution might account for the observed phenomena, which would thus reduce to a case of chemical parthenogenesis.—The forms of endogenous multiplication of *Haemogregarina lacertae*: A. **Laveran** and A. **Pettit.** A detailed description with diagrams.—Observations of the

sun, made at the Observatory of Lyons during the third quarter of 1908: J. **Guillaume.** Observations were taken on sixty-seven days, and the results are summarised in three tables giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—The cyclid of Lie: A. **Demoulin.**—The singularities of analytical functions: Paul **Dienes.**—Multiform integrals of differential equations of the first order: Pierre **Boutroux.**—The condition that seven right lines should be situated on a surface of the fourth degree: E. **Traynard.**—The Thomson formula, $T=2\pi\sqrt{CL}$, relating to the discharge of a condenser: André **Léauté.** In the case of coils carrying several layers of wire, the capacity is no longer negligible, and the Thomson formula requires modification. The theory of this case is developed in the present paper, and it is shown that the current due to the discharge of a condenser through a coil with two layers may be considered as formed by the superposition of an infinite number of sinusoidal currents, the amplitude of which tends towards zero with the period. This theory explains the presence of striæ in induction sparks.—The radiation and temperature of the flame of the Bunsen burner: E. **Bauer.** The temperature of the Bunsen flame found by these measurements is $1760°\pm50$, and is near the 1870° found by M. Féry, on the assumption that the emission of the D line is a purely thermal phenomenon.—Supertension and viscosity: Ch. **Marie.**—The synthesis of ammonia by means of peat: H. **Woltereck.**—The inconveniences of potassium bichromate when used as a preservative for milk samples intended for analysis: A. **Monvoisin.** The addition of 0·1 per cent. of potassium bichromate to milk samples intended for analysis is at present compulsory in France. This addition prevents the detection of added formaldehyde or hydrogen peroxide, and also renders it impossible to state whether the milk has been heated or not.—Contribution to the study of the humic matter in peat wool: L. **Roger** and E. **Vulquin.**—The reciprocal influence of respiratory phenomena and the behaviour in certain Actinia: Henri **Piéron.**—The development and affinities of *Sorosphaera Veronicae*: R. **Maire** and A. **Tison.**—Carpocyphosis: the normal anatomy and pathology of the lower radio-cubital articulation: R. **Robinson.**—The discovery of a human skeleton at Chapelle-aux-Saints (Corrèze): A. and J. **Bouyssonie** and L. **Bardon.** Details of the discovery and removal of this fossil skeleton, described by M. Boule in the *Comptes rendus* of last week. Both above and around the skeleton were many broken bones, as well as tools of flint and quartz. The animal remains included the reindeer, horse, and a large ruminant.—The anatomy of the appendicular organs of the female reproductive apparatus of *Periplaneta orientalis*: L. **Bordas.**—Experimental researches on the evolutive mutations of certain crustaceans: Edmond **Bordage.**—The upper limit of the proportion of the encephalus with respect to the weight of the body in birds: Louis **Lapicque.**—*Syllis vivipara* and the problem of its sexuality: Aug. **Michel.**—Filtration of the X-rays by aluminium: H. **Guilleminot.**—Geological structure in the Salzkammergut in the neighbourhood of Ischl and Aussee: Émile **Haug.**—The hydrography and climate of Algeria since the Oligocene epoch: J. **Savornin.**—The substratum of the *nappe du charriage* in the Peloponnesus: Ph. **Négris.**—The supposed submarine spring of the Port-Miou (Bouches-du-Rhône): E. A. **Martel.** This spring, the existence of which has been described in various works for the last 200 years, does not appear to exist.—The variations of climate: Henryk **Arctowski.**—The seismic disturbances of December 12 and 18, 1908: Alfred **Angot.**—The traces of a positive movement along the western coast of Corsica, and its function in the morphology and evolution of the coast-line: Paul **Castelnau.**—The telluric currents between stations of different altitude: Bernard **Brunhes.**

NEW SOUTH WALES.

Royal Society, November 4.—Mr. W. M. Hamlet, president, in the chair.—Note on pucherite from West Australia: E. **Griffiths.** The physical properties and composition of the mineral agree with those recorded in Dana's "System of Mineralogy" for the mineral pucherite. This is believed to be the first recorded occurrence of pucherite in Australia.

DIARY OF SOCIETIES.

MONDAY, JANUARY 4.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Cinchonamine and Certain Other Rare Alkaloids: B. F. Howard and O. Chick.—Reactions between Dyes and Fibres; W. P. Dreaper and A. Wilson.—A Physico-chemical Method for Comparing the Antiseptic Value of Disinfectants: Drs. S. B. Schryver and R. Lessing.

VICTORIA INSTITUTE, at 4.30.—Life in a Country Town of Lycaonia—(Conditions of Christian Life under the Eastern Empire): Sir W. M. Ramsay.

THURSDAY, JANUARY 7.

RÖNTGEN SOCIETY, at 8.15.—A Description of Three Sub-standards of Radio-activity recently prepared for the Röntgen Society: C. E. S. Phillips.—A New Localising Apparatus designed by Staff-Surgeon Dr. Gillett: H. C. Head.

CONTENTS.