THURSDAY, DECEMBER 21, 1916.

A TEXT-BOOK OF HUMAN PARASITOLOGY.

The Animal Parasites of Man. By Dr. H. B. Fantham, Prof. J. W. W. Stephens, and Prof. F. V. Theobald. Pp. xxxii+900. (London: John Bale, Sons and Danielsson, Ltd., 1916.) Price 45*s.* net.

THIS volume is, according to the title-page, partly adapted from the fourth edition (1908) of Braun's "Die Tierischen Parasiten des Menschen," but the section on the Protozoa has been almost entirely rewritten in order to bring it up to date, and the section on the worms has received so many additions to its text and figures, and has consequently been remodelled to such an extent, that it also may be regarded as in large degree new.

An introductory chapter deals in an interesting manner with the general characters of parasites and the influence of parasites on their hosts.

The section on Protozoa (186 pages, by Dr. Fantham) contains a systematic account of the Protozoa known to occur in man, and also of the more important forms, especially the trypanosomes, which have been found in animals—laboratory, domestic, and draught—likely to come under the notice of medical officers. In addition to the undoubted Protozoa, the Spirochætes and the Chlamydozoa receive adequate treatment. The morphology and life-history (so far as this is ascertained) of the various organisms are stated in clear and concise terms, and the results of recent work—up to about July, 1915—are incorporated, the later papers being noticed in an appendix, which also contains directions for preparing culture media and some helpful notes on general protozoological technique.

There does not appear to be any mention of Amœbæ of the *limax* type, found from time to time in the large intestine of man; a statement of the characters of this type of Amœba would have been helpful.

The whole account is well done, but the part dealing with the flagellates may be especially commended.

The section on the flat and round worms (271 pages, by Prof. Stephens) is an excellent piece of work, in which the numerous recent researches on these groups have received full attention. By the insertion, in the section on Schistosoma (Bilharzia), of a slip giving the characters of the two species, *S. haematobium* and *S. mansoni*, based on the observations of the War Office Bilharzia Mission in Egypt, the literature on these parasites is brought down to March, 1916. The anatomy of the adult, the characters of the egg and the known larval stages, the accompanying symptoms, and the pathological effects of the various parasitic worms recorded from man are clearly set forth. Special praise is due to the author for the excellence of the illustrations, many of which are either new or reproduced from recent memoirs.

The section on the Arthropoda (133 pages, by Prof. Theobald) gives a systematic account of the mites, ticks, and insects which have been recorded as attacking man. Much unaltered text from the previous edition has been retained, and with this numerous paragraphs dealing with new matter have been incorporated. This has no doubt been the cause of the use in places of obsolete nomenclature, *e.g.* the dog flea is named *Pulex serraticeps* on p. 546; its correct modern name is given on the next page, but without any suggestion that the two names are in any way synonymous.

The first part of this section deals with the Arachnida—mites, ticks, etc. Much work has been done on ticks since the last edition was issued, and many excellent figures have been published, but the present account is illustrated only with the four figures from the edition of 1906. The legend of one of these (Fig. 359B) is incorrect, the structure shown being the terminal part of the chelicera and not "the terminal joint of the maxillary palpi." The statement of the characters of some of the species of ticks is entirely inadequate, *e.g. Amblyomma cajennense* is "characterised by the possession of eyes," and no other characters are given except the measurements of the adult male and female.

The short account of the lice is reprinted with the old figures from the edition of 1906, and there is no reference to the body-louse as carrier of relapsing fever and typhus. The five figures of fleas in the former edition are reprinted; new figures should have been added to enable the reader to follow the essential differences between the principal genera described. The characters of the plague-flea are insufficiently set forth, and in the short paragraph on the relation of this flea to plague is the statement: "How the flea infects man does not apparently seem to have been proved, as it does not do so through its bite." The work of Bacot and Martin on the part played by fleas in which the proventriculus is blocked by a culture of plague bacilli has evidently been overlooked.

In the account of the structure of a mosquito two defects may be noted: on pp. 548 (last line) to 550 the terms labium and labrum are transposed (as in the last edition); and the mosquito's œsophagus bears one large ventral diverticulum in addition to the two small lateral (really dorso-lateral) ones mentioned on p. 550. The account of Phlebotomus is wanting in several respects, *e.g.* the statement of the characters of the larva is so defective as to be valueless.

The difficulties to be overcome in preparing an adequate account of insects in relation to man are undoubtedly great, but the present account does not attain the same high standard of accuracy and completeness as the first two sections of the volume.

A supplement (115 pages) contains a translation of Dr. Seifert's appendix to the last German edition giving clinical and therapeutical notes. The first part of this, on the Protozoa, has been largely rewritten, but the parts on parasitic worms and arthropods are little changed.

ACOUSTICS AND BEYOND.

Hyperacoustics. By J. L. Dunk. Division i., *Simultaneous Tonality.* Pp. vi+311. (London: J. M. Dent and Sons, Ltd., 1916.) Price 7*s.* 6*d.* net.

THE title of the work of which the present volume is but the first division is thus dealt with in the preface: "Between the region of phenomena [undefined] comprised in the science of acoustics, and the experiences of music considered as phenomena, there appears a great gulf, which invites attempts to bridge." "The 'gulf' has two sides, and can be approached either by working forward from the material aspect of acoustics, or backward from the experiential aspects of music. However, in the present investigation it is the purely scientific side that is emphatically insisted upon. Hence the name 'Hyperacoustics' may be proposed, as indicative not only of something beyond, but also of a presumption requiring justification as to the existence and rationality of something beyond the known facts of acoustics."

It is held that the subject may be considered under the divisions Tonality, Rhythm, Organisation, and Significance. The present volume is restricted to the aspect of "Tonality," the science of musical sound in pitch and quality.

As to the treatment of the subject, whenever incidental references are made to the various intervals, whether in the just or equally tempered intonations, the author shows an accurate knowledge of the facts. But, immediately he steps beyond the facts themselves to any discussion of them, all seems on a different plane—a plane of pure fancy, or "hyperscience."

This treatment might conceivably exercise some fascination over certain minds inclined to the occult and esoteric; and in such matters the mere man of science is not competent to judge. It may be that a feeling of shrinking on the part of the ordinary reader is inevitable towards a work designed to bridge in this wise the gulf between physics and music. But, without doubt, the work is quite lacking in all appeal to either the physicist or the musician. Indeed, the scientific reader cannot help wondering whither it all tends or what it is supposed to establish. Every few pages sees the introduction of one or more terms of a strange character and vague import. These are then woven into the discussion, which again continues without any apparent advance.

One of the simplest and least fanciful parts of the work is that in which the intervals are likened to colours. Thus the perfect fourth is regarded as red, the major third as green, and the minor third as violet. Then, by composition, are obtained the following. The perfect fifth is green plus violet equals blue, the minor sixth is red plus violet equals mauve, the major sixth is red plus green equals yellow. Again, the octave is red plus green plus violet equals white, and the unison is zero equals black.

An illustration of the more general style of the work is afforded by the following quotation (p. 221):—

"The fact that, acoustically, the Seriopolar aspect of the Matrix is only effective in the Fundamental Species, and that the approximation of the Tensor Heptad to the Hemicyclic type is nearer than the Laxator Heptad, is evidently responsible for the recognition of a distinct chiral bias in progression denoted at an early date by the word 'Authentic.'"

MORPHOLOGY: OLD AND NEW.

Form and Function: a Contribution to the History of Animal Morphology. By E. S. Russell. Pp. ix+383. (London: John Murray, 1916.) Price 10*s.* 6*d.* net.

A SCHOLARLY and thoughtful book like this makes one feel how much is lost to students of biology by lack of attention to the historical development of the science. Not only is the human interest missed, but also the educativeness of tracing the history of fundamental ideas. Moreover, for lack of historical discipline, the same mistakes are made over and over again, and sound generalisations which have ceased to be prominent are unconsciously restated as new, it may be in a form far inferior to that given them by Cuvier, E. Geoffroy Saint-Hilaire, von Baer, or some other outstanding thinker of older days. We welcome, therefore, Mr. Russell's contribution to the history of morphology, for it is based on many years of first-hand study of the documents and is illumined by insight. It is true history, not chronicle; it displays the continuous endeavour from Aristotle until to-day to understand the forms of animals, both in their original establishment and in their individual reproduction in every life-cycle.

The author distinguishes three main currents of morphological thought. The first he calls "functional or synthetic," which interprets form as the manifestation of function or activity. It is "associated with the great names of Aristotle, Cuvier, and von Baer, and leads easily to the more open vitalism of Lamarck and Samuel Butler." The second he calls "formal or transcendental," which regards function as the result of form—the outcome of organisation. "The typical representative of the second attitude is E. Geoffroy Saint-Hilaire, and this habit of thought has greatly influenced the development of evolutionary morphology." The third he calls "materialistic or disintegrative," which was greatly influenced by the cell-theory.

The author's general position is with the morphologists of the first school; he believes that attention should be concentrated "on the active response of the animal, as manifested both in behaviour and in morphogenesis, particularly in the post-embryonic stages." He frankly adopts "the simple everyday conception of living things—which many of us have had drilled out of us—that they are active, purposeful agents, not mere complicated aggregations of protein and other substances."

Mr. Russell displays a fine sense of the historian's function in the way in which he has thought himself into the position of the various morphologists whose ideas he expounds. He shows a remarkably sympathetic imagination, and we suspect that he has understood some of the old masters—Lamarck, for instance—better than they understood themselves. We think his estimate of Haeckel is too severe, but his fair-mindedness is so conspicuous that we suspect our partiality may be at fault. The whole book shows fine workmanship, but we may perhaps refer to the outstanding excellence of the discussion of the controversy between Cuvier and Etienne Geoffroy Saint-Hilaire, of the Meckel-Serres law and its successor the recapitulation doctrine, of the work of von Baer, of the cell-theory, and of the import of the young subscience of experimental embryology which Roux founded. No previous English discussions of these subjects show in such high degree the qualities of scholarship, clearness, and grasp of essentials.

This masterly book suggests many reflections, and we would try to state two of these. (*a*) Mr. Russell bids us choose between the position held by Cuvier, which insists on the priority of function to structure, and the position of Geoffroy, which maintains the priority of structure to function. But may we not recognise a partial truth in both positions? The organism is indeed a particular kind of activity, a unified reaction system, but it cannot get on without organisation, any more than a stream without a bed. It conditions its organisation as the stream makes its bed, but the organisation soon begins to condition it, as the bed the stream. We do not feel compelled to admit the rigid antithesis which Mr. Russell would force on us. (*b*) In his account of the embryological work of Roux the author says that "the introduction of a functional moment into the concept of heredity was a methodological advance of the first importance, for it linked up in an understandable way the problems of embryology, and indirectly of all morphology, with the problem of hereditary transmission, and gave form and substance to the conception of the organism as a historical being." What Mr. Russell has said in this book and elsewhere concerning the conception of the organism as a historical being is very important, but what we are not sure about is that Roux's "linking-up" was "understandable." As regards linking-up, did Roux do more than suggest the hypothesis that specific chemical substances produced in connection with functionally acquired form-changes might soak through from body to germ-cells and induce in them a predisposition to similar form-changes in the offspring? The hypothesis surely takes a good deal of understanding, and, speaking for ourselves, we are not enamoured with the prospect of interpreting the form of animals in terms of their activity if it cannot be attained without a belief in the transmission of functional modifications more firmly based in fact than that of Lamarck, Samuel Butler, or Semon. Is there not some other way in which an organism may be a historical being?

EXPERIMENTAL INVESTIGATIONS INTO THE DEVELOPMENT OF VERTEBRATA.

Growth in Length: Embryological Essays. By Richard Assheton. Pp. xi + 104. (Cambridge: At the University Press, 1916.) Price 2*s.* 6*d.* net.

ALL zoologists will be grateful to Mrs. Assheton for the publication of these embryological essays found amongst the papers of her late husband. Whilst nominally dealing, as the title indicates, with "growth in length," they are really a beautiful and clearly expressed summary of the early stages in development of the Vertebrate embryo, ranging through the whole series from the Elasmobranch to the Mammal. The facts are, of course, interpreted according to the late Dr. Assheton's views, with most of which we should be inclined to agree. The only point of criticism that seems to us worth raising is whether Dr. Assheton was justified in accepting on the evidence the statement that the "segmentation cavity" in the segmenting eggs of Amphibia becomes incorporated in the gut. Brachet's work (which Dr. Assheton quoted) does not warrant such a conclusion; he found, indeed, that the wall dividing the gut from the segmentation cavity was often torn during growth, but that the rent healed up again. This temporary communication between the two cavities is therefore only one of the dislocations produced by unequal growth, and has no further significance.

Dr. Assheton arrived at the conclusion that the blastopore in all Vertebrata (including Balanoglossus) becomes the anus, and that the mouth is an entirely new formation—as appears to be the case also in Echinodermata. This is a view for which there is strong evidence. The only consideration which makes us hesitate in accepting the ontogenetic processes in these two groups as a full record of their evolutionary history is that the formation of a new mouth seems to us to involve a breach of functional continuity which we find it difficult to picture to ourselves as actually occurring in the history of the race.

To the essays on "Growth in Length" is appended a reprint of Dr. Assheton's paper on "The Geometrical Relation of the Nuclei in an Invaginating Gastrula (Amphioxus)," which was an endeavour to substitute for Driesch's vague conception of the "entelechy" a force alternately monopolar and bipolar, radiating from the nuclei of the blastomeres as the efficient agent in bringing about invagination. This explanation of vital phenomena, like so many others, can be made to fit this particular case; but our doubts as to its validity are raised by its inability to fit other similar cases. How can the position of the nuclei in the cells explain the invagination in the gastrula of Echinus, when this invagination can be changed into an evagination by allowing the egg to develop in warmer water? Still, it is only by propounding and testing theories of this kind that progress can be made, and Dr. Assheton's clear

exposition of the problem and his gallant attempt to solve it will, we hope, stimulate other biologists to follow in his footsteps and carry on the work to which his life was devoted, *i.e.* experimental embryology. E. W. M.

OUR BOOKSHELF.

The Heat Treatment of Tool Steel. By H. Brearley. Second edition. Pp. xv+223. (London: Longmans, Green and Co., 1916.) Price 10*s.* 6*d.* net.

THE fact that a demand has arisen for a second edition of this book within four years from its first appearance is the strongest evidence of its practical value. The author states in the preface that he is now less restrained than formerly, and is free to describe in greater detail the different methods of treating steel, and this has enabled him to deal with the subject much more completely than in the first edition.

For some time past, and especially during the stress of the last two years, it has been more fully realised than ever that the life of a tool will depend as much on the manner in which it is worked into the finished shape and on the heat treatment it receives as on the material from which it is made, and a record of the practical experience of the author will be of great value to all directly interested in procuring the best working results from the various steels used in the manufacture of tools.

For efficient handling, the subject demands an adequate knowledge of the science bearing on it, and familiarity with the results of recent research, together with a wide experience in workshop practice. The author possesses these qualifications to a high degree, and although the book deals more particularly with the practical than with the scientific aspect, it can be strongly recommended to all interested in this important subject either from the practical or from the more purely scientific point of view.

Alloy steels, and high-speed steels in particular, are more fully dealt with than was the case in the first edition, and the chapter on case-hardening has been omitted, as it has been made the subject of a separate volume.

The whole subject is well handled, and the book can be strongly recommended as a clear and comprehensive treatise on this important branch of technology. F. W. HARBORD.

Laboratory Manual in General Microbiology. Pp. xvi+418. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10*s.* 6*d.* net.

THIS book is planned to serve as a manual of instruction in practical microbiology. To a large extent it represents the course given in this subject at the Michigan Agricultural College, and it therefore deals mostly with agricultural microbiology, and the disease-producing organisms, with two or three exceptions, are omitted.

The course is divided into 126 lessons or exercises, of which 53 are devoted to general laboratory methods and to the general morphology of micro-organisms, 33 to the physiology of micro-organisms, 15 to air, water, sewage, and soil, 11 to dairy and plant microbiology, and 14 to animal diseases and immunity.

Each lesson is detailed under a definite plan—the apparatus required, the cultures necessary, and the method of carrying out the exercise. At the end of each lesson questions are asked regarding the particular results that may be obtained and their significance.

The details given for each lesson are sufficiently full to enable the student to work independently of a teacher, and anyone who were to follow them out would possess a good practical knowledge of the subjects dealt with.

Formulæ for stains and special culture media, tables of the coliform organisms, metric and other tables, and a list of works of reference are given in an appendix, and the text is illustrated with a number of plates and figures.

The work should be of considerable value as a laboratory handbook to both teacher and student, and we can cordially recommend it for this purpose. R. T. HEWLETT.

LETTERS TO THE EDITOR.

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

Pre-Columbian Use of the Money-Cowrie in America.

THE letter entitled "Pre-Columbian Use of the Money-Cowrie in America," by Mr. J. Wilfrid Jackson (NATURE, September 21, p. 48), offers a discouraging instance of superficial reading of carefully observed and recorded data.

In 1915 Mr. Clarence B. Moore unearthed, in the Roden Mound in northern Alabama, five cowries (*Cypraea moneta*). These shells, which came from a burial in the body of the mound, had been pierced for stringing, and showed evidence of considerable age. They were the only evidence found at this site of contact with the Old World (C. B. Moore, "Aboriginal Sites on Tennessee River," in Journ. Acad. Nat. Sci., Philadelphia, second series, xvi., p. 293). In all Mr. Moore's more than twenty years of most careful and painstaking exploration of mounds, cemeteries, and dwelling sites of the southern United States, from the Atlantic coast to Texas, and from the Ohio River to the Gulf of Mexico, no previous instance of the finding of *C. moneta* had been noted by him, nor has it ever been recorded as occurring with American pre-Columbian remains. The logical conclusion from the mass of this negative evidence is that the Roden Mounds were, in part, early post-Columbian, and that any other evidence of contact they may have contained was of a perishable nature. To assume, on the basis of this string of shells, the pre-Columbian use of the cowrie in America is no more justified than to claim for iron working a pre-Columbian age in the western hemisphere on the evidence of the iron celts found by the same Tennessee River expedition in Citico Mound, where absolutely nothing else save four glass beads from a superficial burial suggested the white trader and his wares. In each instance the presence

of these Old World materials dates the grave as later than 1492.

In the fifteenth and early sixteenth centuries the "porcelain shell," or cowrie, was the trade medium for both the Orient and Africa, for which purpose it was strung.

In a recent statement to the present writer, Dr. William H. Dall, the foremost of ethno-conchologists, so expressed himself:—"I think the presence of *C. moneta* in a mound is evidence that the deposit is post-Columbian. Columbus believed that he was on a voyage to the (East) Indies, and no voyager of his day would have fitted out a ship for that goal without including the money-cowrie in his trade goods. That the records make no mention of them is probably due to their being considered too much a matter of course."

Moreover, strings of cowries were a part of the trappings of a gentleman's mount, and, in this capacity, some are likely to have reached the southern United States in the days of its earliest exploration.

The *C. moneta* which Mr. Wilfrid Jackson erroneously states was found *in* the Serpent Mound, Ontario, is recorded by Mr. Montgomery as among the objects "which were found in the same locality, some of them last year, and others previous to that time. Some of these were discovered upon the mounds or near them; others were either found upon the surface of the ground or ploughed up in the neighbouring fields. A few were obtained about four miles distant from the mounds" (Trans. Canadian Institute, ix., 1910, p. 6). Mr. Montgomery himself says of the artifacts in this enumeration:—"Nothing can be positively stated as to who their manufacturer was." The shell was unpierced, and there is nothing in the record, so far as published, to prove that it was ever in the possession of an aboriginal American.

As for the Cree dress, decorated with cowries, collected by the Lewis and Clark expedition, and described by Mr. Willoughby (*American Anthropologist*, 1905, p. 640), does Mr. Wilfrid Jackson maintain that the blue glass beads and brass buttons which adorned the opposite side of this shirt are also of pre-Columbian date? In sooth, it proves nothing. In 1804–5 the Cree were in close trade relations with the Hudson Bay Company, and had been in touch with the white man for more than a century and a quarter.

The modern use of the cowrie in the ancient ceremonies of the Ojibwa and Menomini tribes, cited by Mr. Jackson, is likewise wholly inconclusive of the antiquity of *C. moneta* as a culture object. Hoffman, describing "The Midéwiwin, or 'Grand Medicine Society' of the Ojibwa" (Bureau of American Ethnology, vii., Ann. Rept., 1885–6), states:—"The mígis is considered the sacred symbol of the Midéwigan, and may consist of any small white shell, though the one believed to be similar to the one mentioned in the above tradition resembles the cowrie. . . . It is admitted by all the Midé priests whom I have consulted that much of the information has been lost through the death of their aged predecessors" (p. 167). On p. 191 Hoffman again refers to "the mígis, a small white shell (*C. moneta*, L.)," and on p. 220 he further states:—"The mígis referred to in this description of the initiation consists of a small white shell, of almost any species, but the one believed to resemble the form of the mythical mígis is similar to the cowrie, *C. moneta*, L. . . . Nearly all of the shells employed for this purpose are foreign species, and have no doubt been obtained from the traders. The shells found in the country of the Ojibwa are of rather delicate structure, and it is probable that the salt-water shells are employed as a substitute, chiefly because of their less frangible character."

The related Menomini, in their corresponding ceremony, were undoubtedly using the money-cowrie as a culture object in 1890 (Hoffman, "The Menomini Indians"; Bureau of American Ethnology, xiv., Ann. Rept., p. 101), but the earliest records of the doings of this medicine society are not so convincing of the identity of the shell employed (*e.g.* Schoolcraft, "Indian Tribes," iii., p. 287). Dr. Dall has kindly permitted me to quote his private communication as follows:—"I believe the cowrie to be a comparatively late substitution, in the ceremonies of the Ojibwa and associated tribes, for some native American shell formerly used by them, just as, after the coming of the traders, the exotic *Dentalium tarentinum* rapidly replaced the smaller and more fragile *D. indianorum*, which was so highly esteemed by the West Coast tribes. The marine shell, *Marginella apicina*, which was traded up from the Gulf Coast in large quantities, in pre-Columbian and early post-Columbian times, is likely to have been the object, 'in shape and colour like a small bean,' which was thrown at the novice in the Black Dance ceremony of the Dakota, according to the earlier narrative used by Jonathan Carver in 1778 (Bureau Amer. Ethnol., Ann. Rept., xiv., p. 112). Fletcher's report of the corresponding ceremony of the Winnebago, where they used 'a small white seashell about the size of a bean' (*ibid.*, p. 110), exactly fits the Marginella."

The case thus rests entirely on Mr. Moore's find, and in the face of perhaps a hundred thousand aboriginal graves innocent of cowries, to construe the single instance of Roden Mounds as evidence of prehistoric acculturation is to sire the concept by a wish.

H. NEWELL WARDLE.

The Academy of Natural Sciences of Philadelphia.

THE question of the pre-Columbian use of the money-cowrie in America is fully discussed by me in an exhaustive memoir, dealing with the use of cowries as cult objects in the Old and New Worlds, which is on the eve of publication by the Manchester Literary and Philosophical Society. (It will probably be published by the time this letter appears in print.) The whole subject is too vast to be discussed in a short letter, but the following remarks may be offered on the criticism levelled by Mr. H. Newell Wardle at my letter in NATURE of September 21.

The evidence provided by the remarkable discovery by Mr. C. B. Moore of shells of the money-cowrie, *C. moneta*, in the Roden Mound, where they were associated with a human skull, forms merely one link in the remarkably complete chain of cultural connection between the Old World and the New in pre-Columbian times. There are other equally suggestive facts, which point conclusively in the same direction, including the significant use of large stone cists for burial purposes in the immediate neighbourhood of the place where the cowries were found, as well as elsewhere in America.

The custom of placing money-cowries in graves with the dead is a widespread Old World practice, which has a definite and wholly arbitrary significance; and it ranges in time from pre-dynastic Egypt to the present day.

As for the Cree dress decorated with cowries, I do not pretend to claim that the actual dress, with its blue glass beads and brass buttons, is of pre-Columbian date; but the idea of using cowries to decorate such a dress, which again has a very precise meaning in Africa and southern and eastern Asia, was certainly not so recent as the brass buttons suggest. To imagine that the Hudson Bay Company introduced such Oriental customs, or even knew of their existence, is surely crediting these traders with an extent of ethnological knowledge and enthusiasm for disseminating exotic beliefs, with a strong Indonesian colour, which I am not sufficiently imaginative to admit.

If it be admitted that the Hudson Bay Company traded cowries, it must have been due to having seen such already in use by the Indians, for without this appreciation of the special mystical value of the cowrie there would have been no demand for them. On the west coast of Africa the cult of the cowrie was certainly not first introduced there by the white traders of the fifteenth century; they found the blacks already in possession of these white shells, the custom of using them and the superstitious reverence attached to such shells having filtered through Central Africa ages prior to the advent of the whites. It is only natural that full advantage should have been taken by traders, and thus an enormous trade in these shells sprang up. So far as I am aware there is no evidence that the Hudson Bay Company traded in the money-cowrie.

Mr. Wardle's arguments do not explain the remarkable identity in the association of the money-cowrie with medicine ceremonies in places so far apart as Africa and America. In both these continents the cowrie is regarded as the "symbol of life"—a distinction which no other shell enjoys.

In a magazine article he has previously expounded the procedure of Columbus in introducing the cowrie, *C. moneta*, into the New World. But in his account, the gist of which appears in his foregoing letter, he omits the most wonderful episode of his "wonder-tale," as he himself calls it—I refer to the fact that after all the imaginary wanderings and episodes on sea and land, the cowries should eventually have come to rest in the heart of the American continent, and, "of course purely by accident," have become linked up with the identical beliefs and fantastic practices with which they are associated in Africa, India, and eastern Asia.

To such lengths does the American ethnologist go rather than admit the patent fact that these shells, along with the associated beliefs and practices, were taken from eastern Asia to America long before the time of Columbus.

J. WILFRID JACKSON.

Manchester Museum.

Field Glasses for Army Use.

SOON after the outbreak of the war, my father, Lord Roberts, asked the public to lend their glasses for the use of the Army. After two years I think your readers may be glad to have some particulars of the result of his request.

Upwards of 26,000 glasses have been received, without reckoning those which, in pursuance of my father's suggestion, have been collected in Australia, the Malay States, and elsewhere, and issued forthwith to the local forces on their way to the seat of war. The instruments sent comprise every type, and have been classified and issued according to the needs of different units. Particularly useful have been the fine prismatic glasses sent, which have been allocated to artillery and machine-gun units, according to their power; large mounted telescopes for batteries, deer-stalking telescopes for gunners and snipers, and good old-fashioned non-prismatic racing glasses for detection of the nationality of aircraft, locating snipers, signalling by disc, collecting wounded, and musketry instruction.

I am indeed grateful for the way in which my father's appeal has been met. British people all over the world have given their best, recognising that, in spite of the fact that their glasses are on loan and that the organisation for their return has been arranged, the chances of loss are many, and that they may never get them back.

When I think of the enormous numbers of good glasses sent, it may seem ungracious to ask for more, but the demand is still great. I am told that at watering-places and on racecourses and elsewhere large numbers of glasses are still to be seen in private hands, and to the owners of these I would once more appeal. I should add that we have been entrusted by the Ministry of Munitions with the purchase of individual glasses from those who cannot afford to lend them, and that the address for sending glasses for either purpose is the same. Every good glass (except opera-glasses) and every telescope (except toys) is wanted for the service of the country.

December 18. ROBERTS.

Address for sending:—The Manager of Lady Roberts's Field Glass Fund, National Service League, 72 Victoria Street, S.W.

SCIENCE AND INDUSTRY IN AUSTRALIA.

THE second report of the Executive Committee of the Advisory Council of Science and Industry for the Commonwealth of Australia shows that energetic steps are being taken to provide and set in motion the necessary machinery for the promotion of industrial research in the Commonwealth. Strong committees have been formed in all the States with the exception of Tasmania, and it is hoped that this State will soon take action and complete the scheme recommended by the Advisory Council.

The Executive Committee has commenced its work in a methodical manner by making inquiries with the view of compiling information regarding Australian industries, problems arising in connection with them, the laboratories and *personnel* now available for research, and the facilities for the education of future investigators.

We look forward with considerable interest to further reports to learn what conclusions are arrived at as to the education of the research workers of the future. The leaders in this research movement in Australia are, of course, familiar with all our educational systems in the Old Country, and, indeed, many of them are graduates of British universities. With the special problem before them of training research workers, it will be interesting to see to what extent they will go along the old lines, or whether they will recommend new methods, having fewer Education Acts and educational interests to take into account.

The Executive Committee, since its first report a few weeks previously, has been able not only to complete the machinery of the scheme, but also to consider many suggested researches. The broad character of these shows that the committee intends that its functions should include all types of industries that can be benefited by research. Problems relating to engineering, chemistry, gold-mining, diseases of cattle, agriculture, bread-making, and other matters appear in the list.

We notice that a special committee has been appointed to deal with the standardisation of physical apparatus for the teaching of science in the technical and other schools and colleges of Australia. The object is to enable the apparatus to be made in Australia, as it is inconvenient to depend on supplies imported from a great distance.

We sometimes wonder whether there is not too much standardisation in apparatus for elementary teaching. Instrument-makers are, of course, a necessity for specialised and accurate instruments, but it might be better if schools and colleges depended more on their own workshops.

The work already accomplished in Australia, and indeed also in Canada, shows that the movement towards research methods in industry is going on all over the Empire, and it is encouraging to know that the necessary co-operation, without too much centralisation, is being arranged between the councils operating abroad and the Advisory Council at work in London. Sufficient organising machinery would seem to have been provided both at home and in Australia and Canada. The supply of trained workers is the important matter, and that brings us back to our educational systems. Will the universities be able to give the necessary care to research to enable them to meet the demand for trained investigators that we hope to see in the near future? If they are to do so larger staffs will be necessary, and there must be less school-work in the universities. There are few university professors who do not spend a large portion of their time teaching school-work. Higher entrance examinations would remedy this evil, but the university is not always so rich that it can ignore the question of students' fees.

In connection with the establishment of this Federal research scheme in Australia, it is interesting to turn to the report of the British Science Guild adopted at the annual meeting on July 1, 1915, and to find that so early as January, 1914, the South Australian branch of the Guild had drawn up plans for a Federal Institute for Original Research which were to be brought before a conference of the Australian Premiers. The institute proposed by the Guild was designed to give special attention to agriculture, and to undertake "research work beyond experimental farming." The Guild realised the importance of studying from a research point of view everything underlying the successful use of the land, including the well-being in every respect of the people engaged in farming operations. The list of subjects mentioned above, which the executive committee deals with in its report, shows that agriculture in all its bearings is receiving attention, and in this respect the idea of the South Australian branch of the British Science Guild has certainly borne fruit.

It would be well for us to consider in this country whether our agricultural research deals sufficiently with matters "beyond experimental farming." Experimental farming in its narrower sense can only lead to improvements in detail. Research work of a more fundamental character is required in agriculture as in other industries. The schemes adopted since the beginning of the war provide for such research work in connection with our manufactures, but it is not sufficiently clear that we intend to give the necessary attention to fundamental research bearing on agricultural pursuits.

THE ERADICATION OF SLEEPING SICKNESS FROM PRINCIPE.[1]

PRINCIPE is one of a group of four islands in the Gulf of Guinea. It is 17 kilometres long and 10 kilometres wide, and is 200 kilometres distant from the mainland. The main export of the island is cacao; sugar-cane, coffee, and palm kernel being practically negligible. For the cultivation of the cacao crop labour has been imported in the past from the African mainland. In all probability among these labourers there would be cases of sleeping sickness. These in themselves would constitute no danger to the island population or to their uninfected fellow-labourers, but in Principe unfortunately the carrier tsetse-fly, *Glossina palpalis*, also existed, and sleeping sickness mortality became so great that the economic life of the island was gravely menaced. The annual mortality was about 200 in a population of 3800 (average), so that in twenty years the mortality would be in excess of the total population.

How and where the fly was first imported (if it were so) is a matter of conjecture, but it is thought that this occurred in 1825 with the importation of cattle and slaves, and though so far as we are aware there are no other records of the fly putting to sea, Fernando Po, 40 kilometres from the coast, is also fly-infested, whereas San Thomé, 130 kilometres south-west of Principe, is free from fly and likewise from sleeping sickness. As regards the distribution of the fly in the island, it is practically identical with that of the wild pigs. Neither is found higher than 250 metres above sea-level. In the case of the pig this distribution is determined by that of the oil-palm, on the fruit of which the pigs feed; but how far it is a case of the fly following the pig, or the latter finding security in the haunts of the fly, is a matter of some doubt.

The section of the work dealing with the trypanosomes of various animals, pig, ox, mule, dog, is unfortunately incomplete. A dimorphic trypanosome—that is, one showing flagellar and aflagellar forms—was found in the ox, dog, and mule, but its identity is not established. It may be the dimorphic trypanosome common in cattle in Africa, *T. ugandae* (dimorphic form of *T. brucei*), or it may be *T. gambiense*, though cattle are not definitely established as hosts of this trypanosome of man. Whether, too, the human trypanosome of Principe is a special variety of *T. gambiense* must remain doubtful, as the fallacies of the biometric method of distinguishing trypanosomes introduced by Bruce and here adopted are so many that its usefulness is problematical. This book gives an account of the results obtained by the third mission dispatched to study sleeping sickness by the Portuguese Government, the first having set to work in 1871. Knowledge of the subject has increased greatly since that time, when indeed the cause of the disease was unknown, but the last mission was so successful in the practical application of this knowledge that the disease,

[1] "Sleeping Sickness. A Record of Four Years' War against It in the Island of Principe." By B. F. Bruto da Costa, J. F. Sant' Anna, A. C. dos Santos, and M. G. de Araujo Alvares. Translated by Lieut.-Col. J. A Wyllie. Pp. xii+260. (Published for the Centro Colonial, Lisbon by Baillière, Tindall and Cox London. 1916. Price 7*s.* 6*d.* net.

or, to be strictly accurate, the carrier of the disease, has been stamped out in the island.

The methods used for getting rid of the fly comprised:—(1) Clearing of vegetation, felling of forest, clearing of woodlands and secondary jungle growth, so as to admit light and air into the haunts of the shade-loving tsetse. (2) Drainage of swamps and clearing of the banks of streams. (3) Extermination of pigs, dogs, and cattle.

For the protection of those at work in the fly areas the Maldonado method of trapping the fly was adopted. The members of the fly brigade wore canvas, back and front, covered with a viscid preparation made in Reading. (It would appear to be composed, like fly-papers, largely of boiled linseed oil.) By this means at the beginning of the campaign as many as 500 flies could occasionally be caught by a single man in a day, and the average caught by the gang was about 17,000 a month in 1911, less than 6000 a month in 1912, while in the first three months of 1914 only 14 flies were caught by 297 men, and in the last nine months of the year none.

The mission is to be congratulated on the success of its efforts. J. W. W. S.

CLEMENT REID, F.R.S.

THE death of Mr. Clement Reid on December 10 is a severe loss alike to geological and to botanical science. Born on January 6, 1853, Reid joined the Geological Survey in 1874, and began field-work in the south-west of England, but was soon transferred to the eastern counties. Here, in mapping the Cromer Forest Bed and other plant-bearing formations exposed on the coast, he entered upon the investigation of our Pliocene and Pleistocene flora, which thereafter he pursued with characteristic enthusiasm and ability throughout his life. Devising ingenious methods for separating out the seeds of plants from any material in which they lay hidden, he showed the significance of these inconspicuous fossils as indicators of past climate; and he soon became recognised as our leading authority on this subject. In the "Cromer" memoir of the Geological Survey (1882) he firmly established his capability both as an investigator and as an expositor. His next field-work was in Yorkshire, first on the north-eastern moorlands and then in the Holderness country, after which it was carried southward into Lincolnshire, the results being published in the "Holderness" memoir (1885). This done, he was sent to map the South Downs and the coastal tract of Sussex; and he worked westward thence through Hampshire and part of the Isle of Wight into Dorset and Wiltshire, describing this country in several more memoirs, published between 1898 and 1903. Meanwhile, he had also produced a collective "General" memoir on the Pliocene deposits of Britain (1890), during the preparation of which he visited Belgium and North Italy for the study of the equivalent deposits there.

Besides his official work, Reid had by this time contributed many notable and widely discussed papers to scientific societies and periodicals, dealing mainly with the palæobotany of the later geological periods; with the climatal conditions indicated by geological formations; and with subjects in the debatable territory where geology and archæology meet. In 1899 he summed up his knowledge of past botanical conditions in a book full of acute observation and suggestion, entitled "The Origin of the British Flora"; and, in 1913, he dealt similarly, in a small book, with our "Submerged Forests." His critical study of the fossil Characeæ, in collaboration with Mr. J. Groves, of which the first-fruits are in course of publication, has now been lamentably arrested.

In his later researches Reid was ably assisted by his wife (previously Miss E. M. Wynne Edwards), joint-author with him in his description of the interesting Pliocene flora of Tegelen, Holland, and in several other botanical and geological papers.

On his advancement to the post of district geologist in 1901, Reid was placed in charge of the Geological Survey work in Cornwall and Devon, and afterwards in the south-eastern district around London. On retiring from official duty early in 1913, he went to live at a chosen spot at Milford-on-Sea, overlooking the Solent, and died there, after a short illness.

In recognition of his work, Reid was awarded by the Geological Society the Murchison Fund in 1886, and the Bigsby Medal in 1897; and by the Royal Geological Society of Cornwall, the Bolitho Medal in 1911. He was elected a fellow of the Royal Society in 1899. He served terms of office on the council of the Linnean Society and of the Geological Society, being vice-president of the latter from 1913 to 1916. He leaves a widow, but no children.

WILLIAM ELLIS, F.R.S.

FOR the third time in about six months the Royal Meteorological Society has to mourn the loss of a past president. Mr. William Ellis was born at Greenwich on February 20, 1828, and succumbed to heart failure on December 11 at Blackheath, having spent nearly the whole of his long life in the immediate neighbourhood of the Royal Observatory. His father, Henry Ellis, was an assistant there, and he himself began work there as a boy computer in 1841. After several years' experience as an astronomical observer, he left in 1852 to take charge of Durham Observatory, returning in 1853 when a vacancy occurred on the staff at Greenwich. He was attached to the Time Department, and soon afterwards had charge of it, including the galvanic batteries and circuits, but after eighteen years' superintendence of that work, and more than twenty years as a regular astronomical observer on the staff, he was transferred, on Glaisher's retirement, to the Magnetical and Meteorological Department, of which he was superintendent for nineteen years, until his retirement at the end of 1893, in which year he

was elected F.R.S. During his short stay at Durham he communicated results of his observations of minor planets to the Royal Astronomical Society, following them up with further contributions, and was elected a fellow of the society in 1864. Soon after succeeding Glaisher in 1875, he became a fellow of the Royal Meteorological Society, and was president in 1886 and 1887, also serving as official referee for papers for nearly thirty years.

The most important Greenwich publication associated with Ellis's name is that which deals exhaustively with air temperature for fifty years, 1841–90, in the production of which he did a very great amount of hard work in rendering the earlier observations comparable with those taken under his own superintendence. But he is probably better known in connection with his contribution to the Philosophical Transactions of the Royal Society for 1880, in which he showed for the first time a relation between sun-spot frequency and terrestrial magnetic disturbance, a subject which he followed up with further contributions to the R.A.S. Monthly Notices. He strongly objected to the notion that the moon affects the weather, and so long ago as 1867 maintained in the *Philosophical Magazine* that the idea of the moon's clearing away clouds was nothing but a poet's fancy. To the subject of cloudiness he returned later, dealing in one of his presidential addresses to the Royal Meteorological Society with seventy years' cloud observations at Greenwich. His association with the Time Department is reflected in a highly interesting article in the Monthly Notices of the Royal Astronomical Society dealing with the rating of several clocks destined for use during the observations of the transit of Venus in 1874, in which he showed that the oscillation of one pendulum was distinctly affected by that of another in the vicinity, especially if the clocks were mounted on the same stand.

Ellis was a frequent contributor also to the Quarterly Journal of the Royal Meteorological Society, and for many years a member of the Institution of Electrical Engineers, in connection with which he investigated the effect of the City and South London Electric Railway trains on the earth-current registers at the Royal Observatory. He was keenly interested in the new magnetic instruments introduced at Greenwich by the present Astronomer Royal, which he was unfortunately unable to see for himself, as his sight had practically failed for some years before his death. He insisted to the last on attending the annual visitation of Greenwich Observatory, putting in his seventy-fifth consecutive appearance at that function last June, but no one who saw him then can be surprised that it was his last visitation day. He was able to appreciate a reference in the current issue of the *Observatory* magazine only a few days before his death, but had been for some weeks confined to his bed, though suffering from no specific ailment of any great importance. Though twice married he had no children, but he leaves a widow. He was buried at Charlton Cemetery on Saturday, December 16. W. W. B.

NOTES.

By the will of the late Mr. Percival Lowell, a fund amounting to 10 per cent. of the income of his total estate of a million dollars is set apart for the maintenance of the Lowell Observatory at Flagstaff, Arizona, to be used especially for "the study of our solar system and its evolutions." It is specified that the observatory is never to be merged or joined with any other institution. The fund devoted to this purpose is to be held in trust by the late astronomer's brother-in-law, Mr. W. Lowell Putnam.

We regret to announce the death on December 14, at seventy-three years of age, of Prof. T Purdie, F.R.S., emeritus professor of chemistry in the University of St. Andrews.

Capt. C. Bathurst has been appointed Parliamentary Secretary of the Food Control Department in the new Ministry, and not of the Board of Agriculture, as was expected last week. This office is held by Sir R. Winfrey, who occupied the same post in 1906–10, when Earl Carrington was Minister of Agriculture.

The death is announced of Dr. Hugo Münsterberg, since 1892 professor of psychology, and director of the psychological laboratory, Harvard University.

Mr. W. Kewley has been appointed secretary-superintendent of the Middlesex Hospital in succession to the late Mr. F. Clare Melhado.

Dr. A. Yersin, director of the Pasteur Institute of Indo-China, has been awarded the Lasserre prize for the present year for his work on anti-plague serum.

It is announced in the issue of *Science* for November 17 that the American Academy of Arts and Sciences on November 15 presented the Rumford medals to Dr. C. G. Abbot, of the Smithsonian Institution, for his researches on solar radiation.

We learn from the *Times* that Sub-Lieut. O. J. Hobbs, previously reported missing, is now reported killed on or about November 13. At the outbreak of war he was science master at the King Edward VI. Grammar School, Southampton. Announcement is also made that Lieut. J. C. Simpson, R.E., an associate of the Royal School of Mines and a fellow of the Geological Society, was killed on December 4.

We regret to note that *Engineering* for December 15 records the death, on December 11, in his sixty-fourth year, of Mr. Archibald Colville, the chairman of Messrs. David Colville and Sons, Ltd., the well-known steel-makers of Motherwell. Mr. Colville was chairman of the Scottish Steel Makers' Association, and was a member of the Board of Trade Iron and Steel Industries Committee.

A fund is being raised to purchase the very valuable scientific library of the late Prof. Silvanus Thompson and to present it to the Institution of Electrical Engineers as a memorial of his life and work, the library to be accessible to the public on the same conditions as the Ronalds Library. Those who wish to subscribe to this fund or to have further information regarding it are requested to communicate with Mr. W. M. Mordey, 82 Victoria Street, London, S.W.

At a recent meeting of the Anatomical Society of Great Britain and Ireland the following members were appointed to edit and manage the *Journal of Anatomy*:—Prof. T. H. Bryce, University of Glasgow; Prof. E. Fawcett, University of Bristol; Prof. J. P. Hill, University College, London; Prof. G. Elliot Smith, University of Manchester; and Prof. A.

Keith, Royal College of Surgeons of England—the last-named to serve as acting editor. At the same meeting a unanimous vote of thanks was given to Prof. Alex. Macalister, F.R.S., for the able manner in which he had managed and edited the *Journal* in past years and for his generosity in transferring its control to the Anatomical Society.

AN expedition in the interests of the Smithsonian Institution will leave shortly for the French Congo and certain of the neighbouring parts of West Africa. It will be known as the "Collins-Garner Congo Expedition, in the interests of the Smithsonian Institution," and will be headed by Mr. A. M. Collins, of Philadelphia, a well-known explorer and sportsman, who has made several trips to Africa and other regions in search of big game. Mr. R. L. Garner, of New York, who has already made extensive investigations concerning the apes and monkeys of Central Africa, is manager of the expedition. The other members of the party are Prof. C. W. Furlong, of Boston, and Mr. C. R. W. Aschemeier, of Washington, who represents the Smithsonian Institution as collector of natural history specimens for the United States National Museum. The natural history collections will go to the United States National Museum.

THE trustees of the Elizabeth Thompson Science Fund announce their readiness to consider applications for grants in aid of scientific work. Appropriations are restricted to non-commercial enterprises, and are intended solely for the actual expenses of the investigation, not for the support of the investigator or for the ordinary costs of publication. Grants are made only for those researches, not otherwise provided for, the object of which is, broadly, the advancement of human knowledge; requests for researches of a narrow or merely local interest will not be considered. Usually grants are not made in excess of three hundred dollars. Applications for grants from this fund should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The application should be sent to the secretary of the board of trustees, Dr. W. B. Cannon, Harvard Medical School, Boston, Mass., U.S.A., who will furnish further details.

MUCH is being done all over the country to provide entertainment for our soldiers, but the Scientific Society of the Birmingham and Midland Institute appears to have opened up a somewhat new line. On a recent evening many members and friends of the society visited the Y.M.C.A. Hut at Sutton Coldfield to give the convalescents stationed there a "Popular Science Evening." The tables were crowded all the evening, and the soldiers evinced the greatest interest in the exhibits and experiments. Exigencies of time had been carefully considered, so that the preparations in the room took only about half-an-hour, whilst an even shorter time served for clearing away. The following list of some of the exhibits may be a useful guide to other societies desirous of organising similar exhibitions:—"Rainbow Cup," showing colours of very thin soap films; Cartesian diver; radiometer; spontaneous combustion; shocking coil; fire from flint, steel, and tinder; floating magnets under a controlling magnet; diffusion figures, formed by the spreading of dyes in blotting paper; harmonigraph (four-phase); several microscopes; gyroscope, spinning eggs, etc.; resonance experiments with tuning forks, resonators, swinging balls, etc.; soap bubble experiments.

IN an address before the opening meeting of the Illuminating Engineering Society on December 15 Mr. L. Gaster referred to the great loss which the society had sustained in the death of Prof. Silvanus P. Thompson. A message of condolence from the Russian Electrotechnical Association, expressing admiration of Prof. Thompson's great gifts, was also read. The address dealt mainly with the problem of war economies in lighting, which, it was suggested, should take the form of avoiding waste of light rather than aiming at indiscriminate diminution. The prejudicial effect of the darkening of the streets was illustrated by the progressive increase in the number of accidents during the past few years, and the economic loss involved in the interference with traffic was considerable. The present methods of screening lamps were in general uneconomical and badly devised, and the conditions varied greatly in different districts. These anomalies appeared to be due to the conflicting claims of different authorities urging respectively the claims of economy, the convenience of traffic and safety, and precautions against hostile aircraft. After two years of war the time was surely ripe for a systematic study of the present lighting conditions and for the establishment of a central authority, acting under expert advice, to determine how these various requirements could best be met.

MR. J. REID MOIR has sent us, as an excerpt from the Proceedings of the Prehistoric Society of East Anglia (vol. ii., part ii., for 1915–16), a paper on a series of pre-Palæolithic implements recently discovered at Darmsden Hall, Suffolk, a place about eight miles north-west of Ipswich. The sand underlying the pebble-bed is at present undatable, but the deposit was laid down prior to the excavation of the Gipping Valley, and the pebbles were deposited from the Woolwich and Reading beds. These Darmsden implements, which are precisely the same as the sub-Crag specimens, are more ancient than the Pliocene Red Crag, and can therefore be referred to an early phase of the pre-Palæolithic period. The human origin of the chipping is said to be certain. There is no evidence that they were fractured in the bed in which they are now found, and they show no signs of pressure flaking or scratches, the result of moving pressure. They have obviously been flaked by blows, and the angles at which the flakes were moved show that such blows were intelligently directed.

IN the *Psychological Review* (vol. xxiii., No. 6) K. S. Lashley raises the problem of the importance of the human salivary reflex. He points out that the experiments of Pawlow have provided a method of investigation which has proved useful in the study of the sensory physiology of animals, and promises to be even more valuable in revealing fundamental factors of habit formation and of central inhibition and reinforcement. He suggests that an extension of the method to man is desirable, as in the few attempts already made to investigate the conditioned salivary reflex in man the results are not in harmony with one another, due probably to differences in technique and interpretation. The ease with which the quantity of secretion of the salivary glands can be measured, the consistency of their reactions, and their relative freedom from inhibition, make them especially promising for studies of the relation of the intensity of the stimulus to the organism, which studies have hitherto been restricted to the elaboration of the laws of psycho-physics.

A SYSTEMATIC entomological paper of much interest is one on the Dermaptera and Orthoptera of the coastal plain and piedmont region of the south-eastern United States by J. A. G. Rehn and M. Hebard (Proc. Acad. Nat. Sci., Philadelphia, lxviii., part 2).

The district studied extends over Virginia, the Carolinas, Georgia, and northern Florida, ranging from the Appalachian summits to the sea-level. Lists of species characteristic of the various regions are given, and in the systematic part of the paper variation is studied so far as possible in relation to geographical conditions.

"A SYSTEMATIC Account of the Prairie-Dogs," by N. Hollister, has lately been issued (No. 40, "North American Fauna," U.S. Dept. Agric. Biol. Survey). The genus Cynomys is divided into two subgenera and five species, in the descriptions of which nearly 900 specimens have been utilised. There are comparative photographs of skulls and distributional maps. It seems a pity that in valuable zoological memoirs such as this the ridiculous misnomer "dog" should be stereotyped for these animals, which, according to the author, are "true ground-squirrels, or spermophiles."

A CATALOGUE of the earthquakes felt in the Philippine Islands in the year 1915 has recently been published in the U.S. Weather Bulletin. The number of shocks recorded during the year is 170, only forty-eight of which reached the degree 4, or a higher degree of the Rossi-Forel scale, though fifty-seven were registered at the Manila Observatory. One earthquake, which occurred on March 12 in south-east Luzon, though it attained an intensity of only 6–7 (that is, of less than destructive intensity), disturbed an area of about 45,000 square miles, and was recorded at seismological observatories all over the world.

CAPT. GOURLAY'S note on a phosphorescent centipede, recorded in NATURE of November 23 (p. 233), has elicited some further facts worth putting on record. They have been sent us by Mr. S. Priest, hon. sec., Dartford Naturalists' Field Club, and relate to the experiences of members of the club residing at Stone and Dartford. He cites two cases of centipedes, seen during October and November, emitting a trail of light as they crawled along, and exuding phosphorescent matter on to the fingers when handled. Another specimen left "trail-like drops of green light" behind it. The light in this case was so brilliant as to show through the handkerchief in which it was placed after capture. Finally, Mr. Priest cites a case of this luminosity persisting in a crushed specimen.

THE purification of oyster-beds by means of chlorinated water has formed the subject of experiment by the Board of Fish and Game Commissioners, California. According to *California Fish and Game* (vol. ii., No. 4), a trace of calcium hypochlorite can be passed through the gills and alimentary canal of the oyster without any detrimental effect upon the animal, while any water-borne disease, such as typhoid, is effectually destroyed. In the same issue it is urged that more use should be made of the immense quantities of the edible mussel to be found along the rocky shores of Humbolt County. Not only, it is insisted, do they provide a most nutritious food when eaten in the fresh state, but they are scarcely, if at all, less palatable when pickled. Finally, protective measures have been framed for the "Alabone," or Haliotis, which has been almost exterminated for the sake of its shell. It is urged that this mollusc can be made to produce pearls of extreme beauty by inserting foreign bodies between the mantle and the shell.

BULLETIN No. 61 of the Agricultural Research Institute, Pusa, gives an interesting review by Mr. A. Howard of the bearing of soil aeration upon crop production, with especial reference to the agriculture of India. Striking illustrations of the importance of this factor have been furnished by the experimental work of recent years in that country. The requirements of nodule-producing leguminous crops for supplies of nitrogen and oxygen in the soil render soil aeration a factor of obvious importance in their growth, and experience with the gram and indigo crops and in the general practice of green manuring fully bears this out. The distribution of gram in India follows the occurrence of well-aerated soils. Experiments at Pusa have demonstrated that the growth of gram in deficiently aerated soil can be greatly improved by the simple expedient of incorporating considerable quantities of tile fragments with the soil. The indigo plant provides an even more striking instance of dependence upon soil aeration, and much of the money expended in attempts to improve the production of natural indigo might have been saved had more attention been paid to the needs of the plant in this respect. Soil aeration has been shown also to have an important bearing upon the maturation and quality of grain, fruit, vegetables, and tobacco. Various practical applications of soil aeration are indicated, including more rational irrigation, manuring, improvement of crops and cattle, and the development of wheat and rice areas. With efficient aeration adequate nitrogen supplies can be derived directly from the air by bacterial activity, whilst soil fungi will liberate supplies of available phosphates and potash.

THE twelfth memorandum of the Health of Munition Workers Committee deals with the output of munition workers in relation to hours of work, and the question has been investigated from a statistical point of view by Dr. H. M. Vernon. It was found that, when the number of working hours per week was increased beyond a certain level, the output was not correspondingly increased, but tended to fall off owing to the occurrence of "broken time" from sickness or fatigue. The number of working hours per week which yielded the maximum output varied with the character of the work. For moderately heavy labour, the maximum output was attained with sixty hours' work a week, whereas those engaged in light labour worked as much as seventy hours a week in order to reach their maximum output. Dr. Vernon points out that the production of a maximum output day after day by the worker must impose a considerable strain, and that in many cases the strain became too great to be borne and the worker had to drop out altogether. Hence the optimum length of the working week, suited for peace times, is considerably shorter than that mentioned, although the principle of graduating the number of hours to the type of work performed still holds good. The memorandum also gives instances of considerable delay in starting the day's work and of a similar slackening just before the day's work ceases, and it is pointed out that the elimination of these causes of lost time would increase the worker's output without lengthening his working day.

THE September number of *Terrestrial Magnetism and Atmospheric Electricity* contains the results of the measurements of the deviation of the magnetic compass from true north made by the survey ship *Carnegie* during her circumnavigation of the Antarctic continent between December, 1915, and June, 1916. The great bulk of the observations relate to latitudes between 50° and 60° south, but in the neighbourhood of Australia many observations were taken north of this belt. According to the new survey, the British Admiralty Chart gives the deviation to the west in the South Atlantic a fraction of a degree too great, and the error south of the Cape of Good Hope rises to 6°. In the south of the Indian Ocean the chart over 10°

of longitude gives the deviation to the west 3° too small. South-west of Western Australia it is in error by 10° in the same direction. South of Australia it agrees with the new observations to within a small fraction of a degree. East of New Zealand there are a few points where the deviation to the east is given in the chart a degree or more greater than it is. In the middle of the South Pacific there is a considerable region over which the chart gives the deviation to the east 2° or 3° too small, while south of Cape Horn it is in fair agreement with the new observations.

IN an address recently delivered to the Western Section of the Institution of Electrical Engineers, the chairman, Dr. D. Robertson, compared the field of scientific knowledge to a goldfield. The first-comers acquire the surface veins and nuggets with comparative ease and with the crudest equipment, but their successors must expend more and more preliminary labour without immediate result, and they must possess more and more knowledge if these labours are not to prove abortive. In the field of research we are past the first stage, and the investigator now must go through a long preliminary training and have behind him resources sufficiently great to support him during the non-productive period. We shall, Dr. Robertson said, never get a sufficient number of men of the right temperament until we offer them prospects comparable with those open to the other learned professions. Dr. Robertson insisted also on the necessity of the scientific man keeping in constant touch with the manufacturing side, if only by weekly visits to the workshops and chats with the managers and foremen. The remainder of his address was devoted to a consideration of new sources of energy for the time when our coalfields are exhausted. He estimated that a dam eight miles long across the Bristol Channel would furnish a million kilowatts of tidal power, and that one at a lower part, thirty miles wide, would give ten million kw. Another suggestion he put forward for consideration was that we should "grow our fuel"—that is to say, produce a plant of high calorific value suitable for use directly as fuel, or indirectly by distilling alcohol or other spirit from it, or, better still, by taking up the energy electrically from the plant so as to save the thermodynamic losses of the heat engine.

THE Hardness Tests Research Committee of the Institution of Mechanical Engineers presented a report on November 17 giving particulars of tests made at the National Physical Laboratory by Dr. T. E. Stanton. After some preliminary investigations, it was decided to devise a wear test which would apply to cases in which the relative movement of the surfaces was considerable, and thus enable results to be obtained which would give information regarding shafts, or pins, working at high speeds under heavy loads. In the machine used, the specimen (diameter d) was revolved, and the load applied by means of an abrading ring (internal diameter D); by means of an Oldham coupling, both specimen and ring revolved at the same speed, hence in each revolution the slip of the ring over the specimen was $\pi(D-d)$. Abraded particles were removed by a strong air-blast. The wear was expressed as thickness of surface layer worn away in mils per 1000 ft. of slip, and the relative resistance to sliding abrasion as the reciprocal of this number. The results of the entire investigation show that the Brinell hardness number divided by 6 is approximately equal to the scleroscope number; the characteristic which distinguishes sliding abrasion from rolling abrasion is that the former does not cause any perceptible hardening of the surface under wear as the test proceeds. Comparison of the results for the resistance to sliding abrasion with the Brinell hardness numbers shows that the Brinell numbers are not a safe guide in predicting relative resistances to wear of a miscellaneous selection of steel. The report forms a valuable contribution to our knowledge of this important practical subject.

ON Friday, December 15, the inaugural address to the Royal College of Science Chemical Society was delivered by Prof. Gilbert T. Morgan, the subject of his lecture being "Synthetic Chemistry and the Renascence of British Chemical Industry." Prof. Morgan congratulated the society on having this year reached its twenty-first anniversary, and referred to the developments which had taken place in the Royal College of Science since the foundation of the society by Sir William Tilden in 1895. Affiliation with the Imperial College of Science and Technology had given an increased bias to the college curricula in the direction of applied science, and the war had since revolutionised existing ideas as to the national importance of synthetic chemistry. Two chemical crises had arisen; first, the industrial dislocation produced by the stoppage of German dyes; and, secondly, the shortage of high explosives. These crises pointed the same moral, the vital importance to the nation of a well-organised coal-tar industry. This essential development can be attained only by the employment of large staffs of well-trained chemists. The prizes of the chemical profession will be greater, but the competition keener, than has hitherto been the case. The student can best prepare for this strenuous struggle by undergoing a thorough training in analytic and synthetic chemistry. On the practical side, he should aim at perfection in all the laboratory arts. On the theoretical side, he should endeavour to acquire that particularly chemical outlook sometimes termed "the chemical instinct," which is gained by a careful study of molecular theories of constitution, and especially of stereochemical relationships. If time permits, some knowledge of the industrial applications of chemical products will be a valuable addition to his fund of knowledge, and an acquaintance with the elements of mechanics and machine design will tend to render more harmonious his relations with his future works colleague, the engineer. The value of researches in synthetic chemistry, both inorganic and organic, was emphasised by many instances of recent date. Chemical synthesis moves forward unceasingly, and progress over one difficulty leads to many fresh advances at different points along the line. In order to ensure the willing co-operation of many trained workers, it will be necessary to introduce the collegiate spirit into our chemical factories and technical laboratories, so that the splendid team work displayed by our new armies in the field may be rendered available for industrial developments.

THE first number of *Air*—the official organ of the Aeronautical Institute of Great Britain—has just been issued. It is hoped that this publication may stimulate public interest and encourage the study of aeronautics. Articles are included on the Air Board, by L. Blin Desbleds; on the cost of a pre-war aerial misconception, by A. J. Liversedge; and on the steel construction of aeroplanes, by G. C. Loening.

THE following volumes have been arranged for, for appearance in the "Fauna of British India" Series (London: Taylor and Francis):—"Butterflies (Lycœnidæ and Hesperiidæ)," H. H. Druce; the "Longicorn Beetles," C. J. Gahan; the "Ixodidæ and Argasidæ," C. Warburton; "Leeches," W. A. Harding; the "Brachyurous Crustacea," Lieut.-Col. A. Alcock; the "Apterygota, Termitidæ and Embiidæ," A. D. Imms; the "Diptera Brachycera," E. Brunetti; the "Rutelidæ," G. J. Arrow, and the "Operculata," G. K. Gude.

OUR ASTRONOMICAL COLUMN.

RÖMER'S DISCOVERY OF THE VELOCITY OF LIGHT ("Om Ole Rømers Opdagelse of Lysets Tøven": Høst & Søn, København).—When Römer in 1676 announced to the Paris Academy his discovery of the gradual propagation of light from observations of the first satellite of Jupiter in the course of eight years, he gave no details as to these observations. He merely stated that the period of revolution of the satellite deduced from immersions in the shadow of Jupiter (when the earth is approaching Jupiter) was always shorter than the period found from emersions observed when the earth was receding from the planet. The result was that light took about twenty-two minutes to travel over the diameter of the earth's orbit. (It appears from a letter to Huygens that this was found from observations made in 1671–73.) The only observation quoted in the short paper was one of an emersion on November 9, 1676, at 5h. 35m. 45s. p.m., ten minutes later than was calculated from observations in the previous August, as predicted by Römer in the beginning of September. Three years ago a sheet was found in the University Library at Copenhagen on which was written in Römer's hand a list of eclipses of the satellites observed in the years 1668–77. In a paper published in the Transactions of the Danish Academy of Sciences Mrs. Kirstine Meyer discusses these observations in order to find whether they represent a part of the material on which Römer's discovery was based, and shows that this is really the case. It is shown by several examples that the observations of 1671–73 give, in fact, the approximate result announced by Römer, but that the single results differ a good deal. It is interesting to see from some figures jotted down by Römer in the MS. in question that among the values found by him for the time light takes to pass from the sun to the earth is also the correct one of about eight minutes, but he probably rejected this result as founded on rather short intervals of time. The author calculates the amount resulting from the published observation of November, 1676, and finds that it is eight and a half minutes. Curiously enough, Newton, in his "Optics," gives eight minutes, though the only result published by Römer was about eleven minutes.

PARALLAXES OF TWO STARS WITH COMMON MOTION.—Some time ago it was found by Adams that the two stars, A.Oe. 14318 and 14320, though separated by 5′ in declination, had remarkably similar proper motions and radial velocities. The parallaxes and proper motions in R.A. of these interesting objects have since been determined by O. J. Lee from plates taken with the 40-in. refractor of the Yerkes Observatory (*Astronomical Journal*, No. 697). The resulting parallaxes are 0·025″ ± 0·008″ and 0·061″ ± 0·012″, and the proper motions in R.A. −0·0699s. and −0·0692s. respectively. More trustworthy determinations of proper motion by Prof. J. G. Porter give the total motions as 3·693″ in the direction 195·7°. and 3·675″ in the direction 195·6°. The difference of parallax, amounting to 0·036″, agrees well with the value 0·031″ previously given by Russell, and the evidence that the two stars are very widely separated in space, while having practically identical motions both in and across the line of sight, is now fairly conclusive. It may be recalled that the two stars are of magnitudes 9·6 and 9·2, and of types G4 and G5 respectively. The radial velocities are exceptionally great, being +307 km./sec. and +295 km./sec., according to the observations of Adams, and the difference is probably not greater than the errors of observation in the case of such faint stars. The two stars have the same R.A., 15h. 5·5m., while the declinations are −16° 2·5′ and −15° 57·5′.

THE DIRECT JOINING OF GLASS AT MODERATE TEMPERATURES.

IN a paper presented to the Faraday Society on December 18, Messrs. Parker and Dalladay described some interesting experiments on the direct joining of glass at relatively low temperatures which they have carried out in the research laboratories of Messrs. Adam Hilger, Ltd. The results described are not only of very considerable direct scientific interest, but afford great practical advantages in the construction of glass apparatus out of what is actually a single solid piece instead of using more or less unsatisfactory cements. The advantage of such solid construction is particularly evident in polarimeter tubes and absorption cells—the latter can now be constructed with truly parallel faces and with inside faces optically worked. The process of joining which the authors have worked out consists in placing the surfaces of glass to be united in good optical contact under pressure, and then raising the temperature to a carefully determined degree. The glass surfaces thus treated become perfectly united, so that the two pieces of glass will not separate along their former interface, and the composite piece acts as if it were a single solid mass; even a crack or a diamond-cut will pass through the junction without hindrance or deflection. The temperature employed is chosen as high as possible in order to lessen the time required for union of the surfaces, but if distortion of the optically worked surfaces is to be avoided, then the temperature must not be taken too near the limit, which the authors describe as the "annealing point." This point they determine by observing the strains set up in a piece of glass while being heated at a definite rate in an electric-tube furnace; for each kind of glass they find that these internal stresses—which are readily observed by means of polarised light—disappear quite suddenly. At this point, also, the glass becomes appreciably soft, and can be indented by a sharp tool. When similar kinds of glass are used, having similar "annealing points," then the welding of surfaces in optical contact takes place well below this annealing point. Very dissimilar glasses, however, cannot well be joined, since the softer becomes distorted before the harder is hot enough to weld freely.

THE EXPLOITATION OF INSHORE FISHERIES.[1]

MANY advisory and other committees, some in connection with the great Government departments and others among the leading scientific societies, are at present engaged in deliberations in regard not only to immediate and pressing war problems, but also to the later, and possibly equally important, after-war questions, which are bound to arise, affecting the prosperity of the country and the maintenance of the Empire. A large number of these matters turn upon the application of scientific knowledge and scientific methods to various industries, and amongst these not the least important are those concerned with the allied subjects of agriculture and aquiculture, or the scientific regulation and cultivation of our land crops and our sea-fisheries.

It is recognised that, with the view of making a rapid recovery from the effects of the war, amongst other things, agriculture and allied industries must be promoted, and it must be seen to that no suitable land is wasted, that none is applied to the wrong purpose, and that the most favourable treatment to ensure the best results is given to each area. In fact, a more

[1] Introductory address (abridged) given by Prof. W. A. Herdman, F.R.S., in opening the discussion on Inshore Fisheries in the section of Zoology of the British Association at Newcastle-upon-Tyne on September 7.

systematic study and more intensive cultivation of the land must be made. In quite a similar way, and for no less important reasons, the harvest of the sea must be promoted, the fisheries must be continuously investigated, and such cultivation as is possible must be applied to our barren shores. All such fisheries cultivation is one of the natural applications of biological science, and ought therefore to be supported and directed by the members of this section and other marine biologists.

Now that considerable areas of the British fishing grounds are either closed to trawlers or impracticable for the usual fishing operations, any increase of employment on the seashore and in shallow waters round the coast may be of direct and immediate advantage both to the men and to the country. Such industries as shell-fish cultivation, shrimping and prawning, whitebait and sprat fishing, and herring fishing and curing, if extended and exploited judiciously, will add to employment, will increase the food supply of the country, and may lead to the establishment of permanent industries of a profitable nature. On the west coast the Lancashire and Western Sea-Fisheries Committee has been alive to such possibilities for some time past, and much of its scientific fisheries work has been directed towards showing the improvements that might be introduced in connection with the local shell-fish industries. It has been shown in its annual reports how mussels and cockles can be fattened and greatly increased in value by transplanting to better feeding grounds, and how, if reared in sewage-polluted waters, they can then be cleansed and purified before being sent to market. The Lancashire Committee, realising the present opportunity of helping such deserving industries, has worked out several concrete cases where a moderate expenditure, either in transplanting or in purifying the shell-fish, or both, would be likely to give immediate beneficial results, and so far as opportunity offers it is endeavouring to promote such useful work.

This is not a time when it is easy to induce public bodies to undertake any fresh expense, but it will be unfortunate for the country if such directly productive expenditure, which may reasonably be expected to lead to the establishment of permanent shell-fish industries, be prevented or delayed for want of the comparatively small sums which are necessary to start the work.

As an example of what can be done at a small cost to improve the value of shell-fish by judicious transplanting, the work of the Lancashire and Western Sea-Fisheries Committee in 1903–5 may be cited.[2] It was carried out on the mussel beds at Heysham, in Morecambe Bay, probably the most extensive mussel-producing grounds on the west coast of England.

In 1903 the committee gave a grant of 50*l.* to be expended on labour in transplanting overcrowded and stunted mussels, which were not showing any growth, to neighbouring areas which were not so thickly populated. The result was most striking. Mussels, which in their original condition could never have been of any use as food, had been turned into a valuable commodity at comparatively little trouble and expense. The money value to the fishermen of these mussels that had been transplanted for 50*l.* was estimated a few months later to have been at least 500*l.* In 1904, again, a grant of 50*l.* resulted in the transplanting of under-sized mussels, which were later on sold at a profit of more than 500*l.* In the following year (1905) a grant of 75*l.* resulted in the sale of the transplanted mussels some months later for 579*l.* On that occasion more than 240 tons of the under-sized mussels had been transplanted in six days' work. It was found that on the average the transplanting increased the bulk of the mussels about two and a half times, and the increase in length to the original shell was in some cases well above an inch.

Experiments have also been made on the Lancashire coast in the transplantation of cockles from overcrowded to less crowded sands with equally favourable results.[3]

It is obvious that when, on the conclusion of war, many men return to work along our coasts any increase of employment in connection with such local fishing industries will be of direct and immediate advantage to the country. It is to be hoped that nothing will be allowed to interfere with this transplantation and purification work, and that whenever possible further funds will be devoted towards the promotion of schemes which seem desirable, if not, indeed, essential, from the point of view of the industry and of public health alike. In connection with the public health aspect of the matter, much of Dr. Johnstone's work on the Lancashire coast for some years past has dealt with the condition of the shell-fish beds in relation to sewage contamination, by means both of topographical inspections on the shore and of subsequent bacteriological investigations of samples in the laboratory.[4]

As an example of a local fishery which has been started as the result of a little ingenuity and enterprise, we may take the Morecambe winter sprat fishery which has developed during the last couple of years. The fish are being caught in great quantities by a new method, which is the "stow"-net modified to suit the conditions prevailing in the strong tidal currents of the Morecambe Bay channels. The sprats appear in September, then become very abundant off Morecambe in November, and remain in quantity until the end of January, after which the sprats become smaller and the fishery diminishes in value. During the height of the fishery fully 70 tons of fish were landed per day, and the money value of this catch to the fishermen was more than 300*l.* A ton of sprats contains on an average 130,000 fish. In a day's fishing, therefore, nine millions of sprats may be captured, and this goes on day after day without making any appreciable difference to the abundance of the fish. A full account of this recent fishery and the method of using the "stow"-net is given by Mr. Andrew Scott in the Lancashire Sea-Fisheries Report for 1915.

Another interesting and very profitable local fishery, which has arisen or been resuscitated quite recently in the Irish Sea, is the summer herring fishery off the south end of the Isle of Man. In former days there seems to have been a regular summer herring fishery, but for the last thirty years or so it has failed—the fishermen say because of the absence of herrings, but more probably it is because these men have found more profitable employment on shore. A few years ago a firm of Scottish herring curers was induced to establish a branch at Port St. Mary, and this so stimulated the local fishermen that a fleet was equipped and sent to sea, and a profitable fishery ensued. That was in the summer of 1910, and the same conditions have held good more or less since. But the prices obtained by the men for their catch have fluctuated, notably in accordance with the market facilities and the amount of competition between rival buyers and curers. In 1910–12, with one buyer, the price was 18*s.* the cran; in 1913, with four buyers, the price rose to 40*s.*; in 1914, with two buyers, the price was 30*s.*; in 1915, with four buyers, the maximum price was 91*s.*; while in the present summer (1916), with five rival buyers, the record price of 97*s.* a cran was reached.

From this record of recent years, and from what one

[2] See Lancashire Sea-Fisheries Laboratory Report for 1905.

[3] For further details reference must be made to the successive Annual Reports of the Committee.

[4] All this work has been recorded in detail in recent Annual Reports of the Lancashire Committee.

can ascertain of conditions in the past, it is clear that—in addition to the presence of the fish, which can probably be relied upon in most years—it is necessary for a prosperous herring fishery in the Isle of Man either that a local market should be constituted by competing buyers and curers from Scotland or elsewhere, or that arrangements should be made to transport the daily catch by steam-carriers to a market on the mainland, such as Liverpool, Fleetwood, or Holyhead. As a result of the lack of market facilities, it may be noted that during the greater part of this summer herrings have been sold retail at Port Erin at twenty for a shilling, while in Liverpool they cost from three-halfpence to twopence halfpenny each.

After the war it will for some time probably be just as important as it is now to prevent money from leaving the country, and with a view to this, as well as for other reasons—in brief, the production of food and the employment of men—it is obviously desirable that all home productivity should be organised and stimulated. The exploitation of minor fishing industries along our shores naturally occurs as one step in this direction, and the economic need for developing these deserving industries seems obvious and urgent.

THE LONDON MATHEMATICAL SOCIETY.[1]

IN the midst of the universal cataclysm of the war, when all interests are strained towards the national defence, the London Mathematical Society has passed, without notice, its fiftieth year of activity. The first meeting was held at University College, on January 16, 1865, and heard an address by Prof. de Morgan on the aims and prospects of the society. The de Morgan medal is a reminder for us of his predominant share in the inauguration of the society, which he did not survive long to guide. In the early days the publications consisted of a series of pamphlets separately paged, containing single communications; the names of Sylvester, Cayley, Harley, Tucker occur as authors in the first year. There followed later brief reports of meetings, along with papers by de Morgan, Sylvester, Crofton, Cayley, H. J. S. Smith, Cotterill, and others. These publications now stand as vol. i. of the first series of the Proceedings. With vol. ii., which begins with the annual general meeting of November 8, 1866, the Proceedings became crystallised into a form which has persisted substantially, except as regards size of page, to the present time. The society began operations with twenty-seven original members, nearly all of them members of University College, London; at the end of the first year the number of members was sixty-nine, rising to ninety-four in November, 1866; and the society had already become representative of British mathematical science by having on its roll most of the eminent investigators in our subject belonging to Cambridge and Oxford, as well as London.

On January 15, 1866, it was resolved "That steps be taken to ascertain on behalf of the society whether and on what terms rooms can be obtained at Burlington House," and on November 8 a report was made that "by the kindness of the Chemical Society in lending their rooms, the society had been enabled to hold their meetings at Burlington House, where they now meet for the first time." By 1868 most of the British authorities on pure and applied mathematics of that time, who were resident within reach, including de Morgan, Cayley, Sylvester, Hirst, Crofton, H. J. S. Smith, Archibald Smith, Clerk Maxwell, Spottiswoode, S. Roberts, Clifford, Stirling, had been taking active share in the work of the society by attendance and service on the council, as well as by the contribution of papers for discussion at the meetings. We must not omit from this list Lord Rayleigh, whose memoirs illuminated our Proceedings for many years; who, stimulated by the increasing importance of the society, became the donor of our most substantial benefaction, which has largely increased our resources for publication ever since the early days. In November, 1870, the society migrated to rooms occupied also by the British Association, in the house of the Royal Asiatic Society, 22 Albemarle Street, where accommodation was found for the library, of which a nucleus had been formed by the books of Sir J. W. Lubbock, the physical astronomer, presented by his son, afterwards Lord Avebury; and there by successive forms of tenancy we have remained until now.

For some years past the library, rendered valuable by accumulation of scientific journals through exchange, and by donations of books, has quite outgrown the accommodation available; and weighty complaints became frequent that, by overcrowding, the books had become, notwithstanding the zeal of successive honorary librarians, almost inaccessible to members of the society. The problem, thus pressed upon them from many sides, was taken in hand resolutely by the council during the last session, and after various plans had been proposed and closely considered, a solution was reached.

It came to the knowledge of the council that the Royal Astronomical Society would probably be willing to extend hospitality to the Mathematical Society, as regards both place of meeting and general headquarters, thereby establishing, or rather renewing, an alliance between British mathematicians and astronomers, whose activities have always interpenetrated with the closest mutual benefit. Following on the confirmation of this plan, subject to the approval of the Office of Works, arrangements have also been made with great cordiality by the authorities of the Science Museum at South Kensington, whereby our library will be deposited in their scientific library under a scheme which will maintain full use of it by the members of the society, in surroundings where the cognate scientific literature, and extensive mechanical applications of mathematical principles, will be accessible for study.

We have, therefore, the pleasure now of holding the first of our meetings under the new conditions, at Burlington House, in very congenial surroundings.

The necessities of the national emergency have mobilised with striking success the industrial resources of science, hitherto neglected too largely in our defensive organisations. A most welcome result is the increased sense that has arisen of the national value of scientific pursuits; but danger is by no means absent that, in the haste to secure the material fruit, the welfare of the tree of knowledge, the pure and fertile source from which it springs, may be neglected or even impaired, and, like others of ancient days as well as recent times, we may succumb to the temptation "propter vitam vivendi perdere causas."

It is our duty here to take into consideration how our own special energies may best be rejuvenated and renewed, so as to become more effective in the enhanced and purified national life which, as we trust, will emerge from our present ordeal. Mathematical knowledge, in all ages the ally of sustained and exact activities, is now more indispensable than ever, when our material well-being depends so much on scientific engineering in its mechanical, electrical, and chemical forms. The highest commendation of any growing department of research is to be able to say that it is approaching the quantitative, the mathematical, form; many sciences, formerly descriptive and

[1] From an address delivered at the anniversary meeting of the London Mathematical Society on November 2 by the retiring president, Sir Joseph Larmor, M.P., F.R.S.

classificatory, are even now struggling to assimilate a mathematical method. But if it is just to claim that other sciences, nowadays even the biological, aspire with increasing success to become mathematical—that is, exact—in structure, there is, on the other hand, a duty enjoined on mathematicians to see to it that the main stream of their discipline is kept accessible—free from specialities and complexities, which, valuable and promising as they may be, and usually are, on their own account, to those capable of cultivating them, are yet for the present outside the current of the main advances of human knowledge. The play of human thought knows of no boundaries; it can pursue and clarify itself without limitation into endless mazes. All the more, we must be careful, in reclaiming and cultivating our boundless domains of mental evolution, not to lose touch of one another; if a theorist cannot command the attention of his own generation, he is scarcely likely to attract the interest or serve the purposes of posterity. The one criterion that is available of the value of an addition to pure knowledge is the human mental interest it can excite. We have our very being inside a well-ordered cosmos, intellectual and material, which it is our highest mental pleasure to explore in all directions and learn to comprehend; and we have a not unsafe guide in trained instinct and sense of fitness and symmetry, industriously applied, to appraise aright the value of each new departure. Knowledge thus cultivated on a broad basis for its own sake, so far from obstructing industrial applications, is their profound source. The study of curves, especially the conic sections, by the Greeks, at home and afterwards at Alexandria, is not, as is sometimes asserted, an example of mere useless mental ramifications happening to receive an application in later ages; it was on the direct path of progress, and formed the material, adequate and effective because not unduly complex or abstract, on which the ideas of the infinitesimal calculus—and may we add the mechanics of Archimedes and Galileo?—were gradually matured. And if it became in Newton's hands the weapon for the elucidation of the doctrine of universal gravitation, whereby human science first reached out securely into the illimitable universe, what analyst will deny the preordained fitness of the association?

There was a time, when the annual output of the Mathematical Society was smaller in bulk than it is now, that many of us made a point of taking an interest in all the papers that it published. It would be a great thing if we could get back again towards that state of affairs. At least two of our most distinguished analysts have in my hearing traced the aloofness, and even aridity, of much recent work to the neglect of geometrical ideas, the potent source in the past of mathematical progress and consolidation, and the vehicle for the diffusion of our science. It seems a strange phase of development, when we consider the preponderant graphical, tentative, and practical bent of the national intellect, and remember how much of our most characteristic progress and originality in theoretical physics has been, for the sake of being comprehensively grasped and mastered by the mind, so concisely wrapped up in geometrical imagery, and so freed from analytical technicalities, as to have been even obscure to communities trained in more formal and syllogistic methods.

There is always risk in getting too far from the main currents of our times; there is the danger, not always avoided, that in the fog of ignorance and the lack of interest we may encourage expansion in artificial and unfruitful, and even tedious, ramifications, while criticising and suppressing with rigour worthy, but immature, attempts in the well-explored regions of our science, where improvements are so important and originality is so difficult. The contrast with the difficulty of obtaining publication at all a century ago, except in brief summary, gives ground for reflection.

Of recent years the question must have presented itself to not a few of our authors whether the Proceedings, developing in so abstract a direction, are now quite as suitable a place for the publication of mathematical physics as they were in the days when Maxwell and Kelvin, and Rayleigh and Routh, were frequent contributors. Yet the potent source of even the most abstract branches of modern analysis has lain in the seizure and orderly cultivation of the intuitional ideas, largely cast in geometrical mould, that are forged by physical science in the effort to systematise its observations of the uniformities of the rational world around us. To renew our strength for wider flights we must return frequently to mother earth. The main feature of the technique of physical mathematics is that we are seldom dealing with a completed, and therefore strictly limited, logical complex; it is of its essence that the specification of the problem is fluent and provisional, always ready to take on new features as the discussion opens out. The student of mathematical physics cannot with safety afford to be a specialist; every department of physics is dovetailed into the other departments and progresses by their aid; knowledge must be so far as possible on an intuitive basis, to prevent it from becoming top-heavy, and all the threads must be in hand. For intuition sees, however imperfectly, all round a problem at a single glance; while analysis afterwards consolidates a permanent structure by fitting brick to brick. Even the most abstract of analysts must work at a disadvantage if he has no informed interest in the problems of external nature for which his analysis might be of assistance; and conversely, even the most recondite constructions of pure analysis would be of interest to a wider audience if they could be expounded in a non-technical manner, without the great detail that is sometimes thought to be essential to the necessary degree of precision. Nature is never irrational, but our main intellectual aim is the redemption of our views of her operations from that reproach; it is the freshly detected and systematically traced concatenations of her working that enlarge our stock of ideas, and become for us a source of new generalisations in abstract procedure, giving fresh points of view to be developed and to react in their turn. It is sufficient to cite the names of Cauchy and Riemann, not to mention the supreme examples of Lagrange and Gauss, to show that the most brilliant originality in abstract analysis, and habitude in the intuitions of physical science, can go together, to great mutual advantage.

Fortunately there are signs, abundant on both sides, that the repulsion which somehow arose with us in the last decades between the tentative, yet essentially progressive, though concise, prospecting of mathematical physics, and the stern but limited rigours associated with undiluted pure analysis, is now beginning to be recognised as cramping and unnatural; it may thus melt away in a better mutual understanding, and may one even say mutual interest, to the great advantage of both disciplines. Our analysts have been turning with success, and with a zest of a kind that seems familiar to their more physical colleagues, to semi-empirical methods in the theory of numbers; speculative interest has again arisen even in divergent series, such as would have rejoiced the soul of de Morgan, logician though he was; and the time-worn problems of partitions and combinations have been yielding their secrets to the powerful leverage of an apparatus of arrays and lattices, that may remind us of crystallography and even of thermodynamics.

Our society has lost by death not a few of her veteran members during my two years of office.

Notices of the work of Morgan W. Crofton, W. H. H. Hudson, Benjamin Williamson have already appeared in the Proceedings. In Sir James Stirling, Senior Wrangler of 1860, lately Lord Justice of Appeal, we have lost another of the survivors of our early days, whose interest in our science never flagged, whose mathematical training and gifts were the foundation of a legal and judicial eminence not often arising in a generation. In William Esson, Savilian professor, and John Griffith we have lost two Oxford mathematicians long connected with us. Though F. W. Frankland, an early member, had passed out of sight owing to distance of domicile, his combination of mathematical and philosophical interests had not become dormant. I may be permitted to add the name of John Henry Poynting; though his life-work attached him to sister societies, his wide physical outlook, combined with mental exactness and penetration, has made for him an enduring name in mathematical, as well as experimental, physics.

It is our pride and sad privilege to recall the names of the cultivators of our science who, in response to their country's appeal in time of national peril, have already laid down their lives on her behalf. In E. K. Wakeford, scholar of Trinity College, Cambridge, not a few of us had recognised a future leader in geometrical science. A colleague more senior and more widely known, S. B. McLaren, professor of mathematics at Reading, coming from Australia, and taking a high degree at Cambridge, had become a learned and philosophical inquirer in the difficult domain of statistical molecular dynamics and the relations of the æther to material systems; the work which formed the basis of the recent award of an Adams prize may remain, I fear, unpublished in any finally revised form. We are entitled also to recall the name of H. G. J. Moseley, who, though he would not have claimed to be a mathematician, had in a brief and brilliant career at Oxford and Manchester contributed fundamentally to the data of the mathematical physics of the future, by revealing the earliest universal and unmistakably quantitative relation in the fascinating domain of the correlations of the chemical elements.

Such heavy sacrifices of colleagues who could so ill be spared we must deeply deplore, but not as if they were made in vain. May we not detect beyond them, and on account of them, the promise of nobler and more disinterested times, when the vast destruction of perishable material resources will be far more than compensated in the remembrance of the heroism of the youth of our generation, and in the gain in moral and intellectual wealth that it will stimulate as an abiding possession?

> The world's great age begins anew,
> The golden years return.
> The Earth doth like a snake renew
> Her winter weeds outworn.
>
> * * * * *
>
> A brighter Hellas rears its mountains
> From waves serener far:
> A new Peneus rolls his fountains
> Against the morning star.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The title of emeritus professor of physics in the University of London has been conferred by the Senate on Dr. F. T. Trouton, who held the Quain chair of physics at University College from 1902 to 1907, and after the incorporation of the college held it in the University from 1907 to 1915.

The following doctorates have been conferred:—In anthropology, Mr. B. G. Malinowski, an internal student, of the London School of Economics, for a thesis entitled "The Natives of Mailu"; in botany, Mr. F. J. F. Shaw, an internal student, of the Imperial College of Science and Technology (Royal College of Science), for a thesis consisting of five papers on mycology; in economics, Miss E. D. Proud, an internal student, of the London School of Economics, for a thesis entitled "Welfare Work: Employers' Experiments for Improving Working Conditions in Factories"; in physics, Mr. David Owen, an external student, for a thesis consisting of two papers on "Solid Rectifying Contacts," and subsidiary contributions; in psychology, Mr. G. H. Miles, an external student, for a thesis entitled "Preference and Affective Influence as Factors in Recall," and subsidiary contributions; in engineering, Mr. N. W. McLachlan, an external student, for a thesis entitled "Magnetic Properties of Iron," and subsidiary contributions.

IT is announced that friends of the University College of Wales, Aberystwyth, have expressed their intention of contributing 100,000*l.* to the funds of the college, subject to a reservation of their right to make proposals to the council as to either the capital or the income.

THE governors of the Royal Technical College, Glasgow, at the request of certain donors, offer prizes, amounting to 70*l.*, for essays on the best methods of training and employing in industries, other than agriculture, returned soldiers and sailors, maimed or otherwise. The prizes will be awarded by a committee of the governors, and may be withheld in the event of no essay of sufficient merit being submitted. Essays must be sent in not later than March 1, 1917, addressed to the director, the Royal Technical College, Glasgow.

WE learn from the issue of *Science* for November 17 that the General Education Board and the Rockefeller Foundation have each granted 200,000*l.* for the establishment of a medical department in the University of Chicago. This gift brings Mr. Rockefeller's contributions to the University up to nearly 7,400,000*l.* The University will set aside at least 400,000*l.* for the same purpose, will give a site valued at 100,000*l.*, and will raise a further sum of 660,000*l.* The medical school will therefore start with an endowment of some 1,600,000*l.*

AT the request of the Right Hon. A. Henderson, when President of the Board of Education, the Royal Drawing Society has presented to the Committee on the Teaching of Science a memorial setting forth the value to the scientific worker of drawing and the cognate crafts, and the need for including drawing as an integral part of general education. This, the society maintains, is best accomplished, not by special classes, but by encouraging the faculty which is manifested in nearly all children, and by making it a natural mode of expression in the various branches of school work, *e.g.* history, geography, nature-study, and physical science. The memorial is signed by H.R.H. the Princess Louise, as president, and by many distinguished workers in pure and applied science, some of whom are members of the society's council. In connection with the Conference of Educational Associations, the society has arranged a discussion on the subject, with lantern illustrations, at the University of London, on January 1, at 5.30 p.m. Among the speakers will be Dr. P. S. Abraham, Dr. F. A. Bather, Mr. J. P. Maginnis, and Mr. Ablett.

THE first meeting of the Senate of the new University of Mysore was held on October 12. The proceedings are reported in the *Educational Review* (Madras) for October. In 1913–14 two educational officers of the State studied modern university conditions in foreign countries; a draft scheme drawn up in November last year embodied the joint views of the

Government of India, the deputation, and various public officials; in April last a committee was appointed to give effect to the draft scheme, and the Bill to establish and incorporate a university in Mysore was unanimously passed last July. There are at present two constituent colleges, the Maharaja's College at Mysore and the Central College at Bangalore. Degrees (B.A. and B.Sc.) may be obtained after a continuous three-years' course, and a course leading to a degree in teaching is to be established in the near future. There are 890 students under university supervision, and there are twenty-two professors or assistant-professors. The new University is the first offshoot of the University at Madras, and it is foreshadowed that other universities may be founded at Travancore and Hyderabad. A scheme of university extension work is under consideration. The Chancellor, H.H. the Maharaja, in his speech, stated that the new University was the first to be established outside the limits of British India.

THE "Handbook" of the West Riding of Yorkshire Education Committee is published in parts, which deal respectively with the various grades of education aided by the committee. The pamphlet numbered Section X. of Part II. gives full particulars of the scholarships and exhibitions to be offered in 1917 for the pursuit of higher education. The committee appears to have made provision for the needs of every class of student in the area over which it presides. Among the scholarships and exhibitions offered may be noticed the fourteen county major scholarships of the estimated value of 60*l.* to 65*l.* per annum to be held at universities, university colleges, or other institutions of higher education; the four county technological scholarships of the value of 60*l.* per annum; and others of the value of 50*l.* or less, tenable for day courses or for combined day and evening courses at institutions where higher technical instruction is carried on, and intended for young workmen having three years' general practical experience in an occupation; the county scholarships for women to enable them, for example, to be trained in midwifery and nursing, horticulture, and other vocations; the county agricultural exhibitions; and the travelling scholarships awarded as occasion may arise. Full particulars of the scholarship scheme may be obtained from the Education Department, County Hall, Wakefield.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7.—Sir J. J. Thomson, president, in the chair.—J. T. **Carter**: The cytomorphosis of the marsupial enamel-organ and its significance in relation to the structure of the completed enamel.—Margaret **Tribe**: The development of the pancreas: the pancreatic and hepatic ducts in *Trichosurus vulpecula*. The history of the three pancreatic primordia has been followed out in detail. Their development is traced through the earlier stages where the three are separate from one another; through the later stages where fusion has occurred, but where the primordia are still individually recognisable, up to the late pouch-fœtus in which the identification of the various component parts of the gland is still possible.—H. J. **Watt**: The typical form of the cochlea and its variations. The data and conclusions may be summed up by saying that the cochlea is built according to a constant plan, of which the scale alone varies from case to case. This scale shows a decidedly high correlation with the size of the organism as a whole. A change of scale will obviously alter all the dimensions recorded except the number of whorls. But even that number, when it varies independently, does not alter the other dimensions of the cochlea. The only other variant thus far detected is the rate of curvature of the spiral, which is greater in the bigger scale organs.—Dr. A. D. **Imms**: The structure and biology of Archotermopsis, together with descriptions of new species of intestinal protozoa, and general observations on the Isoptera. *Archotermopsis wroughtoni*, Desn., is exclusively confined to coniferous forests in the N.W. Himalaya, and lives in dead timber, no true nest being constructed. The queen exhibits no indications of degeneration or increase of size common to most species of Termitidæ. True workers are absent, but gynæcoid, egg-laying, worker-like forms occur. The soldiers are remarkable in retaining the external secondary sexual characters, and the gonads in this caste, and in the worker-like forms also, are fully developed. Abundant protozoa occur in the large intestine of the "sterile" castes and nymphs, they are scarce in the winged forms, and absent in the queens and young larvæ. These organisms usually have been regarded as parasites, but it appears more probable that they are symbiotic in their relations to their hosts. By breaking down ligneous matter they contribute towards the digestion of the latter by the Termites. Polymorphism in Termitidæ is not adequately explained on the grounds of special nutrition, nor does the theory of "castration parasitaire" account for the observed facts. The Mendelian inheritance of mutations appears to offer a reasonable solution of several of the outstanding difficulties associated with polymorphism and the inheritance of germinal characters in sterile castes. Archotermopsis is one of the most primitive of the Termitidæ, and its structure and bionomics throw light upon important biological problems.—J. J. **Guest** and F. C. **Lea**: Torsional hysteresis of mild steel. In this paper a series of experiments is described which show that, when mild steel is subjected to a torsional reversal of stress, the material does not follow Hooke's law, and that there is a distinct stress-strain hysteresis loop even for comparatively small ranges of stress.

Physical Society, November 24.—Prof. C. V. Boys, president, in the chair.—H. R. **Nettleton**: The measurement of the Thomson effect in wires. The paper describes how absolute measurements of the Thomson effect may be made in wires. The theory is fully worked out, and the sources of error likely to arise—especially owing to the smallness of the area of cross-section—are considered. The method is sensitive, consistent, and very rapid; its ultimate object is to determine the Thomson effect at different temperatures in a number of metals, both rare and base, at the same time, and with the same specimens, finding their thermo-electric powers.—C. R. **Darling** and A. W. **Grace**: The thermo-electric properties of fused metals. One of the authors has for some time been investigating the possibility of using base metal thermo-couples at temperatures above the melting point of one of the constituents. For this purpose it was necessary to determine whether any peculiarities in the thermo-electric behaviour of metals occur at fusion. In the case of lead, tin, zinc, and cadmium there is no perceptible break in the continuity of the curves obtained. In couples containing bismuth, however, several cases were noted in which the E.M.F. remained constant for a wide range of temperature after the fusion of the bismuth. This occurs with silver, aluminium, iron, or nichrom as the other element. Useful applications of this property are discussed.

Geological Society, December 6.—Dr. Alfred Harker, president, in the chair.—G. C. **Crick**: Recent researches on the belemnite animal. Attention was con-

fined to the restoration of a typical belemnite animal and its shell, as shown particularly by examples in the British Museum collection. Mr. Crick first demonstrated, by means of a rough model, the construction of the belemnite shell, including the guard or rostrum, the phragmocone with its ventrally situated siphuncle, and its thin envelope, the conotheca, with its forward prolongation and expansion (on the dorsal side) known as the pro-ostracum. He then exhibited photographic slides of examples in the British Museum collection showing these various characters, and noted the abrupt termination of the chambered cone on the lower part of the pro-ostracum, of which the dorsal surface may have been partly or almost completely covered by a thin forward extension of the guard.

Mathematical Society, December 14.—Prof. H. M. Macdonald, president, in the chair.—Prof. W. **Burnside**: The efficiency of a surface of discontinuity regarded as a propeller.—G. H. **Hardy** and S. **Ramanujan**: (1) Proof that almost all numbers N are composed of about $\log\log N$ prime factors. (2) An asymptotic formula for the number of partitions of a number.—G. N. **Watson**: The harmonic functions associated with the parabolic cylinder (second paper).—Prof. D. **Buchanan**: Orbits asymptotic to an isosceles-triangle solution of the problem of three bodies.—Prof. H. S. **Carslaw**: Diffraction of waves by a wedge of any angle.—Prof. L. J. **Rogers**: Two theorems of combinatory analysis and two allied identities.—Prof. W. H. **Young** and Mrs. **Young**: (1) The internal structure of a set of points in space of any number of dimensions. (2) The inherently crystalline structure of a function of any number of variables.

EDINBURGH.

Royal Society, November 6.—Dr. J. Horne, president, in the chair.—The President opened the session with a short address on the relations of industry and science.—Dr. J. **Tait**: Experiments and observations on Crustacea. Part i. Immersion experiments on *Ligia oceanica*. In distilled, or in tap, water Ligia dies within two days. When sea-water is added the period of survival is increased, and in full sea-water, steadily aerated, Ligia can live without food for three months. Size and condition as regards moult influence the period of survival. Part ii. The moulting of Isopods. Isopods appear to moult in two stages. Splitting occurs (1) transversely between the fourth and fifth free thoracic segments; (2) longitudinally at junction of coxopodite with tergite, thus revealing otherwise invisible lines of concurrence of segments. Ligiæ kept for weeks without food in sea-water moult normally. The opinion expressed by Réaumur that a crustacean moults because it has grown too large for its coat is incorrect.

November 20.—Dr. J. Horne, president, in the chair.—Prof. E. T. **Whittaker**: The adelphic integral in dynamics. The adelphic integral is defined to be such that the infinitesimal transformation corresponding to it transforms the members of a family of periodic orbits (corresponding to the same value of the constant of energy) into each other. It is shown that a dynamical problem with two degrees of freedom possesses only one really distinct adelphic integral, and that the finding of this integral is the most natural way of obtaining the complete solution of the problem. The integral is obtained as an infinite series, and it is shown that the difficulties connected with Poincaré's theorem on the non-convergence of the series of celestial mechanics may be surmounted by its means.—Dr. J. **Tait**: Experiments and observations on Crustacea. Part iii. Limb flexures and limb taxis in the Pericarida. The design and arrangement of the limbs in five orders were described, the mode of inquiry being physiological, advantage being also taken of the principle of analogy. A series of swimming limbs (Mysidacea) develop tri-alternate flexures when the animal passes from a homogeneous fluid medium to a fixed bounding surface. The proximal segments of these limbs are at first directed laterally outwards from the body (Cumacea, Tanaidacea), and the limbs from two groups, anterior and posterior. By a process akin to the rotation that occurs in vertebrate limbs the principal plane of flexure comes to lie antero-posteriorly in the Cammaridea. In the Isopoda further rotation has occurred, producing a taxis suitable for clinging. In the isopodan limb the most proximal joint is a universal hinge like a spheroidal bony joint. The author discussed the application of functional conceptions to the study of structure.

DUBLIN.

Royal Irish Academy, November 30.—The Most Rev. J. H. Bernard, Archbishop of Dublin, president, in the chair.—H. **Ryan** and W. M. **O'Riordan**: The tinctorial constituents of some lichens which are used as dyes in Ireland. Four species of lichens, viz. *Parmelia saxatilis*, Ach., *Ramalina scopulorum*, Ach., *Ramalina cuspidata*, Nyl., and *Physcia parietina*, De Not, were examined. The first three of these are known to have been largely used in the west of Ireland, and also in parts of Scotland, for dyeing wool a brownish colour. The chief constituents of these three lichens were found to be as follows:—*Parmelia saxatilis*, Ach., contains stereocaulic acid and salazinic acid, $C_{30}H_{24}O_{16}$; *R. scopulorum*, Ach., contains scopuloric acid, $C_{31}H_{26}O_{16}$, and *d*-usnic acid; *R. cuspidata*, Nyl., contains cuspidatic acid, $C_{34}H_{32}O_{20}$, or $C_{17}H_{16}O_{10}$, and *d*-usnic acid. The tinctorial properties of the lichens were found to be due to the presence in them of salazinic acid, scopuloric acid, and cuspidatic acid respectively. The fourth lichen, *Physcia parietina*, De Not, is not largely used as a dye. It contains, however, a yellow substance, physcione, which, when demethylated by means of strong sulphuric acid, yields emodin, which dyes wool an orange colour.—H. **Ryan** and P. **Ryan**: The condensation of aldehydes with ketones. III.—Benzaldehyde with methyl *iso*propyl ketone. Benzaldehyde condenses with methyl *iso*propyl ketone to form the benzylidene derivative of diphenyldimethyltetrahydropyrone, which was previously obtained from benzaldehyde and dimethylacetylacetone. Monomethylacetylacetone with benzaldehyde forms another compound melting at 157° C. Benzaldehyde also condenses with ethylacetoacetic ester to yield cinnamoylbutyric acid.—J. **Algar**: Unsaturated ketones derived from diaceto-orcinol. In this communication is described the preparation of diaceto-orcinol from orcinol-diacetate. It is identical with the diaceto-orcinol obtained by Collie from diacetylacetone. Diaceto-orcinol condenses with aldehydes in the presence of alcoholic caustic soda, and in this manner unsaturated ketones were prepared. A description is given of the preparation of dibenzylidene-, dianisylidene-, diveratrylidene-, and dipiperonylidene-diaceto-orcinol.

PARIS.

Academy of Sciences, November 27.—M. Camille Jordan in the chair.—E. **Picard**: The integrals of total differentials relating to regular algebraical surfaces.—G. **Bigourdan**: The position and co-ordinates of the astronomical station of the island of Notre-Dame. The works of Auzout. This station was where Auzout made a part of his observations, constructed his telescopes, the largest up to that time, and invented the micrometer with movable thread.—C. **Guichard**: The K networks of a quadric of revolution. — F. **Gonnessiat**: A star with a large proper motion.

Barnard noted a star on the photographs made at the Yerkes Observatory with an annual displacement of 10·3″, the largest known. This star has been found in the photographic catalogue of Algiers, and gives an annual displacement of 10·286″. It is the nearest star known; its parallax corresponds to 3·26 light years. Full details of the method of reduction will appear shortly in the *Bulletin Astronomique*.—Ch. Ed. **Guillaume**: Modifications of the expansibility of invar by mechanical or thermal actions. Both in annealed and tempered invar wires drawing down causes a rapid lowering in the coefficient of expansion; the coefficient is also affected by the heat treatment. Prolonged heating to 100° C. not only renders the condition of the metal after wire-drawing stable, but gives a material with a coefficient of expansion which is practically zero under the tension used in geodesic operations, and hence eliminates temperature errors.—G. **Kœnigs**: The general geometrical form of the properties of the second order of plane movements with two parameters.—M. **Mesnager**: Formula of the thin plate, with edges fixed on a plane rectangular contour.—L. **Fabry** and H. **Blondel**: The elements of the planet discovered by M. Sy at Algiers, May 26, 1916. It is proved that the elements of the Sy comet do not coincide with those of 562 Salomé. It would appear probable that this planet is new.—H. **Arctowski**: The fluctuations of the solar constant. It is shown that besides the sun-spots, other phenomena affect the solar constant in a manner sufficiently strong partially, or even totally, to mask the effect of the spots.—R. **Ledoux-Lebard** and A. **Dauvillier**: Theoretical and experimental researches on the bases of radiological estimations. In the special form of X-ray tube described by the authors, giving intense K spectra, the energy supplied (continuous current) being known, the estimation is reduced to a time measurement.—J. **Repelin**: The geology of the islands of Pomégnes and Ratonneau (Bay of Marseilles). The islands have been erroneously assumed to be a continuation of the massif of Notre Dame de la Garde, but are now shown to be constituted by Urgonian limestones arising from an accident altogether independent of this massif, and spreading out as a layer on a substratum of the upper Aptian.—A. **Boutaric**: Nocturnal radiation. A theoretical expression is developed for the nocturnal radiation, the loss of heat per minute of 1 sq. cm. of a black surface exposed to the air. Some experimental data obtained at Montpellier in 1913 and 1914 are in fair agreement with the formula, and show at least that the results of calculation and observation are of the same order of magnitude.—F. **Gérard**: Four new Ochnaceæ of Madagascar.—A. **Béclère**: The inoculability of variole in the vaccinated, but not completely immunised, calf.

BOOKS RECEIVED.

University of Sheffield. Calendar for the Session 1916–17. Pp. 742. (Sheffield.)

A Defence of Classical Education. By R. W. Livingstone. Pp. xi+278. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

A Text-Book of Organic Chemistry for Students of Medicine and Biology. By Prof. E. V. McCollum. Pp. xiii+426. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s*. net.

The World as Imagination. By E. D. Fawcett. Series I. Pp. xlii+623. (London: Macmillan and Co., Ltd.) 15*s*. net.

Decennial Index of the *Analyst*. Vols. xxxi.–xl. Compiled by M. A. Baker. Pp. 733. (London: Simpkin, Marshall and Co., Ltd.)

What is Instinct? By C. B. Newland. Pp. xv+217. (London: John Murray.) 6*s*. net.

The Control of Hunger in Health and Disease. By A. J. Carlson. Pp. vii+319. (Chicago: University of Chicago Press; Cambridge: At the University Press.) 9*s*. net.

Second-Year Mathematics for Secondary Schools. By E. R. Breslich. Pp. xx+348. (Chicago: University of Chicago Press; Cambridge: At the University Press.) 4*s*. net.

The High Price of Sugar and How to Reduce It. By H. H. Smith. Pp. iv+54. (London: John Bale, Ltd.) 1*s*. net.

Highways and Byways in Nottinghamshire. By J. B. Firth. Pp. xviii+426. (London: Macmillan and Co., Ltd.) 6*s*. net.

Some Questions of Phonetic Theory. By Dr. W. Perrett. Pp. vi+110. (London: University of London Press, Ltd.) 2*s*. 6*d*. net.

Charts: Their Use and Meaning. Prepared by Dr. G. H. Fowler. Pp. iv+47+charts viii. (London: J. D. Potter.) 4*s*.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 21.

CHEMICAL SOCIETY, at 8.—Studies on the Walden Inversion. V. The Kinetics and Dissociation Constant of α-Bromo-β-phenylpropionic Acid: G. Senter and G. H. Martin.—The Alcohols of the Hydroaromatic and Terpene Series. III. The Isopulegols corresponding with *l*-Menthol and *d*-Neomenthol: R. H Pickard, W. Lewcock, and H. de Pennington.—Lead Sub-iodide, with Details of the Preparation of Lead Suboxide: H. G. Denham.—Note on the Solubility of Lead Iodide: H. G. Denham.—Chromium Phosphate: A. F. Joseph and W. N. Rae.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Economic Geology of the Insizwa Range: W. N. Goodchild.

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