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PLANT PHYSIOLOGY AND ECOLOGY.

Plant Physiology and Ecology. By Prof. F. E. Clements. Pp. xv+315; 125 illustrations. (London: A. Constable and Co., Ltd., 1907.) Price 10s. 6d. net.

THE task of summarising the principles of ecology and other branches of botany concerned with the relation of plant to environment is one with which teachers are confronted at the present time. Prof. Clements in this book outlines a course which he has carried out in a session with second-year students. His views on vegetation as an "organism" are already known from "Research Methods in Ecology" and other publications. The present book, briefly stated, is an attempt to graft on to "Research Methods" the physiology of Sachs and Pfeffer and the ecology of Warming and Kerner. The tree shows signs of one day being a symmetrical organism, but at present the traces of the grafting are somewhat conspicuous. Prof. Clements has all along taken up his standpoint without much consideration for the traditions of European schools; yet anything he writes is worth careful consideration. "Research Methods" was distinguished by such a marked disregard for principles admitted in Europe that it provoked much criticism; one, therefore, turns to the new book curious to see what the last three years have brought about.

The opening chapter is axiomatic, therefore important. The author's conception of physiology is given in his own words. "A plant is an organism capable of nourishing itself under the control of external conditions, and of modifying its form and structure in accordance with this fact." "The proper task of physiology is the study of the external factors of the environment or habitat in which the plant lives, and of the activities and structures which these factors call forth." "The former are causes, the latter effects." "The sequence of study is consequently factor, function, and form." "Physiology was originally understood to be an inquiry into the origin and nature of plants." "This is the view that pervades the following pages, and in accordance with this the subject-matter of ecology is merged with that of physiology." A stimulus is defined as "any factor of the habitat that produces a change in the functions of a plant." The real test of a stimulus is "furnished by the plant, since the presence of a stimulus can only be ascertained by the response made by the plant." Stimuli are grouped "with respect to the force concerned." "The factors of a habitat are water, soluble salts, humidity, light, temperature, wind, soil, pressure, physiography, gravity, polarity, and biotic factors." "Certain of these, namely, soil, physiography, pressure, and biotic factors, can act upon plants only through the action of other factors, as a rule." This grouping together of all the factors of the habitat as stimuli, in "Research Methods," evoked the criticism of physiologists accustomed to distinguish between work which is the direct outcome of energy flowing in from without (transpiration and photosynthesis), and work done as the equivalent of potential energy, the conversion of which is set going by inflowing energy ("New Phytologist," iv., p. 234). Commenting on this distinction between tonic and stimulatory action, Prof. Clements says:—"a careful analysis of these two processes shows that at the bottom they are essentially the same," and differ only in degree. He also adheres to his earlier views on the nature of response. Adjustment is "functional response" where "reactions to stimuli are functional only." Adaptation is "structural response" where a structural change also occurs. "Adjustment may be expressed in the movement of parts or organs . . . or in growth or modification of structure." "Adaptation comprises all structural changes resulting from adjustment."

These are fundamental principles of this book. Five chapters (pp. 7–143) are concerned with adjustment to water, light, temperature, and gravity; two (pp. 144–184) with adaptation to water and light. The chapter (ii.) on "the water of the habitat" is already familiar to readers of "Research Methods." The difficulties of a beginner in field-work are not quite fully realised, but with the aid of this chapter and the experiments suggested he should be able to grasp the objects of this line of investigation. The system employed in framing the chapters on adjustment is to give a general—often a very general—outline of the structure of the organs concerned and to add experiments on function. This part of the work lays itself open to frequent criticism, and most instructors, while appreciating the suggestions, will improve along their own lines. Adjustment to water is subdivided under topics; "absorption" includes structure and function of the root and the principles of imbibition, osmosis, diffusion, and turgidity; "transport" includes brief descriptions of stem structure and the upward movement of water; "transpiration" deals with leaf structure and function. One must admit that it is no easy task to give a condensed account of these processes, but a clear conception of them is essential, even to the ecologist, and their treatment here does not satisfy. Either the student has become familiar with elementary anatomy and physiological experiments during an earlier period of his course, or he ought to know more than is given in these pages. Many phrases suggest a first primer; thus, "the fibrovascular system is usually in the form of an interrupted circle of bundles strung like beads upon the ring of cambium." So also do some experiments; thus, osmosis is demonstrated by a thistle funnel and parchment (no other experiment), and turgidity with a piece of "dialyser tubing." The ecologist may be sadly in need of the more intimate and exact methods of the physiologist, as Prof. Clements says, but this deficiency is not removed by acquaintance with a few elementary experiments, and the ecologist should be induced to follow the latest the laboratory physiologist is doing. One cannot help thinking that the author has not taken this part of his work seriously, but has thrown out as suggestions what first came to mind; even in the proof-reading perfection is not aimed at; in one case (p. 68) several errors occur in a few lines.

The chapter on adjustment to light deals with light stimuli, the measurement of light, and the process of photosynthesis. Under "Adjustment to Temperature" the relation of plants to temperature is included along with digestion, respiration, germination, nutrition of hysterophytes, growth, reproduction, and propagation. The connection of all these with temperature is not very obvious, as they are the outcome of many factors. In an ecological text-book one might well expect a more recent treatment of propagation, a subject of prime importance, and one to which Danish and Swiss workers have given much attention. The chapters on adaptation to water and to light include all structural changes, and they proceed on conventional lines: decrease of water-loss through leaf position, rolling of the leaf, changes of epidermal cells, stomata, &c.; types produced by adaptation to water, xerophytes, &c.; the relation of organs to light, types of leaves as determined by light, and other topics. "The Origin of New Forms" (chapter ix.) includes a short history of evolution, and sketches rapidly origin by adaptation, variation, and other processes.

The latter part of the book (chapters x.–xv.) shows Prof. Clements at his best. His views as given in "Research Methods" have already had great influence; these form the basis of the chapters in the present work, but the new arrangement is a great improvement on the old. The study of vegetation by quadrats and transects is now a recognised method of the ecologist, and the chapter on it forms a good introduction for the advanced student. The plant formation (chapter xi.) is defined as "an area of vegetation, such as a meadow, a forest, a prairie, a bog, a cliff covered with lichens, or a pond of water-lilies." The cautions given under "recognition of formations" are timely, because "the unit itself shows parts which may be mistaken for formations"—a very common error. The formation depends on habitat, and is a product of it, but the author wisely points out the existence of a historical factor "due to the accidents of migration and competition, or to the fact that the plant itself has a certain ancestral or historical quality that enables it to persist." No student of ecology can omit to read carefully the description of the formation, or what one naturally calls the "Clements formation"; it matters little whether it is synonymous with the conceptions of other authors, but it is an introduction to the varying phases of vegetation which in its definiteness and detail has few rivals. The chapters discussing aggregation and migration (xii.), competition and ecesis, or the adjustment of a plant to a new habitat (xiii.), invasion and succession (xiv.), and alternation and zonation (xv.) are all important; they deal with features one constantly meets in the field, and these chapters will assist much in giving that mental perspective so greatly needed in Britain, where the units of vegetation are limited in extent and liable to disturbance.

The irritating nomenclature of "Research Methods" does not appear in this book; such terms as are retained are few, and so useful that they have already been adopted. The illustrations, where they refer to ecology, are helpful and are well reproduced. The provision of an index is an improvement on the author's former book, but we think the omission of references to literature is not justifiable in this period of ecology and in a book which is obviously only feeling its way. The publication of this book will have a marked influence on teaching, and it is well that one backed by so much experience should lead the way. The enthusiasm of the author can be traced through every page; ecology is always in his mind, and he weaves it into botanical teaching from the commencement. The course leads in the right direction, although slight differences of opinion on detail may be inevitable.

W. G. S.

MARINE METABOLISM.

Conditions of Life in the Sea. A Short Account of Quantitative Marine Biological Research. By J. Johnstone. Pp. xiv+332. (Cambridge: University Press, 1908.) Price 9*s*. net.

SINCE Hensen published, in 1887, the first account of his methods for the quantitative estimation of the plankton, an ever-increasing number of workers has entered the field of marine biological research. To quote from the author in the preface:—"It is characteristic of a really great idea in science that it should stimulate further discovery by the suggestion of new lines of research and new methods of investigation." Already many results of the greatest interest have been obtained, and the lines on which modern research is being carried out are rich in promise. The absence of any adequate summary of these researches has been a serious gap in scientific literature, for on account of the diversity and inaccessibility of a great number of the memoirs, this subject still remains a *terra incognita* to the great majority of readers. To meet this demand in a satisfactory manner the range of the subjects that would have to be entered into is very considerable; and Mr. Johnstone is to be congratulated on the masterful manner in which he has carried out this task in writing "Conditions of Life in the Sea." A clear and concise account of all the more important work is given in language devoid of unnecessary technicalities, and in dealing with the more speculative problems the author states *pro* and *con.* with an impartiality which is quite refreshing.

Part i. is an introduction to the problems discussed later on in the work, and is primarily intended for the benefit of those who have no special knowledge of oceanography. A short account is given of the gear and methods of the marine biologist. Facts relating to the geology and to the hydrographical and physical conditions of the north-western ocean are summarised. The reader is made familiar with the commoner and more widely distributed marine fauna and flora, special reference being made to the plankton. Finally, the economic and biological importance of the fishing industries is briefly outlined.

Part ii. deals with the methods and results of quantitative biological research. The author discusses fully the classical experiments of Hensen and Lohmann on the quantitative estimation of the plankton, giving the defects and limitations of these methods without bias. The last two chapters in this section are headed "A Census of the Sea" and "The Productivity of the Sea"; in them an attempt is made to view questions of economic value from a quantitative biological standpoint. That the estimation of the number of marketable marine fishes on a given fishing area, or calculations as to its yield per acre per annum, must as yet be purely speculative is fully appreciated. This, however, does not detract from the great value of these deductions, the interest in figures such as these lying more in the possibilities they suggest than in their mathematical correctness. The system of "trial and error" enters so largely into scientific investigation that perfection cannot be hoped to be attained without the aid of some such provisional results.

Part iii., under the title "Metabolism in the Sea," is, perhaps, the main feature of the book. The researches of Pütter on the nutrition of marine organisms, and those of Brandt on the "Law of the Minimum," are treated at length. A chapter is devoted to marine bacteria, and emphasis is laid on the possibility that nitrogen is the determining factor in the sea, and the denitrifying bacteria the cause of the observed scarcity of nitrates and nitrites in tropical and subtropical waters. The extraordinary abundance of planktonic life in the Arctic seas has given rise to much discussion, but in our present state of knowledge this phenomenon can be best explained by the hypothesis that, owing to the inhibition of bacterial activity at low temperatures, there is no diminution from this cause in the supply of the nitrogenous foodstuffs that can be utilised by the marine protophyta. The constituents of sea-water such as nitrates, phosphates, silica, &c., are present in such minute traces that quantitative determination is extremely difficult. The author might have laid greater stress on this point, since no really satisfactory methods of analysis have yet been perfected.

References to literature, a most important point in a work of this kind, are given freely throughout the text, a bibliography of the more fundamental memoirs being also included as an appendix. Authors and subjects are indexed separately, so that references can be most easily found.

Besides a few obvious misprints we note the following:—P. 67, line 2, oviparous for viviparous in reference to Acanthias, the spur-dog; p. 96 (in the diagram), Aurelia, Rhizosolenia, should read Aurelia, Rhizostoma; and p. 193, line 1, agriculture for aquiculture.

The illustrations are mostly quite diagrammatic, and as such serve their purpose, but in some cases (pp. 68, 79) clearness is sacrificed by representing plankton animals lying across one another. The printing, binding, &c., are uniform with the well-known "Cambridge Biological Series," to which this work is a welcome addition.

E. W. NELSON.

ANATOMY OF THE HORSE.

The Surgical Anatomy of the Horse. **Part iii. By** J. T. Share-Jones. Pp. x+220. (London: Williams and Norgate, 1908.) Price 15s. net.

THE third of the four volumes which are to form a "Surgical Anatomy of the Horse" deals with the hind limb, and will doubtless fulfil the author's hope that it may be "at least as acceptable as the preceding volume both to students and practitioners in the study and practice of the important branch of veterinary work to which it relates." The present volume has all the merits of its predecessors. Of its value as a means by which the practitioner may refresh his memory of the anatomy of the regions with which he is concerned surgically there can be little question. In some places the anatomical descriptions are both long and detailed, and contain all the information which is in any way important. At the same time, the present part of the work is not without some of the defects exhibited in those sections of the work which have already been noticed in these columns.

One matter which the author would be well advised to ponder, in view of the possible demand for a subsequent edition, is that of having all the figures drawn from either the right or the left limb. It does not make for ease of comprehension to find that neighbouring plates illustrate the one the right the other the left limb. Comparison would be a much simpler matter if all the figures represented the same side of the body. It is bad enough when different plates do not correspond, but it is exasperating when the same plate contains figures some of the right and some of the left limb. In Plate xviii., Fig. A shows the superficial markings of the *left* hock, Fig. B illustrates the arrangement of the ligaments from the same aspect of the *right* hock, and Fig. C depicts the disposition of the bones on the medial side of the *left* hock. It may be remarked in passing that Figs. B and C of Plate xx. are not of the *left* hock. Plates xxiv. and xxv. both illustrate the seat of anterior tibial neurectomy, but one figure is drawn from the left limb, the other from the right.

While recognising the enormous importance of the tarsus as a surgical region, we are not prepared to admit that it is necessary to have seven figures to illustrate the position of the various bones, nor are we prepared to allow that the grooves and ridges on the medial side of the tarsus are of such surpassing significance as to merit so much attention. Their importance from the clinical aspect is open to question, and, from the anatomical side, it is clearly recognised that the degree of their variation is great.

Mr. Share-Jones again makes use of a nomenclature in the defence of which there is little to be said. So long, however, as his readers understand what is meant, exception can be taken to the terms employed on academic grounds only. At the same time, it seems a pity that adjectives like "external lateral" and "internal lateral" should not be omitted, if only on the grounds of the desirability of brevity.

To apply the term "sciatic" to the internal popliteal nerve (n. tibialis) until it arrives on a level with the heads of the gastrocnemius muscle is not justified by common usage among anatomists. An error, in the commission of which the author is not alone, is in the spelling "tendo-Achilles."

The judicious use of quotations is to be commended, but Mr. Share-Jones is not well advised in the insertion of too long quotations. We feel that the work would have lost nothing in clearness, and would have gained something in terseness, had the quotations been condensed into a few lines or omitted altogether. There seems little point, for example, in the views of Percival on "ossific diathesis," quoted by W. Williams and re-quoted by our author.

The fact that the author treats his subject so largely from the surgical side leads one to examine the surgical paragraphs with even more care than those which are purely anatomical. Surgery certainly is an art, and not one of the exact sciences, and, therefore, affords great scope for difference of opinion. Mr. Share-Jones, consequently, is entitled to express whatever views he may happen to hold, but he need not be surprised if his readers occasionally disagree with him. It may be doubted, for instance, if it is possible in cases of so-called deferred fracture of the tibia to detect the line of fissure by palpation. It is a matter of opinion whether crepitus can be elicited by manipulation in fractures through the acetabulum. There are those who would say that crepitation can be best produced by movements by the horse himself.

The professional reader, moreover, may inquire why epiphyseal fractures of the femur of young animals are omitted, or, in fracture of the femur, how the bony fragments are to be retained in position, or what may be the value of periosteotomy in "spavin," and how it is done. On many other points, it is safe to say, the practitioner will feel irritated at paucity of information, or will dissent, sometimes strongly, from the views expressed.

From what has been said it is clear that the present part of the "Surgical Anatomy of the Horse" is not without blemish to detract from its numerous merits.

GLASS DECORATION.

Decorative Glass Processes. By A. L. Duthie. Pp. xii+267. (London: A. Constable and Co., Ltd., 1908.) Price 6*s*. net.

THE book before us contains a minutely detailed account of a number of processes employed for the purpose of producing architectural decorative work in glass. Beginning with an account of the various kinds of glass available for such work, and indulging in a retrospect of glass-working that takes the reader back to ancient Egypt, Mr. Duthie describes the production of leaded lights, the technique of glass painting and staining, and the various processes which depend upon the partial obscuring of the glass by means of fluorides or by the action of the sand-blast. Finally gilding, silvering, mosaic, and a number of special processes are described.

Mr. Duthie's account of the varieties of glass available for decorative work is interesting especially as regards the production of "antique" glass with its intentional "imperfections," such as bubbles, striæ and partial devitrifications. On the other hand, the statement that polished plate glass is made by polishing "rough cast plate" serves to indicate that the author is not intimately acquainted with this side of glass manufacture.

In his detailed account of the technique of the various crafts concerned in the production of decorative glass, Mr. Duthie is, perhaps, somewhat uninteresting to the general reader—the descriptions are too minutely detailed and given in rule-of-thumb manner—while for the practical worker the book may serve as a useful reference for recipes not in constant use, but would scarcely be adequate for the needs of a learner. A larger amount of space devoted to the principles of the technique, even at the expense of some of the detailed directions, would have been preferable. Ideas and principles are, however, only introduced in reference to the questions of art involved in the designs for various types of work. This is, perhaps, scarcely the place to discuss these questions, but the fine illustrations with which the author's views are exemplified deserve special comment. Some of these, such as Fig. 15 (leaded panel), Fig. 31 (triple embossing), and Fig. 38 (electro-copper glazing), are particularly fine; the latter is also of special interest technically, as it illustrates a very successful application of an electro-deposition process to glass work. In this work the lead flanges or "calms" are replaced by thin strips of copper laid between the different pieces of coloured glass; upon the projecting edges of these bands ledges of copper are electro-deposited, flanges being thus formed which grip the glass and consolidate the whole panel.

Scientific readers will be particularly interested in the manner in which the action of hydrofluoric acid and of soluble fluorides is utilised for the production of glass surfaces of various degrees of opacity, ranging from the "dead white" of the pure fluoride to the practically clear glass left by the pure acid. As Mr. Duthie remarks, however, it is certainly surprising to find this etching process known by the trade term "embossing," a term which rather suggests the products of the pressed-glass factory. The glass industry is, apparently, the victim of a very curious system of nomenclature; thus the term "metal" is always applied to glass, while such curious terms as "ambitty" (spelt "anbitty" in some places in the book), "larrykin" and "cullett" are found in a short glossary at the end of this book. To the words named in that list Mr. Duthie should, however, have added another, which he employs, apparently, without being conscious of anything unusual—he refers to the process of etching away layers of glass as "aciding" the glass—and this can hardly be regarded as a welcome or even a legitimate addition to the language. Similarly, the continual loose reference to hydrofluoric acid as "fluoric acid" is not to be commended, although no doubt widely incorporated in workshop slang.

In spite of these criticisms, and some further defects from the literary point of view, the book is to be welcomed as an addition to the scanty literature of glass from the pen of a practical glass worker, and it will no doubt find many appreciative readers among those interested in decorative glass. W. R.

ASTRONOMY, MYTH, AND LEGEND.

The Judgment of Paris, and some other Legends Astronomically Considered. By the Hon. Emmeline M. Plunket. Pp. iv+199; illustrated. (London: J. Murray, 1908.) Price 7*s*. 6*d*. net.

NO archæologist denies that in the "myth-making age" (whenever that may have been; we are still making myths now) our primitive ancestors were often struck with the appearance of the heavenly bodies, and made pretty stories out of them. But what he does deny is that, at any rate in the case of Greece, the majority of the myths, or anything like the majority, are of celestial origin. We know, also, far too much about the probable early history of the Ægean countries to believe for a moment that many Greek *legends* (as distinct from myths) are connected with the movements of the sun, moon, and stars. But the Hon. Miss Plunket finds an astronomical explanation for all legends as well as myths. She confuses the two; for her Achilles or Agamemnon are as unreal as Aphrodite and Hera, and all four are but symbols, so to speak, of some aspect of the heavenly bodies at some time or other.

To the Greeks Aphrodite and Hera were as real as Achilles or Agamemnon. Miss Plunket reverses the process. Both she and the Greeks are equally uncritical in their method! For her everything is unreal and astronomical. But why should not some of the myths, and a few of the legends, be astronomical, and the rest not? After all, we are not all of us star-gazing now, and there is no proof that our "myth-making" ancestors were more given to the pursuit than we are. An archæological discovery has shown us that many of these astronomical explanations of legend are mere fantasy, as we fear much of Miss Plunket's book is. There is far more earthy reality about these stories than she thinks. The murder of Agamemnon by Klytaimnestra and Aigisthos, in which Miss Plunket sees "mythically chronicled an eclipse occurring at or close to the season of the winter solstice," would be considered by the modern archæological historian to be a legendary reminiscence of a real tragedy of a particularly ghastly character perpetrated in the royal burg of Mycenæ at some time during the period of Achaian domination, no more. Why should it be anything else? Why be astronomical? Why should the Greeks have woven all these cryptic legends about stars?

To regard the Trojan war, too, as an astronomical myth after the discoveries of Schliemann is to exhibit a peculiar point of view. Miss Plunket calls it a "conviction." "Convictions" are unscientific; they are merely inverted prejudices, and no scientific worker has any business to be dominated by them. We note, however, from many indications, that Miss Plunket would be scientific enough could she but conceive the possibility that every myth and legend is not necessarily of astronomical origin. With her suggestion that the Gorgon's head is originally the cold full moon we are in cordial agreement. We have then in the Perseus story a queer folk-tale of a sort of Jack-the-Giant-Killer who went up into the sky and brought the moon down, as the primitive mind, like the child-mind now, could easily conceive the wonderful person as doing. In this there is nothing astronomical; and the Medusa on the shield of Athene may very well be the full moon on the body of the goddess of the grey-blue night-sky, γλαυκῶπις Ἀθήνη; why not? But there is no astronomical complication here, only a general sky-goddess with the moon on her, as it naturally would be. Miss Plunket's explanation of the term Τριτογένεια for Athene as "born of Trita," a deity of the Avesta, is at least more probable than the very doubtful connection with Lake Tritonis in Libya. The author makes other suggestions which will compel the most sceptical critic to read her work with attention and respect, even though he may differ *toto caelo* from its main contentions.

H. R. HALL.

HEAT FOR ENGINEERS.

Heat for Engineers. A Treatise on Heat, with Special Regard to its Practical Applications. By Chas. R. Darling. Pp. xii+430. (London: E. and F. Spon, Ltd., 1908.) Price 12*s*. 6*d*. net.

ANY author who attempts to cover the syllabus outlined in the preface and contents of this treatise needs considerably more than 415 pages of the ordinary-size text-book in which to do that properly. Too much has been attempted, and a great opportunity has not been made use of to the fullest advantage. Some portions of the book are elementary to a degree which irritates; other portions are so advanced that needful and useful sections have been sacrificed in order to keep the size of the book within the usual limits. Clearly the author should have divided his matter into two volumes, one elementary and the other advanced. In the preface there is rightly expressed the opinion that "the numerous applications of heat in modern industrial processes" . . . do not "receive more than the briefest mention in ordinary treatises on heat," and it is the avowed object of this book to remedy that omission. Yet "Practical Heat Engines" are disposed of in sixteen pages, and one searches in vain for a mention of that most interesting and instructive heat motor—the Diesel engine. There is nothing about evaporators; a study of the action of multiple-effect evaporators especially conveys much that is useful to the engineering student. We obtain the impression that the book is meant for the student in physics, and *not* for the engineer. If that is conceded, then there is more reason for its contents. In any case, however, space might have been found for dealing with the errors of the aneroid barometer, since the instrument itself is considered and described. An improvement in the arrangement of the contents could be made with advantage. For example, pp. 119 to 136 contain some excellent matter on pyrometers. It is advanced work. From pp. 276 to 358 we are made to wade through much that is quite elementary on conduction, convection, and radiation!

There can be no question about the merits of two important sections of the book, viz. the chapter on calorimetry and that on pyrometry. Here the author is clearly doing work which pleases him, work with which he is both theoretically and practically well acquainted, and work which is done in a manner worthy of all praise. We can recommend our engineering students and our practical engineers to obtain the book for the contents of these two chapters. Great care has been expended throughout in the preparation of the text, and although a few of the illustrations might have been improved upon, yet they are, taken on the whole, good.

As we have suggested above, the title is misleading. The engineer will expect to be able to do without any other text-book on the theory of heat engines. He will, however, require some other manual, and he will find, in consequence, much overlapping. It must be made quite clear that the contents of "Heat for Engineers" is well written. The author has evidently devoted much labour and thought to the preparation of the book. Considered individually, each chapter is excellent. The above suggestions have been made in no carping spirit, but in the earnest hope that engineers will obtain fuller benefits in the shape of a more practical text-book from one who clearly is capable of helping them to understand difficult problems. C. A. SMITH.

HIGHWAY ENGINEERING.

Highway Engineering. By Chas. E. Morrison. Pp. v+315. (New York: J. Wiley and Sons; London. Chapman and Hall, Ltd., 1908.) Price 10*s.* 6*d.* net.

A Text-book on Roads and Pavements. By F. P. Spalding. Third edition, revised and enlarged. Pp. x+340. (Same publisher.) Price 8*s.* 6*d.* net

THE first-named of these treatises on highways was prepared by the author, who is professor of civil engineering at Columbia University, for the students there, "with a view to furnish a text in which the fundamentals of the subject should not be buried in a mass of detail," and the endeavour has been "to outline and emphasise the basic principles which are essential to good highways."

The book is divided into ten chapters, dealing respectively with road resistance; roads made of earth, gravel, broken stone and other materials; the design of streets, and paving with stone, bricks, asphalt, and wood. It contains a great deal of useful information, especially to engineers having to deal with roads in new countries. The elementary principles of road-making are clearly set out, and copies of specifications suitable for different classes of roads are given. The illustrations are numerous and clear, and in some cases graphic, as, for example, the relative load that can be drawn with the same tractive force on different kinds of road is shown by the number of horses required to draw the same load, this number varying from half a horse on a first-class road to ten on an earthen track.

With regard to the repairs of macadamised roads in rural districts, the author emphasises the fact, recognised by all experienced road engineers, that

"the best results are obtained at a less cost by a system of continuous small repairs, and that to keep a road in an efficient manner, incessant vigilance is required, any signs of ruts or hollows being at once filled up."

As to trees by the side of roads, the author points out that, whatever may be the disadvantages of road-side trees, it has been the practice in the most progressive road-building countries to plant trees by the roadsides. In France all roads having a width of 33 feet or over have a single row on each side, generally at distances varying from 16 to 32 feet apart. In some countries in the rural districts fruit trees are planted for which the road authority derives a revenue by the sale of the privilege to gather the fruit.

It may also be here mentioned that at the recent road conference at Paris it was agreed that, with a view to dust prevention, the planting of trees along the sides of the roads should be encouraged.

The effect of motor traffic on the surface of roads, and the great dust question, which at the present time are receiving so much attention both by the users and the road authorities, occupy only a small space in this book. The oiled roads that are in use in some districts in the United States are, however, more fully dealt with. With the object of preserving the surface of the road and preventing dust in dry weather, oiled roads are in operation over several hundreds of miles in California and other States. The cross-section of roads subjected to this process is graded to an inclination of half an inch to a foot. Before being treated with the oil the surface is sprinkled with water, then rolled with a light roller, after which a harrow having three-inch teeth is drawn over the surface. The oil is then spread from a specially designed tank cart at a rate varying from 8500 to 18,800 gallons to a mile of road 16 feet in width, or, say, from one to two gallons per square yard. Oils having an asphalt base are best suited for the purpose, but all petroleums are used. The surface of a road treated in this way is fit for the traffic twenty-four hours after being dressed, and is found to be impervious to rain-water, the surface remaining hard and firm also in hot weather.

The use of bricks for road paving, so frequently met with in Holland, has been introduced into America, especially in the smaller towns, the popularity of this form of paving being indicated by the fact that in a period of ten years, out of all the hard paving material used, 33 per cent. was of brick, 43 per cent. of asphalt, 10 per cent. of granite, and 9 per cent. of wood. The advantages claimed for bricks as a paving material are: a good foothold for the horses, efficient traction, durability under moderate traffic, absence of noise, and ease in cleaning and repairs.

The second of the books under notice is a third edition, the first having been published in 1894. The aim of the author is

"to give a brief discussion, from an engineering standpoint, of the principles involved in highway work, and to outline the more important systems of construction, with a view to forming a text which may serve as a basis for a systematic study of the subject."

The edition now published has been largely revised, and professes to represent the best recent practice in highway work in the United States of America.

The book is divided into eleven chapters, two of which deal with "country roads," the information in which may be of service in our colonies and in new countries. The other chapters treat of road economics, drainage of streets and roads, macadamised roads, road foundations, brick pavements, bituminous pavements, stone and wood-block paving, and city streets. The information given is practical and useful, and covers very much the same ground as the book previously noticed. In the first chapter the author refers to statistics obtained by the Road Enquiry Office of the United States department concerning the cost of hauling farm produce to market, with the view of basing upon the figures obtained some conclusion as to the average saving resulting from the improvement of roads. The general conclusion arrived at appears to have been that, where the surface of an earth road is macadamised, the load that can be transported by the same number of horses may be doubled, if the earth road be dry and level; but where it is in a wet and rutty condition the load may be increased four- or five-fold. In many instances the economic advantage to an agricultural district may, by allowing the hauling to be distributed over the whole season, amount practically to a saving equal to nearly the entire cost of hauling by permitting the work to be done at times when other work is impossible.

With regard to the use of oil for preserving the surface of macadamised roads and for the prevention of dust, the author fully confirms all that is said in Prof. Morrison's book. The quantity of oil used, according to the author's experience, is about the same as that given by him. The results obtained by this process are deemed so satisfactory that the use of oil is largely extending.

The author refers to the use made by the French road engineers of tar, either as a sufrace dressing or as tar macadam for the purpose of eliminating dust. It has been found that the cost of maintenance of roads so treated is considerably reduced, the dust nuisance is minimised, and the life of the road prolonged. The quantity of tar used for dressing the surface averages about one-third of a gallon to a square yard. The application of the tar is made about once in two years. At the recent road conference held at Paris, the conclusion was arrived at that tar-spreading on the surface of macadamised roads, when properly carried out, is an effective means of preventing dust, and that it also protects the road surface against the destructive action of traffic generally, and specially of motor-cars driven at high speeds. The tarring of the main roads, where this system has been carried out in this country, has also been found to be very effective in preventing dust.

PURE AND ANALYTICAL GEOMETRY.

(1) *Modern Geometry*. By C. Godfrey and A. W. Siddons. Pp. xvi+162. (Cambridge: University Press, 1908.) Price 4*s*. 6*d*.

(2) *The Analytical Geometry of the Conic Sections*. By the Rev. E. H. Askwith, D.D. Pp. xiv+443. (London: A. and C. Black, 1908.) Price 7*s*. 6*d*. net.

(1) THIS book is an interesting introduction to the ideas and methods of modern geometry so far as required for the special examination in mathematics for the ordinary B.A. degree at Cambridge. It deals with certain properties of triangles and of groups of circles, with chapters on harmonic section, pole and polar, similitude, inversion, orthogonal projection and cross-ratios, with a glimpse at the principle of duality both in a plane and in space, but not dealing much with the properties of conics except in the interesting chapter on orthogonal projection. There is a good table of contents, and an index which is of great assistance in finding where any subject is treated.

The book contains a number of theorems, but is written largely on the heuristic principle, as in many cases proofs of theorems are left to the reader, and in some cases important theorems are to be found only among the examples; *e.g.* the fact that if (AB, CD)=(AB, DC) the range is harmonic seems only to be given in Ex. 525 on p. 124. Such examples, which are mostly in thick type, must be treated as additional theorems.

The method of selection of theorems, especially in the early part of the book, is not easy to understand. Thus, two trigonometric properties of a triangle are given, viz. $a/\sin A = b/\sin B$, &c., and $a^2 = b^2 + c^2 - 2bc \cos A$, why is not obvious, as they are contained in any trigonometry. It seems a pity that the latter formula is not proved straight from Pythagoras instead of being merely borrowed from Euclid, Book ii. It would be much more instructive, and would illustrate the use of signs in dealing with segments of a line as discussed in the authors' first chapter.

The great charm of the book lies in its suggestiveness and in the excellent collection of examples, many of which are arranged so as to lead up to the theorems following them. The conciseness of the book will probably prevent it from being the sole text-book, but on the other hand will be of great use in fixing the student's attention on the leading theorems of the subject, and in enabling him to master them. The authors avoid any use of imaginary points, evidently thinking them unsuited for beginners.

(2) This fascinating book is the most complete text-book on the subject since the great work of Dr. Salmon. It is too difficult to be read as a first book, but for more advanced students and for a university course it is likely to be the standard book. The order in

which the various systems of coordinates are considered is in some respects rather curious, *e.g.* tangential equations are not dealt with until the last chapter but one, after discussions on cross-ratios and involution and a chapter on invariants, the succeeding chapter being on covariants. After Miss Scott's brave and able attempt to introduce tangential coordinates to beginners, this seems rather a retrograde step.

Then areal coordinates are introduced before trilinears, because in the majority of cases the resulting equations are so much simpler than the corresponding trilinear equations. In spite of one's sympathy with the reasons, and one's pleasure in the author's treatment of areals, it seems a pity to depart from the historical order, which introduced the student first to abridged notation, which slid so naturally into trilinears, thus preparing the student for appreciating the greater simplicity of areals.

Indeed, in the present book the abridged notation that was so charmingly put in Salmon's treatise is to be found only in scattered places, with no great emphasis placed on it, at any rate until the fifteenth chapter. It is there, but it would need expert guidance for a student to appreciate it at its full value. In this respect, and in the treatment of reciprocation, Salmon's book should still be read. In fact, it is difficult to imagine a time when this incomparable treatise will cease to be a source of inspiration and a delight.

The great interest of the present book lies in its masterly treatment of innumerable problems, and the use that is made of determinants at every turn. The methods of the differential calculus are introduced as alternative to other methods, but are not made an essential part of the development of the subject, as one would rather have expected nowadays, when all scholarship students learn the elementary methods of the differential and integral calculus. Probably this subordination or avoidance of calculus methods is due to the requirements of the Cambridge course.

For scholarship work in schools, the better students could very profitably read a good deal of the earlier part, after they have mastered some easier book. In this respect it is somewhat like Dr. Hobson's invaluable treatise on trigonometry, only selected portions of which are within the range of reading of the majority of scholarship students.

OUR BOOK SHELF.

Formeln und Hilfstafeln für geographische Ortsbestimmungen. By Prof. Th. Albrecht. Vierte Auflage. Pp. viii+348. (Leipzig: Wilhelm Engelmann, 1908.) Price 20 marks.

THE object of this work, which has run through four editions, is to supply within a convenient compass the formulæ that are used most frequently in the determination of time, and of terrestrial coordinates, together with tables by which the application of these formulæ can facilitate the ordinary work of an observatory. But the author has contrived that the book should be more than the mere collection of formulæ and tables. In an illuminating introduction he considers the sources of error which are likely to affect each class of observation, and uses his familiarity with different processes to show how many of these errors can be eliminated or rendered harmless by due precaution in the manipulation of instruments or by judicious selection of methods of observation. In this way the treatise becomes a practical guide in those matters of which it treats. These include the formulæ involved in the reduction of observations made for the determination of time, latitude, longitude, and azimuth. The instruments may be used on the meridian, on the prime vertical, or in the vertical of the Polar Star; they may be altazimuths or zenith telescopes; each finds its suitable application here; similarly, the particular methods which have been suggested to meet practical difficulties are discussed with the thoroughness of the expert.

The chapter on clocks contains much useful information to which Prof. Wanach, of Potsdam, has contributed. The tables of refraction have received special attention, incorporating the Pulkowa results. The numerical values, which very properly are not continued below 80° of zenith distance, may not differ greatly from those of Bessel, but they are founded on more modern theories, and with improved values of the refraction constant. As might have been expected from the author's long connection with geodetic work, references connected with the problems of the determination of longitude and the figure of the earth are particularly full. Indeed, in the latter section some of the tables can hardly be brought under the heading of "Ortsbestimmungen" as usually understood, but the tendency of all such compilations is to increase by the addition of tables and formulæ which have only a very limited application. Such tables have the advantage of being at hand if wanted.

It seems less defensible to cumber the book by other tables with which observatories are equipped quite as conveniently and with greater completeness in other forms. Those tables which give the squares of numbers up to 1000, or of the logs. of numbers up to 1960, or of trigonometrical functions of angles with no great accuracy, seem to us to be hardly warranted in a work of this character. But we hasten to say that this superfluity is not gained at the expense of material more immediately connected with astronomical work, and so far as we have been able to test the care and accuracy exhibited in the compilation, it is possible to speak in the highest terms.

Human Speech, a Study in the Purposive Action of Living Matter. By N. C. Macnamara. Pp. xiii+284. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1908.) Price 5*s.*

MAJOR MACNAMARA'S object in writing this book is to trace the gradual evolution of the living matter found in the cerebral centres on which intelligent speech depends. This is truly a herculean task, and one from which most physiologists and psychologists would shrink; and yet the author has succeeded in producing a readable book, full of information, and in many places both interesting and suggestive. There is not much said about human speech, either as regards its nervous or muscular mechanisms, but the author approaches the subject from the standpoint of general biology. He traces the influence of stimuli on living matter, the effects of the accumulation of stimuli, the gradual evolution of the senses, the corresponding development in greater complexity of the nerve centres, more especially of those connected with the higher centres of vision and hearing, and the changes that coincide with the appearance of such psychic activity as we associate with the brains of man and the higher animals. Waves of sound, falling on the ear, "reach the living matter forming his centre of hearing in such a form that they become impressed on this matter." The sensori-motor auditory centres become related to the living matter in the psychical areas of the brain, these react on the cerebral centre or centres for speech, and, in turn, these "play upon the nuclei of the nerves supplying the muscles of the vocal apparatus."

In supporting this thesis Major Macnamara shows a wide acquaintance with contemporary biology—indeed, to such an extent is this the case that the book can well be recommended as an introduction to this department of science. The only criticism that may be offered is that there is rather a redundancy of statement, and not infrequently an exposition of matters that are not quite pertinent to the subject in hand. As examples we may take the references to current speculations in physics, to Ehrlich's chain-theory, to the description of karyokinetic phenomena and the changes in the early ovum, and to the exposition of new and abstruse notions about reflex activity. No doubt the author has desired to take a wide and philosophic view of the whole subject, even at the risk of introducing matter somewhat irrelevant. Still, conciseness is a virtue worthy of cultivation. This is an excellent additional volume to the "International Scientific Series." The illustrations have been carefully chosen, and there is a good index.

J. G. M.

Exercising in Bed. By Sanford Bennett. Pp. 268. (San Francisco: The Edward Hilton Co., 1907.) Price 1.25 dollars.

IN the introduction to this book, the author explains that he had been a delicate child and had led a sedentary office life, so that at the age of fifty he was dyspeptic, his muscular system was flabby, he was prematurely old! By adopting the system of exercises detailed in the book, he claims that at sixty-seven he is a strong, healthy man, and has regained youthful vigour, and certainly the photographs reproduced illustrating his condition before and after treatment show a very marked contrast.

The author is an enthusiast, but the book is written in a moderate spirit which disposes to the acceptation of his views. He rightly claims that the functions of the body can only be carried on if they be used and exercised. Thus a gland or muscle condemned to inactivity atrophies; it is a physiological law that a certain degree of activity is necessary for the physiological integrity of an organ or tissue. In consequence various methods of physical culture are much in vogue, and are of considerable service in the development of the body and preservation of health, but tend to be unpopular owing to the time necessary to devote to them, and the individual who loves his bed cannot, or will not, rise early enough to carry them out. Mr. Bennett, however, declares that all the necessary exercises can be carried out while in bed, and we think he is right, and a quarter or half-hour may be well spent in healthy exercise without disturbing the ordinary routine. In some ways, in fact, the method has an advantage, as many muscles can be better exercised when lying than when standing, and in those who are getting on in years, perhaps with weak heart and diseased arteries, there is far less likelihood of over-strain. Combined with various movements, massage or rubbing of the muscles is advocated, and is very desirable.

A series of exercises is detailed in the book, illustrated in every case with photographs, by which the muscular system of all parts of the body may be exercised and developed, and most of them can be carried out without any extraneous apparatus. We have no doubt that the exercises suggested, if carried out, would be of considerable benefit, even if they did not actually rejuvenate or restore good looks, as the author claims.

R. T. H.

Cement Laboratory Manual. By Prof. L. A. Waterbury. Pp. vii+122. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 4*s*. 6*d*. net.

THIS is a book for the use of students who are learning the various physical methods of testing cement. In the main it consists of instructions for working out a series of "problems" by the learner during a course of laboratory tuition, as practised in the University of Illinois. The work is arranged much on the lines familiar to students of electricity at Finsbury under the late Prof. Ayrton, the operators working in classes with given apparatus and materials, and being furnished with directions how to carry out the experiments, how to record the results, and how to interpret them.

For comparison of the results with what would be required in actual practice two useful appendices are given. One contains the report of a committee of the American Society of Civil Engineers on the question of uniform tests for cement; the other is a report upon standard specifications for cement, by a committee of the American Society for Testing Materials.

Determinations of the degree of fineness, specific gravity, plasticity, soundness, time of setting, and tensile strength of cements are the chief experiments set out. These are regarded as suitable for class teaching, and a student who works carefully through the exercises should gain considerable insight into what is required in judging the values of cements by laboratory tests. The author, however, rightly points out that a considerable amount of practice, much more than is afforded by the laboratory course, is necessary to obtain uniformly satisfactory results.

Theoretical matters are not dealt with in the book. There are illustrations of the chief pieces of apparatus, and also some trivial pictures—a mason's trowel, a set of scales and weights, and similar things—which are a mere waste of space.

C. S.

"Saint" Gilbert: the Story of Gilbert White and Selborne. By J. C. Wright. Pp. 90. (London: Elliot Stock, n.d.) Price 2*s*. 6*d*.

THIS little book bears a most unfortunate title, for whatever may have been the virtues of Gilbert White, he was in no proper sense of the word a saint. He was an honest, excellent Englishman, with a "curious" intellect and a generous disposition, but assuredly not more saintly than a thousand others. Mr. Wright says in his preface that "it is permissible to regard him as the patron saint of the little village where he spent the greater part of his life." That is well enough, for it suggests no saintliness; but "Saint Gilbert" is most unhappy. The book consists of 85 small pages, largely made up of quotations from White himself and those who have recently written about him. It will do no harm, and may perhaps do some good; and that is perhaps all that need be said about it. The eight photographs which illustrate it are unusually good, and so are the tail-pieces at the end of the chapters.

Les Zoocécidies des Plantes d'Europe et du Bassin de la Mediterranée. Tome i. By C. Houard. Pp. 569; 1365 figures, 2 plates, and 4 portraits. (Paris: Hermann, 1908.) Price for both volumes, 40 francs.

DR. HOUARD deserves congratulation on the successful accomplishment of his task of giving a systematic account of the European galls. Of recent years there has been great activity in the study of galls, which are of equal theoretical and practical interest, and this scholarly and well-arranged catalogue, brought up to date, will be widely welcomed. It is an admirable piece of work. The author gives terse descriptions of the galls, and refers (by name simply) to the gall-forming animals; he arranges the galls according to the families of plants affected; he supplies more than a thousand serviceable illustrations, a statement of the geographical distribution of each gall, and the indispensable bibliographical references. The second volume is in the press; the first volume deals with the galls of cryptogams, gymnosperms, monocotyledons, and the dicotyledons from Ranunculaceæ to Rosaceæ. The work will be a great boon to entomologists, botanists, foresters, and agriculturists. We hope that the author will not write *finis* to his *magnum opus* without discussing, as he is so competent to do, the fascinating biological problems which are raised by the study of galls, crowning his work of description with an essay of interpretation.

Practical Coastal Navigation, including Simple Methods of finding Latitude, Longitude, and Deviation of Compass. By Comte de Miremont. Pp. 88. (London: J. D. Potter, 1908.) Price 4*s*.

IN this small volume Comte de Miremont has collected an enormous amount of useful information and what might be called tricks of the trade, which tell the young navigator everything that has been found useful in coastal navigation after years of experience.

The book is excellently arranged, and the explanations are simple. Besides the various chapters on actual coastal navigation, deviation and rule of the road, and weather forecasting in home waters, are most ably explained.

The book should find a place in every chart-house and navigation school. Comte de Miremont is to be highly congratulated on having produced such a useful aid to mariners, and to those wishing to become efficient in this particular art. H. C. LOCKYER.

LETTERS TO THE EDITOR.

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

The Radiation of the Active Deposit from Radium through a Vacuum.

WHEN the radium emanation is transformed into radium A, the process is accompanied by the emission of α particles with a velocity of $1{\cdot}70 \times 10^9$ centimetres per second (Rutherford, *Phil. Mag.*, October, 1906). The portion of the atom from which the α particle has been emitted, which constitutes the radium A, must therefore be subjected to considerable shock and recoil in a direction opposite to that in which the α particle is projected. If we further consider that the mass of the α particle is $4(H=1)$, and that of the active deposit of the order 100, it follows that at the moment of its formation this product must be travelling with a velocity of the order 10^7 centimetres per second. In ordinary circumstances, when the emanation is mixed with air at atmospheric pressure, the radium A particle will possess only sufficient energy to permit it to travel a fraction of a millimetre before being stopped by collision with air molecules. On the other hand, at very low pressures, these particles should travel considerable distances without being stopped by the rarefied air, and come to rest on the enclosure containing the emanation. These particles should, in fact, constitute a type of very easily absorbed radiation. It has been the object of some experiments which we have recently performed to demonstrate directly the existence of this radiation.

The emanation from a fairly large quantity of radium was condensed at the bottom of a wide glass tube by immersing its end in liquid air. A brass plate, which just fitted into the glass tube, was suspended, in a high vacuum, a few centimetres above the condensed emanation so as to expose it to the bombardment of the active deposit particles being fired up the tube. After a suitable exposure the plate was removed, and its activity tested in the usual manner by a quadrant electrometer. The surface of the plate exposed to the emanation was always found to be highly radio-active.

Now this in itself would afford no evidence of the effect sought, for it is well known that when a large quantity of radium emanation is condensed in liquid air, the condensation is by no means complete, and there always exists in the vessel, above the condensed emanation, a considerable quantity of emanation in the gaseous state. A plate situated above the emanation as described above must therefore of necessity become radio-active on this account. But it was always found that the activity of the surface of the plate facing the emanation was greater than that of the opposite side, and it seems quite certain that this excess of activity is due to the direct radiation of the active deposit on to the plate. The ratio of the activity of the surface turned towards the emanation to that turned away from it has been found, under suitable conditions, to be as great as 50 to 1. The exact ratio obtained depends, of course, on a variety of experimental conditions, but in all circumstances the activity of the surface of the plate turned towards the emanation exceeded that of the reverse side. Moreover, by interposing a screen between the emanation and the plate, the excess activity collected on the surface of the plate turned towards the emanation could be completely obliterated. Experiments have been made at different pressures, and it has been found that the radiation is cut down to one-twelfth by traversing about 8 centimetres of air at a pressure of 1·15 millimetres of mercury. The same distance of air at 2 millimetres pressure is sufficient almost completely to stop the radiation.

These experiments give rise to a number of interesting questions which it is not yet possible to answer with any certainty. In the first place, it seems probable that when the emanation is condensed at the bottom of an evacuated tube, the attendant phenomena must be somewhat complicated, for when in radio-active equilibrium the emanation will be mixed with all its decomposition products. At every stage in the radio-active series at which α particles are expelled, some of the residual atoms should be fired up the tube. Although it is not yet possible to speak with certainty, it would seem that both radium A and radium B are projected up the tube on to the plate exposed to the radiation.

Another question of importance also arises as to whether the particles projected from the emanation are charged or not. Some experiments have already been made on this point with the object of deflecting the radiation by an electric field; but the difficulties are considerable, and no definite evidence has yet been obtained. We hope, however, that these difficulties will not prove insuperable.

S. RUSS
W. MAKOWER.

Physical Laboratory, The University, Manchester,
January 9.

The Isothermal Layer of the Atmosphere.

IT seems to me that in NATURE of January 7 (p. 281) Mr. Dines successfully defends his simple, compact, but extremely efficient apparatus from the suspicions that have been levelled at it. The tests of the instrument before and after use show that it truly records the temperatures and pressures to which it is reduced. Mr. Dines is therefore entitled to call for adequate discussion of the most marked outcome of the experiments—the fact that in nearly all cases the minimum reading of temperature is reached long before the maximum height in the ascent, and long after in the descent. To suggest that the thermometer or the barometer may be slightly out is really to evade the problem.

Taking, then, the readings as fairly accurate, do they prove the "isothermal layer"? What are the circumstances? To the best of my knowledge they are these:—the instrument is screened by a polished metallic cylinder open at top and bottom, the centre of which it occupies, and the draught of air produced by the up-rush and down-rush of the balloon is relied on to ensure that the thermograph, which is of light metal strip, shall take the temperature of the air with which it is in contact. It is hard to suggest a better arrangement for getting some notion of the low temperatures which the upper air appears to delight in producing and maintaining in the most trying circumstances; nevertheless, it is easy to show that the temperature of the instrument will differ from that of the air by a variable interval depending on the speed of the balloon, the density of the air, and the intensity of the radiation from earth, clouds, balloon, sun, air, and vapour.

Suppose I wish to take the temperature of the feed air below the fire-bars of a furnace. If the current of air were sufficient, and the screening of the thermometer almost perfect, I might get a close approximation, but if the draught relaxed in speed or density, or if the screening became less perfect, the thermometer would respond to the radiation by which it was surrounded and rise above the temperature of the air. A *ballon sonde* is such an apparatus. It is in a warm situation, but is surrounded by an intensely cold medium. It is a speck extremely close to a great warm planet, and bathed in his radiations and reflections—to say nothing of sun-rays, which sometimes complicate the problem. The screen is open to the earth below and to the balloon above, and the instrument, though screened itself, follows in the wake of the unscreened balloon and is fanned by the air that has passed over its heated surface.

In the ascent the thermometer reading falls briskly, and soon reaches a figure which may be 100° or more below what it would stand at if it were screened *from air currents* for a few minutes; but this gap between the temperature of the instrument and the temperature proper to its position cannot be extended indefinitely. The up-rush of the balloon attains a maximum velocity and declines, and the density of the air also rapidly diminishes. When the receipt by radiation equals the loss by conduction, the thermometer has reached its minimum, and enters the so-called "isothermal layer," the regularity of the occurrence of which on the traces is due to the similarity of pattern of balloon and outfit and of the other circumstances. I know that Mr. Dines contends that speed upwards or downwards can have no effect on the thermometer, but he takes no account of the circumstance that heat is constantly entering the instrument, and that it is solely the current of air that keeps down its temperature by removing the intruding heat.

It seems a pity that the following question stands barred:—Why *is* the material *Air* so cold where the material balloon and other instruments *would be* so warm? R. F. HUGHES.

16 Westmoreland Street, Marylebone, W., January 9.

IF all balloon ascents had been made by day, I confess that I should be inclined to agree with Mr. Hughes and think that the recorded temperatures were due to radiation, but that idea is disposed of, to my mind, by the fact that the isothermal column of air shows just as plainly in ascents made after sunset as in those made in the day. At night the thermograph must receive some heat by radiation from the earth, and lose some by radiation into space, but both amounts must be infinitesimal in comparison with that which would be given to it by the sun. If, then, exposure to the sun does not seriously alter the temperature, and it does not do so even at the greatest height provided there is a moderate amount of vertical motion, the effect of the radiation after sunset must be utterly insignificant. That solar radiation in the ordinary conditions is not important is proved by the fact that if the balloon bursts, and therefore does not float, it is not possible to say from the trace alone if the ascent was by night or by day. There have been cases in which the balloon did not burst, and the temperature at the top reached the freezing point of water. If I asserted that the rate of ascent does not matter, I must plead guilty to a mistake, but I think I said "apart from radiation," and I still believe that radiation at night to and from the bright metal of the thermograph is so trifling that the rate of ascent is of no consequence. There is also the fact that the up-trace, where the motion is comparatively slow, is identical with the down-trace where the motion is rapid.

W. H. DINES.

An Electromagnetic Problem.

SINCE the solution of the problem put forward by Prof Comstock in NATURE of November 19, 1908, is apparently not obvious to everyone, will you permit me to point out that, so far as I can see, the difficulty arises, not from any peculiarity of the laws of electromagnetism, but from a simple misconception of the meaning of dynamical terms?

Prof. Comstock says that when an electrified sphere expands it loses electrostatic energy, but does not gain either kinetic energy (for the sphere has no mass) or magnetic energy (for the resultant field due to the motion of all parts of the sphere is everywhere zero). Now the energy of a conservative system, such as is considered, is measured by the amount of work which it can do on some external system in passing from its original to some defined final state; the amount of the work which can be done, and therefore the amount of the energy, will vary according to the external system which is chosen, and the principle of the conservation of energy will be true only if the same external system is taken in measuring the amount of work that can be done at various times during the change.

When he states that the magnetic energy of the expanding sphere is zero, Prof. Comstock is taking as his external system, on which work is to be done, a system unconnected with and independent of the expanding sphere; but the electrostatic energy of the sphere with respect to such a system is quite unaltered by the expansion, if the system is either wholly within or wholly without the sphere throughout the expansion, and the change in the electrostatic energy which ensues, if any part of the system passes through the surface of the sphere during the expansion, is independent of the discreteness or continuity of the electrification on the sphere, and perfectly consistent with the conservation of energy. Adopting such an independent system as that on which work is to be done, there is no relevant change in either the electrostatic or the magnetic energy.

On the other hand, when he says that the sphere in expanding loses electrostatic energy, Prof. Comstock is taking as the system on which work is to be done part of the expanding sphere or some system connected rigidly therewith; but then it is clear that in estimating the magnetic energy no account must be taken of the magnetic field due to the motion of this part. Leaving out of account the magnetic field due to this part of the sphere, a simple calculation shows that the magnetic field due to the motion of the rest of the sphere relatively to this part is *not* zero everywhere, but that the value of $\mu H^2/8\pi$, integrated throughout the entire field, is equal to the value of the electrostatic energy with reference to this part lost in expansion. NORMAN R. CAMPBELL.

Trinity College, Cambridge, January 16.

Radium in the Earth.

IN the discourse entitled "Radio-active Changes in the Earth," delivered at the Royal Institution by the Hon. R. J. Strutt, and printed in NATURE of December 17, 1908, the lecturer advanced the opinion that the mineral beryl contained an hitherto unknown element from which the comparatively large quantity of helium present is generated.

This interesting and remarkable conclusion has induced me to direct attention to a statement which occurs in a paper entitled "The Heat of Formation of Glucinum Chloride," by J. H. Pollok (Chem. Soc. Trans., 1904, p. 603). Mr. Pollok prepared a large quantity of basic glucinum carbonate from 2000 grams of beryl, and during the preparation of this compound he detected the presence of another substance, the nature of which he was not able to ascertain. His statement is as follows:—"This precipitate consisted chiefly of iron, zinc, and nickel sulphides, but another substance appeared to be present; its amount was, however, too minute to admit of any satisfactory conclusion being drawn regarding it. This sulphide has also been observed by Kruss and Moraht."

PERCY EDGERTON.

The Laboratories, 61 Cornhill, London, E.C., December 31, 1908.

PRIMITIVE MAN IN THE KESSLERLOCH.[1]

THAINGEN is known to most of us only as a little station on the line from Schaffhausen to Constanz. In the Jurassic limestone that rises above the village, there is, however, a famous cavern, which in the last thirty years or so has added greatly to our knowledge of Palæolithic man.

FIG. 1.—Excavations at the main entrance to the Kesslerloch in 1902.

The Kesslerloch has suffered by being somewhat too accessible. It is even visible from the railway embankment, and has attracted workers, discreet and indiscreet, from several of the adjacent towns. We owe to Konrad Merk, a schoolmaster in Thaingen, the recognition of the cave as a place where prehistoric records might be found. In December, 1873, Merk and a friend named Wepf began their excavations in frozen soil. Wepf took a number of worked flints and a carving in reindeer-horn to Prof. A. Heim, in Zürich. On January 6, 1874, Heim himself visited the cave, and found the beautiful incised drawing of the grazing reindeer, which is now so well known through many reproductions.

The present handsome memoir brings together the discoveries made from time to time, including those of Dr. J. Nüesch in 1898 and 1899; but it deals especially with the systematic excavations organised (p. 27) by the Schweizerische naturforschende Gesellschaft and the Historisch-antiquarischer Verein of Schaffhausen in 1902 and 1903. Dr. Heierli, of Zürich, was appointed as director, and a very complete investigation has been carried out. Merk published his results in 1875, and an English translation appeared in the following year in London. Drawings of a bear and a sitting fox, incised on bone, were included among the objects found in the detrital heaps, and the originals are now in the British Museum. They are again figured in the present memoir (plate xxix.) as a warning to collectors. The true drawings made by Palæolithic man at Thaingen are worked on polished reindeer-horn, or rarely on jet (p. 196); and the bear and fox are certainly in another style of art. Lindenschmit, director of a museum in Mainz, and well acquainted with prehistoric art, soon pointed out that the bear and fox were copied from a book for children that had appeared in 1868. Forthwith a judicial inquiry succeeded in tracing the fraud to an artful workman and an innocent schoolboy; but for a time suspicion fell upon other and far superior specimens. Heim, however, who is here quoted in full, proved his case for the reindeer; a pig that had somehow got figured with a curly tail was shown to have a most proper and straight one in the original; and the carved head of a musk-ox, one of the most valuable relics (plate xxxii.), has proved especially convincing. In fact, only three forgeries are now recognised, thanks to the very searching criticism which each object has undergone. On plate xxxii., by the by, the numbers 5 and 6 should be interchanged.

Dr. Heierli's own excavations were in the yellow loam, which must have accumulated during the epoch of the occupation of the cave by man (p. 60). The hearths in this show that successive groups of settlers came in, but all the remains are classed as Palæolithic, and mostly as Magdalenian. There are no signs of climatic alteration during this epoch (p. 213); but the water-level in the loam has now climbed some four metres higher than when the cave was first inhabited. The loam is regarded by Prof. Meister as accumulating, partly

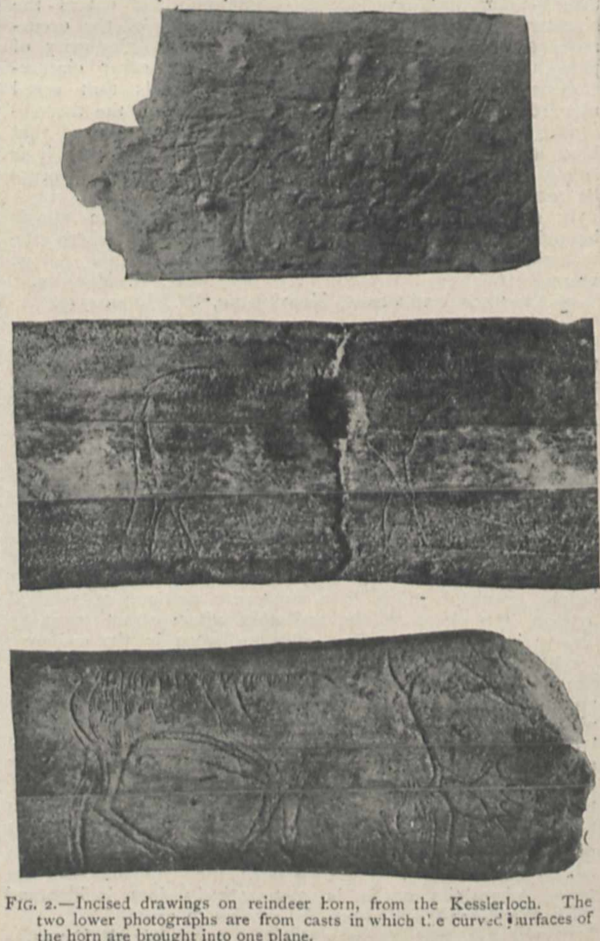

FIG. 2.—Incised drawings on reindeer horn, from the Kesslerloch. The two lower photographs are from casts in which the curved surfaces of the horn are brought into one plane.

[1] "Das Kesslerloch bei Thaingen." By Dr. J. Heierli, with the co-operation of other authors. Pp. vi+214; with 32 plates. (Zürich: Neue Denkschriften der schweizerischen naturforschenden Gesellschaft, Band xliii., 1907.)

in a shallow stream, while the last extension of the Rhine glacier withdrew from northern Switzerland (p. 56).

A full account is given by Prof. Hescheler of the animal remains, which include representatives of the lowland fauna of pre-Glacial times, of an Arctic or Alpine fauna, now known to have been strongly present, and of a fauna proper to the Magdalenian epoch, suggesting steppes and tundras. The cave-dwellers fed mostly on reindeer, hare, horse, and ptarmigan, and probably had no domesticated animals. Among the more interesting remains found may be mentioned those of the mammoth, the lion, the woolly rhinoceros and the musk-ox. G. A. J. C.

THE NEW IMPERIAL INSTITUTE.

WE imagine that few, if any, members of the old Corporation of the Imperial Institute, which was dissolved by Act of Parliament in 1903, believed that within a very few years the institute would be able to produce the record of useful work which has just been presented to Parliament.[1] The policy at first adopted, and persisted in long after it had been discredited, led to a failure, in so far as the complete fulfilment of the objects for which the institute was founded was concerned, and lent plausibility to the view that South Kensington was too "inaccessible" to become a centre of scientific and commercial information concerning the raw materials of the Empire. It has been amply proved, however, now that the original failure was not due to this cause. South Kensington is no longer inaccessible, and in any case the exact position in London of a central establishment, which has to be in close touch with distant parts of the Empire, whence its work chiefly comes, as well as with manufacturers throughout the United Kingdom, is a matter of secondary importance. Whatever may be urged against the South Kensington site, it has not stood in the way of the accomplishment of an increasing volume of work which, it is clear from the present report, must have taxed to the utmost the power and capabilities of the relatively small staff allotted to the institute.

The new era dates from 1903, when the Imperial Institute was transferred to the Government and placed under the control of the Board of Trade, with Prof. Dunstan as its new director. This Government department seems, however, to have been primarily interested in developing in the city a Commercial Intelligence Office, and appears to have done little to facilitate reconstruction at South Kensington. The institute made steady if slow progress during this period, as shown by the report on its work presented to Parliament in 1906, and received increasing support from the colonies, with the result that in 1907 its management was delegated, under the Act of 1903, to the Colonial Office, representation on the board of management being given to the India Office and the Board of Trade.

It may be claimed that the present measure of success is the result of steady and persistent work on scientific lines, and is indeed the outcome of the foundation in 1896 of the scientific and technical department, with the assistance of the Royal Commissioners of the Exhibition of 1851, who, however, ceased to contribute to the support of this department when the institute was transferred to the Government.

The present report deals with each of the several divisions of the work carried on, but we need only refer to that of more immediate scientific interest. This concerns the operation of the institute in conducting investigations and inquiries relating to the commercial utilisation of the raw materials of the Empire.

This work has benefited the British manufacturer, as well as the colonial producer, as is shown by many instances quoted in the report. It is obviously of first importance that this scientific work should be directed to practical ends and made to tell commercially, so that, as a rule, the results are of technical and commercial rather than of purely scientific interest. Nevertheless, the members of the scientific staff have made a very creditable contribution to more purely scientific knowledge, no fewer than thirty communications to the Royal and other scientific societies being noticed in the report. These relate chiefly to the results of researches on the constituents of new vegetable and mineral products. The material placed at the disposal of the institute is so valuable and important, from this point of view, that, in the interests of science, it would be a wise step for the Colonial Office to enable the scientific members of the staff to devote more time to such investigations as these, most of which can only be undertaken successfully by such men with special training and experience, who are at present deterred from undertaking it by the pressure of routine work.

We observe that satisfactory working arrangements have been concluded with agricultural and other technical departments in the colonies, by which only such investigations are conducted at the institute as require special knowledge and experience, or are of a technical character needing reference to manufacturers at home. The colonies are thus left free to devote attention to such work as can best be accomplished on the spot, whilst relying on the Imperial Institute for the conduct of investigations which can most usefully be carried out by a central department at home.

Brief mention may also be made of two other branches of activity.

The "Bulletin of the Imperial Institute" serves as a medium for the publication of the more important official reports of investigations, and also for the dissemination of information respecting developments in tropical agriculture and the utilisation of raw materials. This quarterly publication is stated in the report to have a large and increasing circulation in this country and the colonies.

The public exhibition galleries contain exhibits representative of the natural resources of practically all parts of the Empire. Their reorganisation has been in progress since 1903, and new products, maps, statistical diagrams, &c., are continually being added, with the view of rendering the "Court" allotted to each British possession as representative as possible of its present economic development. The report mentions that special facilities are now afforded to schools, with the object of rendering the exhibition galleries useful as a means of teaching the geography of the colonies and India, and that these facilities are being taken advantage of to an increasing extent.

The Imperial Institute in its new *régime* still suffers to some extent from the prejudice created by its false start. Now that it has justified its existence and shown that it can render services of great importance to the Empire, it may be expected that something further will be done to strengthen its general and financal position. The present report shows that its operations are hampered for want of space. The arrangements made with the Government by the former corporation included the occupation of a portion of the building by the administrative offices of the University of London. In view of the increasing need, both of the university and the institute, for adequate accommoda-

[1] Report on the Work of the Imperial Institute. 1906 and 1907. Colonial Reports—Annual Series, No. 584. By Prof. W. R. Dunstan, F.R.S.

tion in which to carry on their work, which, though entirely different in character in the two cases, is of great importance to the nation, the situation will before long require reconsideration, as new conditions have arisen since the arrangement was entered into in 1903.

BALTIMORE MEETING OF THE AMERICAN ASSOCIATION.

THE sixtieth annual meeting of the American Association for the Advancement of Science and of the several affiliated societies was held at Baltimore, Md., on December 28, 1908, to January 2, 1909. In practically all respects the meeting was the most successful in the history of the association. It was the largest meeting ever held, and the total attendance is estimated at about 1800. In addition to the several sections of the association, important meetings were held by the following bodies:—

The American Society of Naturalists, the American Society of Biological Chemists, the American Anthropological Association, the American Folk-lore Society, the American Philosophical Association, the American Physical Society, American Psychological Association, American Physiological Society, American Society of Vertebrate Palæontologists, the American Chemical Society, American Society of Zoologists, American Nature-study Society, American Mathematical Society, the American Federation of Teachers of the Mathematical and the Natural Sciences, American Institute of Electrical Engineers, American Alpine Club, Association of American Geographers, Association of Economic Entomologists, the Botanical Society of America, the Entomological Society of America, Geological Society of America, Society of American Bacteriologists, Association of American Anatomists, Southern Society for Philosophy and Psychology, the Sullivant Moss Society, and the Wild Flower Preservation Society.

The address of the retiring president of the association, Prof. E. L. Nichols, of Cornell, was entitled "Science and the Practical Problems of the Future," and was printed in an abridged form in last week's NATURE. It was an address of very broad bearing, written by an eminent physicist and at the same time by one engaged in university work. It contained a strong plea for research work in pure science at the universities. The addresses of the vice-presidents, that is, presidents of sections, were all upon important topics. Vice-president Wilson, before the section of zoology, spoke on recent researches on the determination and heredity of sex; Vice-president Talbot, before the section of chemistry, spoke of science teaching as a career; Vice-president Crowell, before the section of social and economic science, spoke on the influence of science on investments; Vice-president Lovett, in mathematics and astronomy, had for a title "The Problem of Several Bodies: Recent Progress in its Solution"; Vice-president Miller, before the section of physics, spoke on the influence of the material of wind instruments on the tone quality; Vice-president Bessey addressed the botanists on the subject of the phyletic idea in taxonomy; Vice-president Hektoen, before the section of physiology and experimental medicine, spoke of opsonins and other anti-bodies; Vice-president Boas addressed the section of anthropology and psychology upon the important topic of race problems in America; and Vice-president Landreth, before the section of mechanical science and engineering, spoke of governmental control of public waters.

The addresses all through the meeting assumed in general an aspect of great interest. Dr. Bogert's address as retiring president of the American Chemical Society was on the subject of the function of chemistry in the conservation of natural resources; Prof. Muensterberg, as president of the American Philosophical Association, spoke on the problem of beauty; the address of the president of the American Society of Naturalists, Prof. Penhallow, of McGill University, was entitled "The Functions of the American Society of Naturalists"; Vice-president Brown, before the section of education, dealt with world standards of education.

The public addresses were of extreme interest. Prof. E. B. Poulton, F.R.S., of the University of Oxford, addressed a large audience on the subject of mimicry in the butterflies of North America; Dr. Albrecht Penck, of the University of Berlin, spoke on the same night before an equally large audience on man, climate, and soil; Mr. W. A. Bryan, of Honolulu, gave a public lecture on a visit to Mount Kilauea, illustrated by moving pictures—this address was appropriate in view of the proposed visit of the association to Hawaii in 1910. An important feature of the meeting was an address by Major Geo. A. Squier, of the United States Army, before the section on mechanical science and engineering, on the subject of recent progress in aëronautics, which was followed by the decision of the section to devote special attention to the field of aëronautics in its future work.

Several symposia of great interest were held during the meeting. That given under the auspices of the section on social and economic science, on the subject of public health, was listened to by a large audience, and included papers by Dr. Wiley, on the nation's pure food problem; by Dr. Howard, on the economic loss to the people of the United States through insects that carry disease; by Mr. Horace Fletcher, on vital economics; by Prof. Irving Fisher, on the movement for health reform; and by Surgeon-General Wyman, on public health administration. The same section held symposia on tariff reform and on stock exchange regulation. An important symposium was held under the section of physiology and experimental medicine on the regulation of physical instruction in schools and colleges from the standpoint of hygiene. The section on geology held a symposium on the subject of correlation, in which the most eminent geologists of the United States took part, and the section on physics held a session at which papers of general interest to scientific men of other specialities were presented.

Possibly the event of greatest general interest was the Darwin memorial day programme, held on Friday, January 1. Prof. E. B. Poulton, F.R.S., was present from England at the invitation of the association to take part in the exercises of the day. Introductory remarks were made by the president of the association, Prof. T. C. Chamberlin, of the University of Chicago, and the following addresses were given:—

The theory of natural selection from the point of view of botany, by Dr. John M. Coulter, of the University of Chicago; fifty years of Darwinism: past and future experimental work bearing on natural selection, by Prof. E. B. Poulton, of Oxford University; the cell in relation to heredity and evolution, by Dr. E. B. Wilson, of Columbia University; the direct effect on environment, by Dr. D. T. MacDougal, of the Carnegie Institution of Washington; the behaviour of unit characters in heredity, by Dr. S. W. E. Castle, of Harvard University; mutation, by Dr. Chas. B. Davenport, of the Carnegie Institution of Washington; adaptation, by Dr. Carl H. Eigenmann, of the Indiana University; recent palæontological evidence of evolution, by Prof. H. F. Osborn, of Columbia University.

These addresses will be published in a memorial volume, together with the following addresses, which were on the programme, but were not read owing to the necessary absence of the authors:—

Determinate variation, by Dr. Chas. O. Whitman, of the University of Chicago; the isolation factor, by Dr. David Starr Jordan, of Stanford University; evolution and psychology, by Dr. G. Stanley Hall, of Clark University.

At night on Friday, January 1, a Darwin memorial dinner was given, attended by about 300 naturalists. Following the dinner, addresses were given by Dr. W. H. Welch, on the debt of medicine to Darwin; by Dr. Albrecht Penck, on the geographical factor in evolution; and by Prof. E. B. Poulton, on Darwin's life and character. Prof. Poulton was particularly happy in his address, and his visit to America at this time and for this purpose was a great gratification to all the members of the American Association. At the close of the dinner a congratulatory telegram was sent to Dr. Alfred Russel Wallace.

The association decided to meet in Boston during convocation week, 1909–10, and the following plans were laid for future meetings: 1910–11, Minneapolis; summer of 1910, Honolulu; 1911–12, Washington; 1912–13, Cleveland; 1913–14, Toronto. The following officers for the coming year were elected :—

President: David Starr Jordan, Stanford University; *Vice-presidents:* Section A, E. W. Brown, of Yale University; Section B, L. A. Bauer, of Carnegie Institution; Section C, Wm. McPherson, of Ohio State University; Section D, J. F. Hayford, of U.S. Coast and Geodetic Survey; Section E, R. W. Brock, director of the Geological Survey of Canada; Section F, W. E. Ritter, of University of California; Section G, D. P. Penhallow, of McGill University; Section H, Wm. H. Holmes, of Bureau of Ethnology; Section I, Carroll D. Wright, of Clark College; Section K, C. S. Minot, of Harvard University; Section L, James E. Russell, of Columbia University; *General Secretary:* Dayton C. Miller, of Cleveland; *Secretary of the Council:* F. G. Benedict, of Carnegie Institution.

Among the resolutions of general interest passed by the council were one protesting against special legislation against vivisection; another requesting Congress to do away with tariff on scientific books, instruments, and apparatus; and a third requesting Congress to enlarge the scope of the National Bureau of Education.

Much pleasure was expressed during the meeting at the very courteous action of the British Association in making the officers of the American Association honorary members for the coming Winnipeg meeting, and in offering to the fellows and members of the American Association membership in the British Association for the meeting on the same terms as old members of the British Association, including the receipt of the report of proceedings of the meeting. It seems certain that there will be a large attendance of members of the American Association at the Winnipeg meeting.

THE PROMOTION OF RESEARCH.[1]

THE question of the promotion of research is one which makes a very direct appeal to scientific men, most of whom have at some time or other been confronted with the difficulties raised by it. In a little volume which has reached us a scheme is outlined for the promotion of scientific research, under which public money may be awarded to persons making discoveries prescribed by Parliament. According to the scheme, any person who has made such a discovery may apply for a grant, the application being accompanied by a specification of the discovery. The specification is examined for formalities and for novelty of subject-matter, and afterwards all the specifications accepted in one year are submitted to an investigation as to the nature and novelty of all the discoveries for that year, grants being then made in relation to the discoveries which comply with the terms prescribed by Parliament.

It will be seen from this brief statement of the scheme that it bears a close resemblance to the grant of Letters Patent to inventors, and, in fact, the scheme is based on the Patents Acts. The patent law enables an inventor to obtain a grant, not of money, but of a monopoly, for a limited time, and by somewhat similar procedure the scheme enables a person making a discovery prescribed by Parliament to obtain a grant, not of a monopoly, but of money. There can, unfortunately, be no doubt that many discoverers have hitherto met with very inadequate remuneration, and that some have not been recognised at all. While it is doubtful whether the establishment of such a scheme would enable discoverers to be remunerated adequately, it would certainly provide for the recognition by the State of "true and first discoverers," and to this extent at least would diminish injustice and encourage scientific research. It might also exert a powerful, though indirect, effect on manufacture, for if such a scheme had been established, and if Parliament had prescribed, say, discoveries relating to glass for optical instruments, how different might have been the position to-day of English manufacturers of optical instruments.

The adoption of such a scheme could without doubt be utilised to accelerate the solution of some of the important problems of physical and chemical science, and many of the life and death problems of medical and biological science.

[1] "A Scheme for the Promotion of Scientific Research." By Walter B. Priest. 2nd edition. Pp. iv+64. (London: Stevens and Sons, 1908.)

AN INVESTIGATION OF THE SOCIOLOGY AND RELIGION OF THE ANDAMANESE.

THE inhabitants of the Andaman Islands have long been recognised as one of the most primitive races of mankind. By their geographical position and their ferocity towards strangers, they were practically isolated from the rest of the world until 1858. The tribes of the Great Andaman, which constitute by far the largest part of the whole race, are rapidly diminishing in numbers, and are fast forgetting their ancient lore; the next half-century will witness their entire extinction. It was thus highly desirable that a full investigation should be made of these interesting pygmies before it was too late. Through the labours of Mr. E. H. Man and the publications of Sir Richard Temple and Mr. M. V. Portman, a good deal was known concerning the general life of the people, their language, and other subjects, more particularly those of the southern tribes of the Great Andaman. Owing to recent developments in the studies of comparative sociology and religion, it was desirable that Mr. Man's observation should be confirmed and extended.

When the Board of Anthropological Studies in Cambridge was entrusted with the selection of the first Anthony Wilkin student, it had no hesitation in appointing Mr. A. R. Brown, of Trinity College, to undertake this important investigation. He started for the Andamans at the end of August, 1906, and spent two dry seasons of six months each at his field work in the jungles of the Andaman Islands. Mr. Brown was able to confirm a great deal of what Mr. Man had written concerning the southern tribes and to supplement this by a thorough study of the northern tribes of the Great Andaman.

Measurements on the living subjects prove the Andamanese to be a very homogeneous race, with little variation and a strongly marked racial type. In their social structure and magical and religious beliefs they are the most primitive people who have yet been systematically studied. The Australians, so often spoken of as very primitive people, have well-developed totemic and local organisations, a classificatory system of kinship names, and elaborate systems of myths and magical beliefs. The Andamanese have no system of clans, but live in small hordes having little cohesion. Their system of kinship terms appears to be antecedent to the classificatory system. Their myths and magical beliefs are equally simple and undeveloped.

The Little Andamans are still left for future investigation, although Mr. Brown spent three and a half months with these wild islanders. As, however, there was no interpreter, the amount of progress which he made in learning their language was insufficient to enable him to pursue the investigation of their sociology and religion, but he has recorded their material culture. A. C. HADDON.

NOTES.

THE third annual general meeting of the British Science Guild will be held at the Mansion House to-morrow, January 22, at 4 p.m., under the presidency of the Lord Mayor. Mr. Haldane, president of the Guild, will address the meeting, and will be supported by Sir W. Ramsay, K.C.B., F.R.S., Sir F. Pollock, Bart., Sir Aston Webb, R.A., Sir Oliver Lodge, F.R.S., Sir Boverton Redwood, Dr. Bovey, and other speakers.

WE see with deep regret the announcement that Dr. Francis Elgar, F.R.S., whose scientific and practical work in naval architecture is of world-wide renown, died suddenly on January 17 at sixty-three years of age.

THE British Association will meet in Winnipeg from August 25 to September 1 of this year. The president-elect is Sir J. J. Thomson, F.R.S.; and the following sectional presidents have just accepted office:—A (Mathematical and Physical Science), Prof. E. Rutherford, F.R.S.; B (Chemistry), Prof. H. E. Armstrong, F.R.S.; C (Geology), Dr. A. Smith Woodward, F.R.S.; D (Zoology), Dr. A. E. Shipley, F.R.S.; E (Geography), Sir Duncan A. Johnston, K.C.M.G.; F (Economic Science and Statistics), Prof. S. J. Chapman; G (Engineering), Sir William H. White, K.C.B., F.R.S.; H (Anthropology), Prof. J. L. Myres; I (Physiology), Prof. E. H. Starling, F.R.S.; K (Botany), Lieut.-Colonel D. Prain, F.R.S.; L (Educational Science), Dr. H. B. Gray; and subsection, Agriculture, Major P. G. Craigie (chairman). A handbook of preliminary information, drawn up by the local executive committee, may be obtained from the office of the British Association, Burlington House, London, W., or will be sent to applicants enclosing 2½*d*. for postage.

A SUM of 20,000*l*. has been placed in the hands of the trustees of the medical school of the London Hospital to be invested to the best advantage, and the income from it to be expended in the advancement of medical research and the promotion of higher education in medicine. The administrators are the chairman, Mr. Sydney Holland, and two members of the acting staff of the hospital. It has been settled that the money is to be spent on increasing the facilities for research, and not for the routine teaching of candidates for examination. The benefits derived from the gift will not be confined to those students educated at the London Hospital, but will be open to qualified medical men from any part of the British Empire who are willing to give up their time to advancing medical knowledge within the walls of the London Hospital or college. The donor of this munificent gift desires to remain anonymous, in the hope that the fund which he has thus started will be added to by others, and that in time it may become of such magnitude as to be of great use to the present and to all future generations in the fight against, and the prevention of, disease.

AN interesting summary by Dr. H. R. Mill of the rainfall of the British Isles in 1908 appeared in the *Times* of January 16. The discussion is only a preliminary one, containing results of observations at ninety representative stations, and comparisons with the average of the last thirty years. A complete discussion of the data will appear later in "British Rainfall," but the author remarks, "the laborious re-computation from all the *data* ultimately available rarely shows the preliminary estimates to be much in error, though, of course, greater detail becomes possible." The production of the present summary in so short a time reflects great credit on the promptitude of the voluntary observers and on the staff of the British Rainfall Organisation. The figures show that the year was technically dry; the following are the percentages of the average for the general rainfall:—England, S., 86; Wales, 95; England, N., 91; Scoland, 98; Ireland, 101; British Isles, 93. The monthly values are, of course, much more variable than the annual; the author summarises them as follows:—"The collective rainfall of the country was above the average from March to the end of September. The dry October brought it back to the average, the dry November greatly reduced it, but a really wet December would have made it up in the end; and even with the moderately dry December the final deficiency, as has been shown, was not very great." June was very dry in England, but less so in other parts. The rainfall for London (Camden Square) was 23·67 inches, an inch and a half below the thirty years' average; but, the author remarks, London is a large place; the general average of the district ranges from about 23 inches in the low-lying parts near the river to at least 27 inches on the encircling girdle of hills.

M. ANTONY POINCARÉ has been elected president, and MM. Eiffel and Maillet vice-presidents, of the French Meteorological Society.

DR. SVEN HEDIN arrived at Stockholm on January 17, and had an audience of the King of Sweden, who presented him with the Grand Cross of the Polar Star. He will give an account of his recent expedition in Tibet at a special meeting of the Royal Geographical Society to be held in the Queen's Hall on February 8.

IT is announced in the *Chemist and Druggist* that Baron Bessières has left a legacy of 3200*l*. to the Pasteur Institute, Paris, to be employed in scientific researches in accordance with special instructions he has left with his executor.

THE seventieth birthday of Prof. G. Lunge will be celebrated on September 15, and a local committee has undertaken to arrange a suitable commemoration of the occasion. Chemists who desire to be associated with this festival should communicate with Dr. E. Berl, Zürich IV, Sonneggstrasse 84.

THE council of the Institution of Civil Engineers, after consideration of the papers on Indian engineering subjects published in the Proceedings for the past session, has awarded the "Indian premium" of the institution for 1908, of the value of 33*l*., to Mr. F. P. Anderson, for his paper on river control by wire net-work.

PROF. E. A. MINCHIN has left England for three months, accompanied by his assistant, Dr. Woodcock, on a visit to the zoological station at Rovigno, in order to carry on researches on the development of the trypanosome of the little owl (*Athene noctua*). All communications should be addressed to him at the Zoologische Station, Rovigno (Istria), Austria.

THE Geological Society of London will this year award its medals and funds as follows:—Wollaston medal, Mr. Horace B. Woodward, F.R.S.; Murchison medal, Prof. Grenville A. J. Cole; Lyell medal, Prof. Percy F. Kendall; Bigsby medal, Dr. John Smith Flett; Prestwich medal, Lady Evans; Wollaston fund, Mr. Arthur J. C. Molyneux; Murchison fund, Mr. James V. Elsden; Lyell fund, Mr. R. G. Carruthers and Mr. Herbert Brantwood Muff.

DURING the past few days the following earthquake shocks have been reported:—*January* 13, *Rome*.—Earthquake shocks at 1.45 a.m. reported over northern Italy. Two distinct shocks with a few seconds' interval. *Vienna*.—Slight earthquake shocks at many points in the southern part of Austria, extending from Serajevo to Trieste. *January* 15, *Cape Town*.—Several shocks of earthquake have been felt recently in various parts of South Africa. One was felt at Johannesburg on this date.

PROF. RICCO, director of the Catania Observatory, who has just returned from Calabria, has stated to a correspondent of the *Times* that the quay and the houses at Reggio which stood near the landing quay of the ferry-boat have sunk considerably as a result of the recent earthquake; the point of the new jetty was actually under water. The sea wave, he says, reached a height of 11 feet at Villa San Giovanni, 13 feet at Pellaro, and rather more at Lazzaro; at Catania it was nearly 7 feet high, and at Messina 6½ feet, though it did more damage at Messina than elsewhere.

THE death is reported of Prof. G. W. Hough, professor of astronomy at the North-Western University, Evanston, Illinois. Prof. Hough was born in New York State in 1836. After holding a subordinate post at the Cincinnati Observatory, he was appointed in 1860 director of the Dudley Observatory, Albany. In 1879 he became director of the Dearborn Observatory, Chicago, and professor of astronomy at Chicago University. He was appointed to his chair at Evanston in 1887. He published many reports embodying his discoveries, which were particularly concerned with double stars and with the planet Jupiter, and invented several instruments for use in astronomical and meteorological investigations.

THE late Prof. Tait contributed to NATURE between the years 1887 and 1893 a valuable series of papers on the physics of golf. It is interesting to note that these scientific articles are becoming a kind of classic, from which writers on the game quote with assurance. In *Golf Illustrated* for January 1, a contributor, by means of a searching analysis of Prof. Tait's writings, shows how mythical must be the story, so familiar on all golf links, that the redoubtable F. G. Tait in 1893 disproved his father's supposed dictum by driving a golf ball further than had been declared from mathematical calculation to be possible. So early as 1891 (see vol. xliv. of NATURE) Prof. Tait had begun to see the explanation of the prolonged flight of a golf ball, and he was the last man to dogmatise on a scientific problem which still demanded a complete solution. It is said that he never denied the mythical tale; but was the question ever distinctly put to him? Moreover, it should be remembered that Prof. Tait enjoyed a good story to the full. No doubt the genial banter between father and son when the historic drive was made goes far to explain the germ of the myth.

THE British Museum was opened on January 15, 1759, and therefore completed a century and a half of existence on Friday last. An interesting article in the *Times* of January 14 describes the origin and work of this great national institution. It is of particular interest to recall that Sir Hans Sloane, who was Newton's successor as president of the Royal Society, was chiefly responsible for the foundation of the museum, and that the main lines of its present constitution are laid down in his will. He made vast collections of specimens relating to natural history and antiquities; and the Act of Parliament of 1753, to which the museum owes its formation, states that one of the objects is "the purchase of the museum or collection of Sir Hans Sloane." The first directing officer of the museum, styled the principal librarian, was a man of science—Dr. Godwin Knight—known for his improvements of the mariner's compass. Until 1865 the chief accessions were specimens relating to classical antiquities, but upon the death of Mr. Henry Christy in that year, the museum accepted his ethnographical and prehistoric collections. In 1880 the natural history collections were removed to the new building provided for them at South Kensington, and it is becoming evident that further separation of the museum and the library must be contemplated. Upon this point the Times remarks:—"In the future the inevitable and constant growth of the library will call for additional space, and the ultimate separation of the national museum and the national library will undoubtedly come. Such a division is unquestionably more natural than the present state of things, which we accept because it has been of slow and unnoticed growth. The separation of the natural history collections may be described as beneficial to both sides of the museum, and may well serve as a precedent for the Government in the future, whenever the question may arise."

PRESIDENT ROOSEVELT has signed, says *Science*, a proclamation setting aside and naming the Ocala National Forest in Marion County, in eastern Florida, the first created east of the Mississippi River, and another proclamation creating the Dakota National Forest in Billings County, North Dakota. The two proclamations add two more States to the list of those wherein land will be put under scientific forest administration. There are now nineteen States, and Alaska, having national forests. Before the creation of the Ocala, in Florida, the two forests in Arkansas, the Ozark and the Arkansas, were the easternmost national forests. Practically all the other national forests are in the Rocky Mountain and the Pacific coast States. The Florida forest has an area of 201,480 acres, of which about one-fourth has been taken up under various land laws. It covers a plateau between the St. John's and Ochlawaha rivers, and at no point is an elevation exceeding 150 feet above sea-level obtained. The new Dakota national forest consists of 14,080 acres in the Bad Lands region. Its creation is important, for it means that an experimental field for forest planting has been secured in North Dakota, the least forested State in the Union, having only 1 per cent. of tree growth. The Forest Service expects to establish forest nurseries with the hope that in time to come the area may be re-forested by artificial means.

THE annual general meeting of the Institute of Metals was held on January 19, when a paper on the relation between science and practice, and its bearing on the utility of the Institute of Metals, was read by Sir Gerard Muntz, Bart. In this paper attention was directed to the fact that among members of the institute are to be found manufacturers, men of science, and engineers. In some cases the three grades are enrolled in one individual, but generally it will be from the harmonious correlation of the three grades that the benefits of the institute will accrue. After summarising the demands made upon the time and ability of the manufacturer, and pointing out that often cause and effect are noticed and taken advantage of in practice, but the reason why never discovered, and so it happens that the road thus shown is not explored, Sir Gerard Muntz dealt with the work of the man of science. Given, he said, results, cause and effect the man of science, if he persistently devotes himself to the task which is offered him, will probably eventually arrive at the why and wherefore of the matter. The man of science, he continued, has the necessary time; his vocation, as a rule, is embowered "in that cloistered seclusion which allows of consecutive thought and reasoning out of obscure and difficult subjects." No doubt a worthy tribute to the man of science on Sir Gerard Muntz's part, but it would have been more convincing had he made it clearer how the man of science he had in mind gains his livelihood. Referring to laboratory work, Sir Gerard Muntz said that without it nothing can be done; but, he went on, it is not sufficient for the man of science to demonstrate in the laboratory. Science must be reduced to practical form for everyday use before it can be made serviceable in manufacture. The practical worker has to depend on the man of science, and needs guidance in not too elaborate a form.

SYSTEMATIC ornithologists will welcome a list of new generic names proposed for birds during the years 1901 to 1905 inclusive, together with records of a number of older names not to be found in the "Index Generum Avium." The list has been compiled by Mr. C. W. Richmond, of the U.S. National Museum, and is published as No. 1656 of the Proceedings of that institution. The additions to the "Index Generum" are about 350 in number, but a certain proportion of these rank as *nomina nuda*.

A PAPER by Dr. E. D. Van Oort on the birds of the Netherlands, published in vol. xxx., Nos. 2 and 3, of Notes from the Leyden Museum, is illustrated by an exquisite photographic plate of two male barn-owls killed in Holland remarkable for their pure white breasts, totally devoid of black spots. In one the feathers of the disk are likewise nearly pure white, while in the other those on the lower border of the same are tipped with orange-buff and blackish-brown.

THE Journal of the Royal Society of Arts for December 25, 1908, contains the report of a lecture on the birds of India, delivered before the Indian section of the society by Mr. Douglas Dewar. After referring to the fact that India does possess song-birds, and mentioning the fearlessness and numerical abundance of Indian birds and the charm of birds in general, the lecturer proceeded to discuss the scientific study of birds, more especially in connection with natural selection.

IN the twenty-second annual report of the Liverpool Marine Biology Committee, Prof. Herdman laments the decease of two original members of the committee (Messrs. R. D. Darbishire and A. Leicester), as well as of other supporters of the Marine Biological Station at Port Erin. He further deplores the lack of earnest and well-to-do amateur naturalists, who formed the main support of that institution twenty years ago, and pleads the urgency of additional financial assistance if the work and publications (which yearly become more expensive) are to be carried on as heretofore. In response to a desire expressed by certain foreign visitors, Prof. Herdman has included in the report a detailed description, with plans, of the hatchery and hatching-boxes. The work of the institution has been carried on successfully during the year, although the problem of hatching and rearing lobsters has not been solved.

No. 2 of the fourth volume of the Journal of the South African Ornithologists' Union contains the report of the committee for bird-migration for the years 1906 and 1907. Although a very large number of post-cards was circulated, the replies received were disappointingly small, not one out of 100 schoolmasters to whom cards were sent answering the appeal. Six species were entered in the schedule, namely, the swallow, bee-eater, lesser kestrel, greenshank, stork, and white-winged pratincole, and reports on the arrival and departure of these and other species were received from fifteen stations, ranging from Cape Colony to the Orange River Colony and Transvaal. The dates of the arrival of the swallow range from August 28 (Amersfoort, Rolfontein, 1906) to December 6 (Bethulie, 1907); the stork first appeared during 1907 on September 20, but the bulk of these birds seem to have come between November 9 and 24, while greenshanks were seen at three stations in the first half of October. The committee has sent out another series of circulars and cards, to which it may be hoped a larger proportion of replies will be received.

ANOTHER issue (No. 1652) of the Proceedings of the U.S. National Museum is devoted to copepod crustaceans parasitic on fishes from the Pacific coast of North America, with descriptions of several new genera and many new species. The author, Mr. C. B. Wilson, had the opportunity of working at a very extensive collection, which yielded very interesting results. Although the number of new species may appear relatively large, it is stated that a great difference between the Atlantic and Pacific representatives of these parasites is only what was to be expected, and but little was previously known of the latter. "The novelty of the characters of these new forms is of much less importance than the close relationship which they show between species inhabiting widely remote localities. . . . There are close correspondences between the Atlantic and Pacific copepods similar to those found in other groups of animals, particularly, perhaps, in the fishes which serve as hosts for these parasites."

THE first part of vol. iv. (zoology) of the report on the scientific results of the voyage of the *Scotia* during the years 1902–4, under the leadership of Dr. W. S. Bruce, has been received from the Scottish Oceanographical Laboratory, Edinburgh. From the start of the Scottish National Antarctic Expedition to its finish a daily record was kept of the observations of the naturalists both on board the ship and at the summer station. A field notebook, or naturalists' diary, of the expedition was thus secured, and this record is reproduced with no material alterations in the work just published. The interest and value of this zoological log is increased by many very striking pictures of oceanic and Antarctic life and scenes, the thirty-three plates including no fewer than a hundred illustrations from photographs. We propose to defer further notice of the work until other parts of the fourth volume of the report of the expedition have reached us.

THE editorial of the *Indian Forester* (December, 1908) is devoted to a well-merited eulogy of the services rendered to the Government of India by Mr. S. Eardley-Wilmot, the late Inspector-General of Forests. During the six years that he has occupied that post steps have been taken towards the better training and higher qualification of the staff, improved conditions of service, and the inauguration of the research institute at Dehra Dun; further, public opinion has been moved to recognise the value of the forests and to appreciate the work of the forest officers.

IN the Journal of the Quekett Microscopical Club (November, 1908) there is published an account of an investigation, by Mr. A. E. Hilton, into the streaming movements of plasmodia of the Mycetozoa. It is noted that the movements consist of rhythmic alternating currents that reverse on an average about every ninety seconds, and it was found possible to superimpose on the normal currents special movements induced by tapping lightly on a cover-glass placed on the specimen. Thus it is argued that pressure and suction or pulsations in the plasmodium are the cause of the currents, and it is suggested that such pulsations are probably indications of respiration proceeding in the organism.

THE subject of plant fasciations is treated by Miss A. A. Knox in Publication No. 98 of the Carnegie Institution of Washington. Fasciation is applied to stems that deviate from the normal circular shape, becoming more or less flattened, and that often show repeated branching. The plants investigated were *Œnothera biennis*, *Œnothera cruciata*, and other species of the genus. They produce rosettes of closely compacted leaves in the first year, and throw up flowering shoots later. They may either fasciate as rosettes, producing lopsidedness of stem and leaves, or subsequently, when the elongated stems become flattened or branch. Four different methods of forming fasciations are illustrated, but in each case development proceeds from a special meristem. In all cases fasciation is attributed to injuries inflicted by insects, and the author differs from de Vries in considering that the tendency to fasciation is not a heritable factor.

THE third and seventh volumes of the publication *Recueil de l'Institut Botanique Léo Errera*, Brussels—to give the title as modified on the last volume—have recently been issued. This publication originated in connection with the purpose of bringing together the papers emanating from Prof. Errera's laboratory. The third volume, containing contributions by several workers that were published in various journals during the years 1885 to 1900, indicates the wide scope of the research prosecuted there. Several papers by Dr. E. Laurent, notably the account of a study of the organisms giving rise to leguminous nodules, deal with the action of soil and fermentation bacteria. Cultures of the Mucedineæ are described by Mr. A. de Wèvre, the effect of external factors on karyokinesis is discussed by Dr. E. de Wildeman, and the morphological articles by Dr. J. Massart include a valuable thesis on recapitulation and innovation in plant embryology.

To the *Reliquary* for January Mr. J. L. Cowan contributes an interesting paper on aboriginal American industries. The chief and earliest of these is basketry, which was found in an advanced stage when Friar Marcos de Niza visited the south-western States in 1539. The designs are not accidental, nor do they represent the artistic conception of the worker. Each has its traditional significance—the cobweb pattern being connected with offerings to the spider deity, the deer-hunt with gods of the chase, and so on. Even a break in the design marks a place where evil spirits can find exit, instead of being confined to injure the owner. In the same way each colour has its own significance, red being the most sacred, as typifying the life of man. The transition from basketry to pottery, the basket being covered with clay to save it from injury by fire, can here be clearly traced. Pottery still maintains its ancient perfection only among the Hopi and Zuni communities, the former being specially noted for grace of design, artistic decoration, and faultless workmanship. The latest industry is that of blanket weaving. The arts of plaiting and weaving were known to the natives before the arrival of the European, but it is only since the introduction of sheep and goats that the craft of blanket weaving has been developed, with the result that the Navajos now admittedly make the finest specimens in the world.

MISS E. H. HALL has shown some courage in selecting as the subject for a doctorate dissertation at Bryn Mawr College "The Decorative Art of Crete in the Bronze Age," while Dr. A. J. Evans is still engaged at Knossos, and other promising sites in the island still remain unexcavated. This art series, extending over some two thousand years, begins with simple linear geometric ornament, notably with the zigzag motive. This develops into curvilinear designs, among which are motives resembling natural objects which gratify the primitive instinct for imitative art. Later on these exhibit increasing realism; but the non-imitative ornament is even more typical. By the Middle Minoan III. period this is superseded by pure naturalistic design, due to a local school trained under Egyptian influence. In the great palace-building age at Knossos and Phaistos conventional flower designs replace, in part, naturalistic motives. Lastly, we reach the stage of debased forms of naturalistic motives unintelligently copied, indicating not only lack of artistic originality, but the approach of a purely geometric style. Miss Hall's classification and analysis of the evolution of this school of art will probably not meet with general acceptance in all its interpretations, and her conclusions are always liable to be upset by new discoveries, but as it is accompanied by good sketches of typical examples it will be useful to students of this chapter in art history.

UNDER the title "The Diet of the Hindu," we published in November last (p. 42) a descriptive notice of a memoir by Captain D. McCay, in which he showed, in a systematic manner, and after thorough investigation, that a vegetarian diet has a deleterious effect on the metabolism and efficiency of the inhabitants of Bengal. We have received from Mr. Bernard Houghton, of Sagaing, Burma, a letter in reference to this article in which he points out that the Bengalis live in a damp, hot climate, that dhall bulks largely in their food, and that this diet is rich in purine substances. He is inclined to attribute part, at any rate, of their malnutrition to these circumstances. He states that the Burmese, who are rice-eaters, are in the hospital returns free from the diseases Captain McCay alludes to, and he believes that the same is true of wheat-eating Punjabis. In conclusion, he asks whether there is any evidence that these diseases are prevalent amongst the rice-eating Chinese and Japanese peasantry. In reference to these remarks, our reviewer, before whom we laid Mr. Houghton's letter, replies that he did not deal with the inhabitants of the Punjab and of Burma because he is not aware that similar experimental and statistical evidence is available on the metabolism of these people. If there are any differences in the general metabolism of the two classes of vegetarians referred to, they may be due to variation in climatic influences or to the amount of purine substances in the food, but positive statements cannot be made until comparative data and statistics are produced. In reference to Mr. Houghton's last question, attention may be directed to the prevalence of the disease called beri-beri among the rice-eating nations, and that diet is an important factor was very strikingly seen at the siege of Port Arthur. At that date the Japanese Navy had abandoned their rice diet, whereas the Army had not, otherwise the two services lived under the same conditions; beri-beri still continued to decimate the soldiers, but among the sailors it was practically stamped out.

THE Meteorological Office has sent us the monthly meteorological charts (1) of the North Atlantic and Mediterranean, and (2) of the Indian Ocean and Red Sea, for the present month. In addition to the usual statistical information referring to winds, ocean currents, &c., prepared for the month in question from various publications of the hydrographic and meteorological offices in this country and abroad, all available space, both on the face and back of the charts, is utilised by data of much importance to seamen. A cablegram from Canada, dated December 12, 1908, reported heavy, close-packed ice at Quebec and L'Islet. On the back of the Atlantic chart is reprinted a very interesting memorandum on observations of waves and swell, drawn up by the late Sir G. G. Stokes while he was a member of the Meteorological Council. With reference thereto, the remark is made that "We learn from Sir George Gabriel Stokes that the low swells of deep water, which have long periodic times, cause high rollers when they come into shallow water."

WE have received from Dr. J. R. Ashworth a copy of an analysis of the meteorological elements of Rochdale, from observations since 1878, reprinted from the Transactions of the Literary and Scientific Society of that place for 1908. The author has subjected the monthly means to harmonic analysis, and has computed six component curves for each element. This method discovers several interesting points relating to the climate of Rochdale, *e.g.* the fifth subperiod of the rainfall formula exhibits a remarkably large amplitude; the author points out that "its maximum occurs on December 29 and every succeeding 73 days." A comparison with the rainfall at other stations shows, *e.g.*, that at Stonyhurst an equally large value for the 73-day period is exhibited, while at Oxford and Cambridge this subperiod is insignificant. This method is, generally speaking, too laborious for ordinary observers, but Dr. Ashworth's investigation will be of considerable use to students to whom the advantages of exhibiting results in the most concise form and the best means of calculating the constants may be unknown. Perhaps the greatest living advocate of the method is Prof. J. Hann; students will find much valuable information on the subject and on the meaning of the various parts of the formula in his papers in *Himmel und Erde*, vol. vi., parts viii. and ix., and Quarterly Journal of the Royal Meteorological Society, vol. xxv., pp. 40–65 (translation by Dr. R. H. Scott).

VOL. xl. of the Transactions and Proceedings of the New Zealand Institute, issued in 1908, contains several interesting contributions. Mr. R. Speight (p. 16), in a paper on terrace-development of Canterbury rivers, properly emphasises the importance of considering the varying amount of waste material supplied to the streams in successive epochs. Mr. A. M. Finlayson describes the interesting veins of scheelite and quartz that are now mined in the goldfields of Otago, the price of the dressed ore having risen in fifteen years from 20*l.* to 160*l.* per ton. Dr. P. Marshall shows that the so-called gabbro of Dun Mountain consists of grossularite and a pyroxene or an amphibole, and he makes the interesting suggestion that this rock probably results from the digestion of an adjacent limestone in the peridotite magma which provides the well-known dunite. Botany is represented by nine papers, including Mr. D. Petrie's account of a visit to Mt. Hector, 5106 feet in height, in which the changes in the flora, and even in the characters of individual species, at successive elevations are discussed. Mr. H. Guthrie-Smith, in "The Grasses of Tutira," describes the struggle between alien grasses and the returning indigenous species over farm lands watched by him for twenty-five years. The land has already become "sick" of the alien species, and, as its fertility lessens, the hardier native species tend to resume possession, and thus to redress "the balance of nature." There are twenty zoological papers, mollusca being largely dealt with; Mr. W. H. Webster contributes seven new species, which are figured. Strong pleas are put in for the protection of native birds, presumably with the exception of the kea, which Mr. G. R. Marriner again holds up to obloquy. This volume, including as it does 608 pages and thirty-four plates, is a monument to the activity of the local societies and of the central institute that unites them.

EVERYONE who is working at radio-activity at the present time feels the need of a standard of activity in terms of which all measurements of activity can be expressed. It was suggested three years ago by Prof. H. N. McCoy, of the University of Chicago, that the activity of one square centimetre of a layer of suitable thickness of uranium oxide, U_3O_8, would furnish an excellent standard. In the December (1908) numbers of the *American Journal of Science* and of *Le Radium* Prof. McCoy gives an account of the work he has done, in conjunction with Mr. G. C. Ashman, to show that such a layer has all the properties required in a standard. The oxide is easily prepared, and samples prepared from three different sources gave identical results. A layer of thickness such that 0·02 gram goes to the square centimetre gives the maximum activity due to the α rays. The radiation due to the β rays is small.

MESSRS. H. F. ANGUS AND CO., 83 Wigmore Street, Cavendish Square, have just issued a summary of catalogues of apparatus for testing and correcting vision, relative magnification, actual magnification, projection, prismatic work, angular and linear measure, and other scientific observations. Of particular interest is the announcement of a series of demonstrations on the manipulation of the microscope and its accessories, free to all who care to avail themselves of them. These demonstrations should be of real service in showing what can be accomplished by modern instruments and preparations.

THE "Science Year Book and Diary" for 1909 is now available. It is edited, as in former years, by Major B. F. S. Baden-Powell, and maintains the distinguishing characteristics to which attention has been directed in these columns on previous occasions. Among other additions in the present issue may be mentioned a table of the vegetable kingdom specially compiled by Dr. Rendle, of the British Museum. The frontispiece consists of an excellent portrait of Sir William Ramsay, K.C.B., F.R.S. The book is published by Messrs. King, Sell and Olding, Ltd., Chancery Lane, London, and its price is 5*s.* net.

MESSRS. MACMILLAN AND CO., LTD., have published a new edition of Mr. T. A. O'Donahue's "Colliery Surveying." The book was reviewed on its first publication in NATURE of March 11, 1897 (vol. lv., p. 438). It is only necessary to add that extensive revisions and additions have been made in the present issue.

OUR ASTRONOMICAL COLUMN.

PERIODICAL COMETS DUE TO RETURN THIS YEAR.—In a letter to the *Observatory* (No. 405, January, p. 56) Mr. Lynn directs attention to the periodical comets which may be re-discovered during the current year.

Halley's comet cannot be reckoned among those of 1909, for its perihelion passage does not take place until next year, but it seems likely that it will be re-discovered, at least photographically, before the present year closes.

The only short-period comet likely to be re-observed is that generally known as Winnecke's, because he, after re-detecting it in 1858, proved its identity with the object discovered by Pons in 1819. The period is about 5½ years, and it was re-observed in 1869, 1875, 1886, 1892, and 1898; on the latter occasion it passed perihelion on March 20, so it should become observable early this year. In 1880 and 1903 it was unfavourably situated, and was not seen.

THE CHANGES IN THE TAIL OF MOREHOUSE'S COMET.—In No. 4297 of the *Astronomische Nachrichten* (p. 1, January 9) Prof. Max Wolf discusses the forms and motions which successively occurred in the tail of comet 1908*c*, as shown by measurements of photographs taken at the Heidelberg Observatory.

Prof. Wolf gives the results of his measures of pairs of photographs taken at definite intervals, and shows that the matter forming the tail appears to have been expelled in waves, these waves being shorter than the similar ones seen in Daniel's comet. The length of these waves appears to be approximately proportional to their distance from the nucleus, whilst their amplitude is still nearer proportional to their distance.

Examined in the stereoscope, these wave-forms take a screw-like appearance, the south-eastern edge of each condensation or cloud appearing to be nearer to the observer than the north-western edge. In general, the measures show that recognisable condensations travelled with a greater velocity as they receded further from the head.

THE MAGNETIC FIELD IN SUN-SPOTS.—In No. 4, vol. xxviii., of the *Astrophysical Journal* Prof. Hale publishes a full discussion of the recent work which led him to recognise the existence of powerful magnetic fields in sun-spots.

As previously described in NATURE (August 20, 1908, No. 2025, p. 368), these fields were demonstrated by the appearance of the Zeeman effect in connection with certain lines in the sun-spot spectrum. Subsequent work has amply confirmed the conclusions then arrived at, and one or two difficulties have been removed. One of these difficulties was that certain doublets did not appear as triplets even when the spot was as much as 60° from the centre of the sun; another was that the iron line at λ 6302·71 appeared as an asymmetrical triplet in the spot spectrum, and was accordingly classed as a doublet with an interfering line of some other element. Work on laboratory spectra, carried out by Dr. King, has, however, shown that these apparent anomalies occur in the terrestrial spectra, and are therefore real phenomena due to the magnetic field.

THE SPECTRUM OF MARS.—The occurrence of the *a* water-vapour band in the spectrum of Mars, previously reported briefly, is discussed at some length by Mr. Slipher in the December (1908) number of the *Astrophysical Journal* (vol. xxviii., No. 5, p. 397), and illustrated by reproductions of the convincing spectra obtained by the author at the Lowell Observatory.

Previous investigators of the question of water-vapour bands in the Martian spectra have been at a loss because, whilst visual observations were necessarily unconvincing, photographic observations of the most suitable region of the spectrum, the *a* band, were very difficult. Mr. Slipher used especially bathed plates, which gave good spectra of this region, and by taking a comparison spectrum of the moon on the same plate, with the altitudes of the planet and the moon approximately the same, he obtained indubitable evidence that water-vapour plays an important part in the planet's absorption.

The photographs reproduced show the reinforcement of the *a* band in the spectrum of the "low sun" as compared with the "high sun," and then show the strong reinforcement of this band in the spectrum of Mars as compared with that of the moon; whilst, on the photographs compared, the other lines and bands of the Martian spectrum are generally weaker than they are in the moon, the *a* band is, without any question, appreciably stronger.

More observations are necessary before the amount of water-vapour in the planet's atmosphere can be stated, but the results favour the existence of "snow caps" and a moderate temperature rather than "hoar-frost caps" and a low temperature for Mars.

A BRILLIANT METEOR.—Mr. P. Evans, of Kettering, reports that he observed a brilliant meteor at that place on January 11. The object appeared at 8h. 10m. p.m., its head being very bright, "like burning magnesium," and followed by a tail 10° or 15° long; Mr. Evans adds that the meteor was seen low down in the west, and travelling in a southerly direction.

CAMELOPARDALIS, CAMELOPARDALUS, OR CAMELOPARDUS?—Prof. E. C. Pickering devotes Circular No. 146 of the Harvard College Observatory to a discussion of the proper spelling of the name of this constellation, named by Hevelius in 1690, in order that a uniform spelling may be rigidly adopted by astronomers when making references to it.

After consulting the classical, zoological, and astronomical authorities, he concludes that the correct spelling is Camelopardalis.

REPORT ON AFFORESTATION IN THE UNITED KINGDOM.

THE second report (on afforestation) of the Royal Commission appointed to inquire into and to report on certain questions affecting coast erosion, the reclamation of tidal lands, and afforestation in the United Kingdom has just been published as a Blue-book (Cd. 4460, price 6*d*., Wyman and Sons, Ltd., 109 Fetter Lane, E.C.).

It will be remembered that in March, 1908, the terms of reference of the Royal Commission on Coast Erosion were extended so that the commission should inquire and report "Whether in connection with reclaimed lands or otherwise, it is desirable to make an experiment in afforestation as a means of increasing employment during periods of depression in the labour market, and if so by what authority and under what conditions such experiment should be conducted."

We propose to discuss the report later, and only give now the summary of the conclusions of the commissioners.

SUMMARY OF PRINCIPAL CONCLUSIONS.

(1) The natural conditions of soil and climate in the United Kingdom are favourable to the production of high-class commercial timber such as is annually imported into the country in very great quantities.

(2) The afforestation of suitable lands in the United Kingdom, if undertaken on an adequate scale and in accordance with well-recognised scientific principles, should prove at present prices a sound and remunerative investment.

(3) In estimating the profits of sylviculture account must, moreover, be taken of two facts, the increasing consumption of timber per head of population all over the world, in spite of the introduction of alternative materials, and, further, the exploitation, waste, and destruction by fire of the virgin forests, especially those yielding the more important building timbers. Already a noticeable shortage of timber supply has resulted, as is evidenced by steadily rising prices and depreciating qualities in all markets. It seems impossible to escape from the conclusion that this tendency will be continued and accentuated, and that a steady and a very considerable rise in prices may be looked for throughout the present century. The security which afforestation offers for investment is therefore likely to be an improving one, with a corresponding increase in profits, but, to avoid all that is speculative, this prospect has been disregarded in framing our estimates.

(4) The amount of land suitable for afforestation, but not now under timber, in the United Kingdom may roughly

be put at a maximum of 9,000,000 acres. In determining this figure two considerations have been taken into account, besides elevation and physical suitability of soil. The first is that the value of the land is not in excess of a sum on which a fair return may be anticipated on the expenditure. This will naturally vary according to the productive capacity of the soil and the crop which it will carry. The second consideration is that the land could not be more profitably utilised in any other way.

(5) A forest of 9,000,000 acres, in which are represented the various series of age-classes, may be expected to yield 9,000,000 loads annually in perpetuity. The importation of foreign timber from temperate climates into the United Kingdom in the year 1907 exceeded 8,500,000 loads, or approximately the annual supply which could be expected from the afforestation of the above-mentioned area.

(6) The withdrawal of 9,000,000 acres from its present uses would cause some gradual curtailment of food supplies and displacement of labour. Land suitable for afforestation is mostly devoted to the production of mutton. Calculations on the basis of the present consumption show that at most 60,000 tons, or 4·8 per cent. of the total home production of meat, or 2·6 per cent. of the present national consumption, would be ultimately displaced. As to labour, the employment furnished by the present uses, mostly sheep farming, to which the land in question is devoted, may be taken to average one man to 1000 acres. This does not represent one-tenth of the permanent employment afforded by the maintenance of a similar area of land under forest.

(7) Systematic sylviculture aims at the production of a steady and continuous supply of marketable timber. To ensure the maintenance of these supplies the area should be divided for planting by the average number of years which the crop needs to mature; for example, if the life of the crop be taken as eighty years, the area to be afforested every year would, out of a total area of 9,000,000 acres, be 112,500 acres. But a more rapid system of planting may be adopted without seriously complicating the rotation, and further, some adaptation to the temporary fluctuations of the labour market is feasible.

(8) The distribution of this 9,000,000 acres of suitable land is somewhat irregular. By far the largest areas are to be met with in the west and north of England, and throughout similar regions in Scotland. Ireland and Wales also contain a relatively large amount of this type of land. In the south and east of England, on the other hand, the areas in the aggregate are less extensive. Great diversity exists in the size of these areas, some counties offering large contiguous stretches, while in others the areas are characterised by their discontinuous nature.

(9) The administration of national forest lands should be entrusted to special commissioners.

(10) In dealing with these lands, subdivision into distinct districts, with an executive and administrative subcentre, commends itself from various points of view. Thus local employment would be afforded, local subsidiary industries would be encouraged, public recreation grounds would be provided, and, in connection with the establishment of such forests, small holdings would undoubtedly be multiplied.

(11) Sylviculture in the United Kingdom is an enterprise which rarely appeals to the private landowner or capitalist. The prolonged time for which capital must be locked up before any return can be expected, the loss of rent and burden of rates over the whole period, and the absence of security for continuous care and management, act as deterrents. None of these objections applies to the State, the corporate life and resources of which lend themselves in an especial degree to an undertaking of this character. If the State plants, it will certainly reap, which the individual owner can rarely hope to do.

(12) If afforestation be promoted on a large scale the provision of suitable lands is the first step. For this purpose a general survey should be made, and the extent and distribution of such lands ascertained. As a rule, it will be found expedient for the State to purchase from time to time such areas as are destined for planting, but some progress may conceivably be made along the lines of profit-sharing, in which case the owner would forego the purchase price. Experience proves that, although much of the land required may be expected to be purchaseable by voluntary treaty, yet compulsory powers would be necessary to facilitate transactions where voluntary treaty had broken down. The principle laid down in the Small Holdings Act of 1907 for the acquisition of lands should govern these proceedings as to arbitration, restrictions, and safeguards. Where private owners can satisfy the Forest Commissioners that they are able and willing to afforest under their supervision and to their satisfaction, and give an undertaking to that effect, compulsory powers should not be enforced against such owners so long as that undertaking is fulfilled.

(13) The value of land falling within the definition of "suitability" may be taken, except in rare instances, to lie between 2*l.* and 10*l.* freehold value; but the average value of suitable lands, including the necessary buildings and other preliminary equipment, may be taken as 6*l.* 10*s.* per acre, and the average cost of afforestation also at 6*l.* 10*s.* per acre. If 150,000 acres be annually taken in hand, a sum of about 2,000,000*l.* would be needed annually to finance the undertaking.

(14) Money expended in afforestation differs in kind from other calls on the national purse. It is a productive investment of capital. To provide this capital sum out of taxes would be an act of unprecedented generosity on the part of the present generation of taxpayers in favour of their posterity. No stronger justification for proceeding by loan than a reproductive outlay exists. The loan should be based on actuarial calculations showing initial cost, expenses of upkeep and management calculated at compound interest over the whole period, and the value of the property when fully matured. Such actuarial statements we have given, which show, for the full scheme, that, after allowing 3 per cent. compound interest on all the capital invested, the approximate equalised revenue would at the end of eighty years amount to 17,411,000*l.* per annum, while the value of the property might be expected to be 562,075,000*l.*, or 106,993,000*l.* in excess of the sum involved in its creation. A smaller scheme, involving the afforestation of 6,000,000 acres (75,000 acres annually for eighty years), would show a profit of about 10,000,000*l.* annually, or a capital value of 320,000,000*l.*, being 60,944,000*l.* in excess of the cost of production.

(15) Coming to ways and means by which a loan of this character may best be provided, a point of great importance to be borne in mind is that, although the period of rotation of a timber crop may be taken as eighty years, yet, after forty years, owing to the value of thinnings and the receipts of some short-period crops, the forest becomes practically self-supporting. Between the fortieth and eightieth years, the sales of timber will be sufficient to meet the annual charges, including the upkeep and the extension of the forest. After the eightieth year a large annual revenue will be derived. These considerations point to a free loan from the Treasury to the Forest Commissioners; the net deficit to be met would in the first year be 90,000*l.* or 45,000*l.*, according to the extent of the operation, and would reach its maximum in the fortieth year, amounting in that year to 3,131,250*l.* or 1,565,625*l.* After this period the deficit would be insignificant, while in the eighty-first year the revenue derived would be 17,411,000*l.* or 10,000,000*l.* respectively, representing about 3¾ per cent. on the total accumulated costs of the undertaking.

(16) On the question of labour and its relations to forestry, the conclusions to which the evidence before them leads your commissioners are that the operations involved in afforestation vary in the degree of requisite skill from little or none in rough road-making and surface draining to a considerable amount in the planting. Your commissioners wish to make it clear that they have in contemplation a scheme of national afforestation on economic lines. They have no hesitation in asserting that there are in the United Kingdom at any time, and especially in winter, thousands of men out of work for longer or shorter periods who are quite ready and able to perform the less skilled work without previous training, and with satisfactory results. There is a still larger class of unemployed who are capable of being trained to perform this or the

higher class of labour, and such men can, if desired, be recruited through labour colonies, distress committees, labour bureaux, or charitable agencies. There is, then, no need to accept inefficient labour with the object of affording occupation to the unemployed. The labour employed in the national forests should not fall below the ordinary standards, and should be remunerated at the ordinary rate of the district for similar labour. Subject to the requisite standard of efficiency being attained, preference should be given to those temporarily or permanently unemployed in the district, especially where evidence of such efficiency can be furnished by public or private agencies for the reclamation and training of the unemployed class.

(17) To establish afforestation on commercial lines does not, however, preclude its being used as an instrument of social regeneration. A broad view of economics cannot exclude from its cognisance the grave national charge which unemployment with all its concomitant results involves, to say nothing of the personal deterioration by which it is often accompanied. Sylviculture is not unsuitable for building up the moral and physical fibre of even the most depressed of the unemployed classes, and its agency may well be invoked for this purpose, and advantage taken of its healthy and wholesome influences, provided that any additional expense incurred by the employment of less efficient labour be defrayed from a separate account.

(18) In estimating the amount of employment furnished by afforestation, it is well to distinguish between the temporary labour involved in the creation of the forest and the permanent labour needed for its maintenance. Taking varying circumstances into consideration, it may be said that, on the average, it will take twelve men to afforest 100 acres in the planting season of four to five months, and that every 100 acres afforested will provide permanent employment for at least one man. If 150,000 acres be annually taken in hand, the labour of 18,000 men will be needed, and permanent employment will in due course be afforded to 1500 men, rising by an additional 1500 every year until the end of the rotation. The number permanently employed would then approach 100,000. The labour absorbed by felling and converting timber, to say nothing of subsidiary industries which spring up around a timber supply, has been considered too remote to warrant detailed estimation, but there is undoubtedly a large field of employment in this connection. It is important to remember that, on the basis of 1,000,000*l*. being annually spent on the operations of afforestation, apart from the cost of the land, employment would be afforded, directly and indirectly, to many more than 18,000 men. Indeed, the number employed may be roughly taken to be represented by about double that figure. For the incidental occupations, such as building, the making of implements, the provision of materials, &c., all involve the employment of additional labour.

(19) A special advantage of forestry in relation to labour is that it offers a new source of employment. The labour connected with timber and timber products imported into the country is performed abroad, and thousands of families are maintained on the produce of the labour associated with the timber industry. Another advantage bound up with the extension of sylviculture is that the market for its produce is so great that it is inconceivable that it could seriously interfere with the output from private woodlands, and no difficulty of competition between the State and individuals need be apprehended.

(20) The acquisition of grazing areas, private or common, for sylviculture might necessitate a modification of the existing agricultural system on certain farms. It is unreasonable to suppose that the remaining lowland areas on such farms could not, in many cases, either be adapted to other forms of agriculture or be profitably utilised for small holdings. Further, the conversion of comparatively unprofitable lands into forests enhances the productiveness of the adjacent areas, and should materially assist the small holdings movement. It has also the advantage of furnishing winter employment to small holders.

SCIENCE MASTERS IN CONFERENCE.

THE Association of Public School Science Masters held its ninth annual meeting at the Merchant Taylors' School on January 12, under the presidency of Sir Clifford Allbutt, K.C.B., F.R.S., who delivered an address entitled "The Function of Science in Education."

"If," he said, "our fathers looked out from a darker world upon a narrower dawn, it was upon an intenser light and a nearer vision than ours. We know better where we are, it is true; we can see more—we certainly run after more; but are we pressing as keenly forward on the line of promise? We are cutting and paving the road better for the throng upon the route; but the engineer who maps and makes the road may be too busy to regard the forerunners who, heedless of moss and rock, are crying to the multitude to cast aside every weight and race forwards to the light. Still, both prophet and engineer are needful to us, and it is a straight and business-like inquiry for men of science to ask themselves how far they are engineers, how far prophets.

"The home and the school should develop the service of the child, the imagination of the child, his intellect, and his ethics. Morals cannot yet be explained to him scientifically; the help of science to ethics will be recognised later. If scientific training does not generate the passion for righteousness, by its ordinances these aspirations are directed and fortified. Until the conceptions of modern science had permeated us, we had no full sense of the unity of society nor of our duty to our neighbour. As now the survival of the fittest has become an emulation, not of individuals, but of social groups, it is the most coherent groups which will govern the earth. In science may be discovered the sanctions of simplicity, sincerity, and brotherhood to chasten a luxurious age, such as in former times literature alone, even an Augustan literature, failed to regenerate.

"What do we mean by science? We do not contemplate experimental science only, we include the pristine idea of all orderly knowledge, of analysis of concepts for the construction of systems of affirmative propositions. There is no branch of education, or of the business of life for which it is to fit us, which science is not busily re-handling, remodelling, and re-interpreting. This is not to say that the methods you and I represent are to become sole masters of mankind. Action may be sicklied o'er by too much thought, by too much analysis, and herein is engendered that distrust—reasonable and unreasonable—which the humanist has always felt of the man of science. The humanist winces to see the flower of literature stiffened into a diagram. My point of view demands the pursuit of what is called 'classical' culture, not as in itself education, but as a constituent of education.

"The British boy, generically speaking, is a very matter-of-fact little person; very serious, very curious, and very handy. It is from his great example *man* that he may learn flippancy, satiety, mental inertia. In our educational methods do we foster the precious seriousness of the boy? Do we feed his curiosity, or do we snub and disgust it, so that when he leaves school all or much of his natural ardour for knowledge is blighted? All schoolmasters must learn, what the science-master can teach them, that, if by his own hands the boy can contrive no great art, yet it is immediately by promoting the activity and precision of his nervomuscular system that nature is building up, not his practical brain only, but also much of the hive of his mind—not to mention the congruities of bodily sanity. The boy will tolerate drudgery if his seriousness is not fatigued, and if his eyes are lifted continually over the dry intermediate task to realise what he is to see at the end of the hard high road. He must be led, not only to do the right things, but also to enjoy them. (By the way, is there a public-school playing-field in England which has been accurately surveyed and mapped by the boys?) The boy's curiosity might be better cherished by a more comprehensive literary outlook. By the new history, the new archæology, the new geography, the 'classics' are indeed becoming more of a living subject; we are bold enough to claim that it is by science that these changes have been wrought, and that, without leaving other studies undone, natural science taught by masters who retain the keen curiosity of the boy, who are still as serious as the boy, and who can beat him in handiness and research, is an integral part of education. It is eminently fitted to cherish his seriousness, to develop his curiosity into research, and to multiply his formative dexterities.

"I admit a little bias against abstract science for boys. Some mathematics must enter into the curriculum; but my impression is that most schoolboys are almost as incapable of abstraction as terriers. Some older boys can get no inconsiderable grip on universals; but it is a topsy-turvy education which begins with universals and ends with a few particulars. For most boys natural history and mechanics may prove more congenial than chemistry.

"Science is not a hobby, nor even a modern system of utilitarian ingenuity; it is a way of observing and interpreting everything, including religion. In later life, most of us have to concentrate upon specific studies or crafts; but while I plead for even more differentiation for the various boy than at present he has, I protest that to box off 'science' artificially on a 'modern' or any other 'side' is to perpetuate an unnatural schism. An education which is not modern is an anachronism. I do not desire to see headmasters more specifically scientific than linguistic; but he who is to mould a school should inspire it as a whole, and be in full and understanding sympathy with every part and function of it. If he only knows so much of science as to misunderstand it, or just to tolerate it, the educational mill will continue to throw out, to the right and to the left, batches of half-educated men."

Mr. L. Cumming, in moving a vote of thanks, took the opportunity to point out that their boys had to pass examinations, and that examiners set questions on "abstract science." Dr. Garnett, in seconding the vote, directed attention to the fact that some boys can learn from reading, some from tactile perceptions. We should be ready to gain access to the mental citadel by the particular gate which happened to be open. In his reply, the president said that there will be a great saving of time when the scientific spirit gets possession of the school and compels coordination in teaching. The universities were partly to blame for the perpetuation of the segregation of schoolboys into classical, modern, and other sides, as their prizes are on the side of Greek and Latin.

Mr. M. D. Hill gave an account of the anthropometric work which has been carried on for fifteen months at Eton. Anthropometry includes psychological and physiological characters as well as morphological, tracing correlations between characters while examining the effect of environment. Psychologists, ethnologists, and statesmen require data which must be obtained from anthropometry. Already the examination of 500,000 children in Scotland as to colour of hair and eyes has solved problems of race-migration. Their work at Eton was connected with medical inspection. Instructions for practical work could be found in the report of the committee of Section H of the British Association, 1908. Mr. Gray, as secretary to this committee, expressed the hope that public schools would take up the inquiry so as to make it national in scope. We want an audit of national physique. Mr. Earl (Tonbridge) had found the value of such observations from the schoolmaster's point of view, as they make possible the detection of defects, and in his experience remedial treatment has resulted in the improvement of the physical tone and alertness of boys.

In the afternoon there was a discussion on the British Association report on the sequence of science studies in boys' schools. Mr. G. F. Daniell introduced the subject, saying that the inquiry had shown the existence of general agreement as to the subjects to be taught and as to their sequence, but that great diversity of opinion and practice exists in regard to methods. This diversity was approved; the teacher's liberty should be preserved and the influence of external examinations restricted. Mr. W. D. Eggar (Eton) spoke of the growth of geography as a school subject. This quite desirable growth had made the subject too wide for one teacher; he advocated putting physiography into the science course, and leaving commercial and historical aspects to be dealt with by other than "science" masters. Mr. R. G. Durrant (Marlborough) read a paper on teaching the nature of solution in schools, and advocated the introduction of the ionic theory as soon as the boys had some idea of atoms and molecules. Mr. G. H. Martin (Bradford) gave an account of his science course for boys on the *classical* side. He had found most successful results from geology, and he concluded that the only form of science suitable to such boys was one which, besides being of immediate application, furnishes the basis of an after-school hobby and permanently enlarges the mental outlook. A discussion followed, in which Sir Clifford Allbutt, Prof. Armstrong and others took part. A resolution protesting against the refusal of the General Medical Council to "recognise" public schools in their regulations for the registration of medical students was passed on the motion of Mr. C. I. Gardiner.

As in former years, the exhibition of apparatus formed an important and instructive feature of the meeting. Twenty-four members contributed useful and novel pieces of apparatus, often of much ingenuity, and occasionally of delightful simplicity. Several well-known firms of apparatus dealers and publishers sent displays which filled the great hall, and the whole display could not be exhausted in the four and a half hours allotted to its examination. We note a few of the objects of interest.

Dr. T. J. Baker showed a safe method of liberating hydrogen from water by action of potassium. A layer of naphtha is poured on the water, and a fragment of potassium is thrown in. The form of Hore's apparatus exhibited by Mr. D. J. P. Berridge derived interest from the fact that it was designed by a boy at Malvern. Mr. Berridge's still and water-bath (made by Fletcher, Russell and Co.) is of a serviceable pattern for school laboratories. Several teachers will thank Mr. Cooke for his method of burning magnesium in steam by plunging an ignited helix into a flask where water boils briskly. Mr. Cross exhibited "components" for building up "simple machines" and compounding them; being well made, they should have much educational utility. Electrical instruments such as can be built in school workshops—perhaps the best way of teaching electricity to many boys—were shown by Mr. L. Cumming. Quite a large and varied set of exhibits was contributed by Mr. Garbutt, including a nearly fool-proof apparatus for showing the volume composition of hydrogen chloride, and an ordinary Bunsen burner converted into a rose burner by drilling holes near the top of the tube and putting a small flat asbestos circle or dish on the top. Most of us have experienced trouble from burettes with broken taps; Mr. Hedley showed us how to repair them with ebonite taps, shaped by any carpenter. Mr. Martin's laboratory illustrations of geological phenomena helped to enforce the arguments of his paper. Mr. Ryley's evaporating crucible and Mr. Talbot's lantern are already well known. We liked Mr. Leyland Wilson's improved shelf for ovens, and his method of purifying sulphuretted hydrogen deserves trial. He passes the impure gas over calcium hydrate and moist sawdust, which absorb the sulphuretted hydrogen only. The latter can be liberated at any desired rate whenever required by passing a current of carbon dioxide over the calcium sulphydrate.

Among the trade exhibits we may mention the galvanometers and curved mirrors by Messrs. Philip Harris and Co., who have just issued an excellent catalogue. Messrs. Becker have attained the acme of simplicity in their burette stand, made in teak, at half-a-crown. We saw some useful clamps for chemical and optical apparatus at the stand of Messrs. Collins. Messrs. Reynolds and Branson have fitted a thoroughly satisfactory microscope attachment to the Stroud-Rendell lantern, and a blow-fly proboscis was shown with good definition and illumination. It is a pity that so few science-masters employ the lantern microscope for class purposes. Good design and accurate finish characterised the instruments for teaching mechanics which Mr. G. Cussons had on view. Experienced workers would not like to be without his "tripod and capstan" stands and clamps. We were reminded that we live in an age of luxury when we looked at Messrs. Griffin's electric furnaces; but the same firm caters for those who, from choice or necessity, seek to reduce expenditure on apparatus. Their school microscope, with objective eyepiece, rack focussing stand with firm foot, is priced at 35*s*. We welcomed old and tried friends in the Becker's Sons' balances, and a new one in the Dobbs's dynamometer, which appeared among Messrs. Townson and Mercer's display. Mr. Thomas Wyatt exhibited the appropriately named Massey series of apparatus for practical mechanics, and some Haldane Gee instruments of better construction than those on the market in former days. The stills and ovens of Messrs. Brown and Son are well known to chemists; they should be well known to science masters.

We have not space to describe the extensive exhibit of books by Messrs. Arnold, G. Bell, Clive, Macmillan, Methuen, and the Cambridge and Oxford University Press.

Some of the amateur exhibitors were at too little pains to show their work effectively, and we would remind them of the necessity of making clear at once, by diagram or otherwise, the main point of their exhibits. If a plan of the exhibits could be added to the catalogue it would be helpful. The trade exhibits are of undoubted utility, especially to country workers, but it is to be hoped that the invaluable display of resourcefulness and ingenuity springing from our school laboratories will not be relegated to a subordinate position. The thanks of all who had the good fortune to see this successful exhibition are due to the hon. secretaries, Mr. D. J. P. Berridge and Mr. G. H. Martin, for their skilled cataloguing and organisation.

The president of the association next year will be Prof. H. E. Armstrong, F.R.S., who has given the society much help since its foundation. G. F. DANIELL.

VARIOUS INVERTEBRATES.[1]

THE fourth volume of zoological reports on the *Discovery* collections is full of interest and fine workmanship. It well deserves its beautiful "get-up." Dr. H. F. Nierstrasz describes the single Solenogaster in the collection—naming it rather awkwardly *Proneomenia discoveryi*, sp. n., and takes a survey of the family Proneomeniidæ. Prof. G. H. Carpenter gives an account of a remarkable collembolon—*Gomphiocephalus hodgsoni*, g. et sp. n.—apparently an ancient connecting link between Poduridæ and Entomobryidæ. In contrast to these two cases of sparse material, we find Mr. W. M. Tattersall reporting on more than ten thousand schizopods, mostly referable, however, to one species. He and Mr. Holt have been able to add ten to the previous list of seven South Polar schizopods, and the present memoir as some interesting results as regards life-history and distribution. The collection includes no species of schizopod common to both polar regions, but all the genera save one, Antarctomysis, are represented in northern waters. The northern species are quite distinct from their southern allies.

Similarly Dr. R. N. Wolfenden notes that the Antarctic copepod fauna is distinct from that of Arctic seas, and that the species which are typical of the Antarctic and most numerous do not extend far into the southern Atlantic at least. The *Discovery*, like the *Gauss*, was fortunate in finding the interesting crinoid Promachocrinus, which was one of the prizes of the voyage of the *Challenger*. Prof. F. Jeffrey Bell deals with this re-discovered treasure, and with a number of interesting new forms; he also directs attention to the "bewildering" variability of several species, *e.g. Cycethra verrucosa*. His memoir has numerous illustrations of a certain dry humour, as when he notes that "even the most recent writers on echinoderms have not yet promulgated the doctrine that difference in size is a specific character, though I am not quite sure that in practice they do not sometimes act as though they had." It has been supposed that none of the Antarctic echinoderms has free-swimming larvæ, but Prof. E. W. MacBride and Mr. J. C. Simpson describe the plutei of a sea-urchin and an ophiuroid. They also found an unsuspected brood-pouch in *Cucumaria crocea*, a well-known holothurian.

Bell's *Antedon adriani* yielded two species of Myzostomum, which Dr. Rudolf Ritter von Stummer-Traunfels deals with. One is new, *M. antarcticum*, illustrating the common experience that every new species means another new species—of parasite; the other, *M. cysticolum*, has been previously recorded from Ross's Sea in the Antarctic, from off the east coast of Japan, and from the tropical West Atlantic—a remarkable distribution which finds its explanation in the antiquity of the myzostomid group and in the uniformity of deep-water conditions. The sipunculids are represented by some thirty specimens. These Mr. W. F. Lanchester describes under the title *Phascolosoma socius*, n. sp., and in so doing makes some interesting critical remarks on the relative value of the systematic specific characters in this group. Two new sea-anemones are described by Mr. J. A. Clubb, but the most interesting part of his report is the description of the sixteen "brood-pouches" of *Cribrina octoradiata* (Carlgren) from the Falkland Islands. Each pouch arises as an invagination of the three layers of the body-wall, retains its external pore, and usually contains two embryos. In reporting on the tetractinellid and monaxonellid sponges, Mr. R. Kirkpatrick describes twenty-two new species of the latter, and establishes four genera. Some of the records of Antarctic distribution are striking, *e.g.* that of *Esperiopsis villosa*, Carter, a form frequently recorded from high northern latitudes, but only from one intermediate station, viz. in deep water off the Azores; or that of *Sphaerotylus capitatus* (Vosmaer), an Arctic form, not reported from any intermediate locality—as yet. There are no fewer than nineteen plates illustrating this memoir, and there are twelve illustrating Mr. T. F. Jenkin's admirable account of the Calcarea, which teems with novelties, two new families, six new genera, and new species galore. Altogether, it cannot be doubted that the *Discovery* was true to her name.

[1] National Antarctic Expedition, 1901-4. Natural History. Vol. iv., Zoology. Pp. 280; 59 plates. (Printed by Order of the Trustees of the British Museum, 1908.)

THE DANISH NORTH-EAST GREENLAND EXPEDITION.

THE account of the Danish North-east Greenland Expedition, given by Lieut. A. Trolle before the Royal Geographical Society on December 7, 1908, is printed in the January number of the society's journal, with several instructive illustrations and a map. During this expedition, which lasted two years, the little-known fjords and coast of north-east Greenland were explored, and much other valuable scientific work was accomplished, though the tragic death of the leader, Mylius Erichsen, and his two companions, Hagen and Brönlund, while on a sledge expedition, gives melancholy interest to it. In his lecture Lieut. Trolle only referred in general terms to the results of the scientific work carried on by the various observers during the expedition, as these will be published later, but the subjoined extracts from the paper, and the two illustrations here reproduced by permission of the Royal Geographical Society, will show that the expedition was marked by notable achievements.

The object of the expedition was to explore the last of the hitherto unexplored parts of Greenland. The whole of the west coast from 78° N. lat. to Cape Farewell is, as is well known, under the administration of Denmark. On the east coast there is a Danish colony at Angmasalik, while great parts of the coast had been mapped by Captains Holm, Garde, Ryder, and Amdrup. The stretch from 72° to 77° N. lat. had been explored, chiefly by Clavering and Sabine, by the *Germania* Expedition, by the English whaler Scoresby, and the Swedish explorer Nathorst. From 77° N. lat. and farther north the country, however, was practically unexplored, though the Duke of Orleans, on the *Belgica*, in 1905, had gone as far as 78½° N. lat., and from his ship had seen part of the outer islands.

The north-west had chiefly been explored by British and American expeditions, and the chief merit of the *Danmark* Expedition is that it has now supplemented what was still wanting in a knowledge of the outlines of Greenland by exploring the whole of the north-east coast.

The expedition consisted of twenty-eight members, and a characteristic feature of its organisation was the unusually large scientific staff and proportionately small crew, in the proper sense of the word. Thus there were six cartographers (under Captain Koch, R.D.I.), two meteorologists, two zoologists, one botanist, one geologist, one hydrographer, one ethnologist, one physician, and two painters, besides one ice-master, two mates (both of whom belonged to the cartographers' staff), two engineers, two stokers, three Eskimo, and only three sailors. The scientific staff, however, had agreed to do the common ship's work besides their own special work, and, upon the whole, this arrangement worked rather satisfactorily.

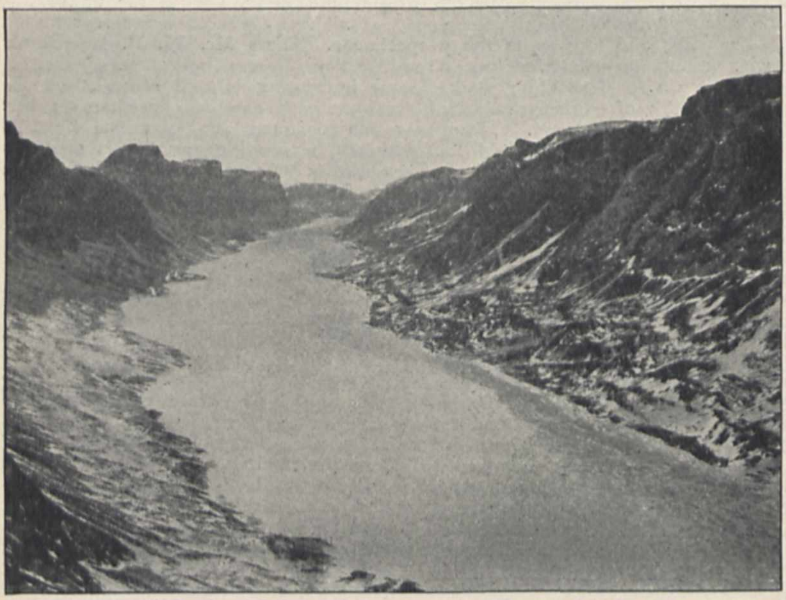

FIG. 1.—Typical Fjord in the interior of King Frederick VIII. Land, Lat. 77° N.

The expedition left Copenhagen in June, 1906. On July 31 we saw our first ice, passing along the outer rim of some small hummocks, and on the next day we were at the border of the heavy pack-ice, as well as at the edge of the continental shelf. We knew this because our sounding-lead, which had just shown a depth of 1300 fathoms, now only showed 165. This seems to indicate that the chief branch of the south-going polar current runs across the shoals which are found everywhere outside the east coast of Greenland, but gradually lessens its strength over the deep sea.

We fought our way through the ice, one day, in spite of continuous efforts, only advancing a mile or two, the next day perhaps proceeding ten to fifteen miles. Twice we were surrounded by the ice for a period of thirty-six hours, and in the beginning it looked dangerous enough, but the conditions soon became better, and we got through.

On August 13—we had taken thirteen days for 140 miles—we reached land. At last we were sailing in the so-called shore-water, where the ice was very loose. We had reached as far north as we had ever dared to hope, but we tried to go still further in the shore-water. At Isle de France (77½° N. lat.) we were stopped by impenetrable pack-ice, and had to go back, after having landed Captain Koch and several other cartographers, together with some big caches of provisions, at the most northerly point of the continent. The harbour place which we chose was one we had previously found inside the outer range of ice, and thus protected against the heavy pressure of the pack. We anchored the *Danmark*, the bow pointing southward, and with hawsers from the stem to the shore. After that we built some houses ashore, in which the various branches of scientific research were to be carried on, and the latter commenced.

The land of King Frederick VIII. is a beautiful mountainous country, in many places very much like Norway—the same picturesque valleys, the same deep fjords, with steep mountains, as high as 2000 feet on both sides, which have inspired our two painters, Fries and Berthelsen, numerous islets and rocks intersected with sounds. Everywhere there were traces of glaciers from the Ice period, but still earlier the country must have had a milder climate. The geologist, Jarner, found impressions of animals and plants from this period in the sandstone of the Malemuk Mountain, on Koldewey Island, and Hochstetter Foreland, and brought a fine collection home.

The country is not very wide. At 77° lat. the bottom of the interior fjords is reached about forty to sixty miles from the coast, and here generally a glacier is coming down from the inland ice. Farther north, at Jökel Bay, however, the inland ice goes directly into the sea, and the coast-line here consists of two ranges of islets. At the Malemuk Mountain there is some more free land, but it is narrower, and becomes lower and lower, until it finally disappears, and the inland ice again goes straight into the sea. Danmark Fjord is a big, mountainous fjord, eighty miles deep. Peary Land is not covered with inland ice; its southern coast is very low, and in the interior there are mountains to a height of 2000 feet. All this coast-line up to Cape Bridgeman and most of the edge of the inland ice has been mapped by the cartographers' staff, under Captain Koch, by theodolite measurements in a very exact manner. The country in the neighbourhood of the harbour has been mapped topographically, and the triangulation there is brought in connection with the German triangulation in 1870.

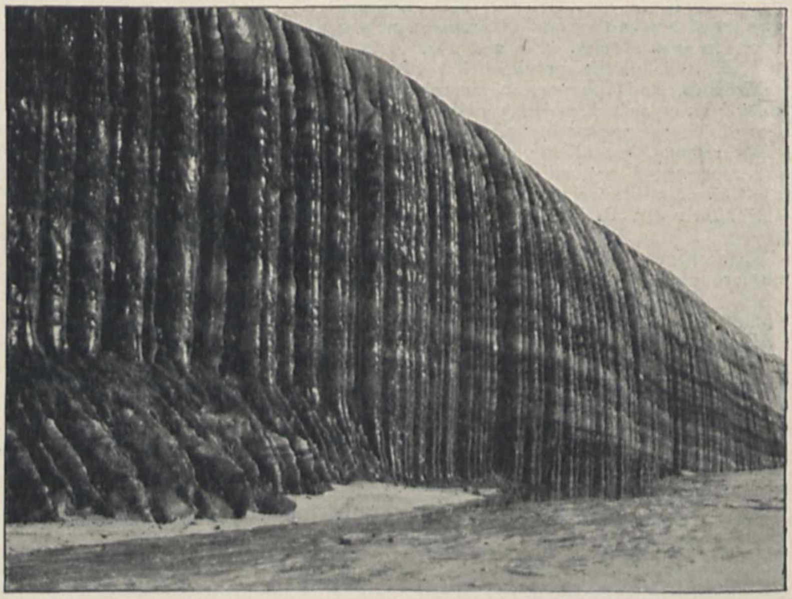

FIG. 2.—Edge of the inland ice, Lat. 77° N.

The most interesting geographical feature is the big peninsula going eastward to 12° W. long., so that the outlet between Greenland and Spitsbergen of the great Polar basin thus becomes rather narrow. In this connection I shall just mention that Dr. Nansen, on account of his hydrographical observations in the Polar sea, supposed the existence of a suboceanic ridge between Greenland and Spitsbergen, and as the coast of Greenland here is quite flat, the probability is that such a ridge really exists.

The frontier of the inland ice is in some places quite steep, in other places you might have mounted the inland ice without knowing it. The glaciers are few and not very productive; still, the fjords are sometimes quite filled up with icebergs stranded on barriers in the mouths of the fjords.

In the interior, about forty miles from the edge of the inland ice, we found and mapped out some islands, nunalands, quite surrounded by the inland ice. Strange though it may sound, we here saw flowers and tracks of foxes; also in some places coal. During the winter the land was covered with snow, with only here and there some bare wind-swept spots. In the spring this snow partly evaporated, even with a temperature of 20° F. Then the water began to melt in the ravines, and, running under the glaciers, it formed the most fantastic ice-grottoes, where the light was broken into all colours through the crystal-like icicles.

The change into summer was quite sudden. Gradually the temperature of the snow had risen to zero, and then in one day it all melted. The rivers were rushing along, flowers were budding forth, and in the air the butterflies were fluttering. It was a lovely time, bringing hard work for the botanist Lundager and the zoologists Manniche and Johansen. The birds came nearly all on the same day, most of them even at the same hour. One day we had only had the ordinary ptarmigan and the raven; the next we had the sanderling, the ring-plover, the goose, the eider duck, and many others. Young sanderlings, icelandic ring-plovers, and Sabine gulls were found by Mr. Manniche, our indefatigable ornithologist, and fine specimens were brought home.

Of larger animals we found bears, musk-oxen, and wolves; foxes on land, and walruses and seals at sea. Bears are rather plentiful; we shot ninety in all, but musk-oxen and wolves are scarce. The five wolves we got were, I believe, all that were there. They were very meagre, and looked as if they had had nothing to eat for a long time. The snow-hares, which we found in great numbers, were very tame in April and May, and we could then go quite close to them. In the sea, the lakes, and the rivers animal life was not abundant. Some polar cod and inferior animals were usually the results of our net-fishing. In one of the lakes, however, salmon were plentiful.

Especially in the autumn we had the most beautiful Fata Morgana, with castles and ships high up in the clear air, while also the outlines of the coast were quite changed. The explanation of this is the great difference in temperature between the air and that of the new ice, which has still the temperature of the water. Our meteorologist, Mr. Wegener, studied these phenomena with great skill, and, moreover, took magnetic and electrical observations.

In the beginning of November the sun left us for good, the red colours of the southern sky grew fainter and fainter, while from the north darkness spread all along the sky. The temperature went down; in February and March it was as low as −58° F., but at times it would again rise to 32° and even to 34°. Mr. Wegener sent up his kites and balloons throughout the whole winter, and the instruments often registered a much higher temperature in the upper strata of the air.

As a rule, the weather was calm and clear, but when the barometer sank the temperature rose, and the sky became overcast; we all sought shelter, for then we knew that a storm was coming, drifting the snow high above the masthead, and generally lasting for two or three days.

We spent two years in Greenland, and in these two years the weather was quite different. (The winter of 1906–7 was cold and calm, that of 1907–8 milder and more windy. The ice in the first winter grew 6 feet thick and broke up very late, in the second it was only 4 feet thick.) In the middle of February the sun came back, and May and June were a period of fogs and faint sea breezes. Otherwise, the wind was constantly from the north-west, coming from the high pressure of air which is found over the inland ice.

We found no living Eskimo, but everywhere along the coast up to the Danmark Fjord we found their tent stones, their meat caches, and in some places even winter dwellings. From kayaks and umyaks they have hunted the same animals which we found there, and besides whales and reindeer, which we did not find. Our ethnologist, Thostrup, made a very interesting collection of their various tools, &c.

Outside the coast the pack-ice was moving southward with the polar current, and we have mapped out the border of this pack-ice, which showed that the current is everywhere following the line of the outer islands and rocks; while in the waters inside this line pack-ice is rarely found. It was rather an interesting fact that we found great lanes in the ice from 80° to 82° N. lat. At the Malemuk mountain we found open water every time, in April, June, and November, the cause of which may be the current. The water in the fjords was mixed polar and gulf water, the gulf water probably running in along the supposed Greenland-Spitsbergen ridge and going southward with the polar current.

By making holes in the ice investigations were carried on even at a temperature of −2° F. In a big fresh-water lake salt water was found, giving an odour of sulphide of hydrogen at the bottom. The lake must formerly have been a fjord, but the land rose so that the fjord became a lake. The geological conditions, as well as the fact that we found the carcase of a big whale at the border of this lake, seem to strengthen this theory. The tides were not very strong; the ordinary difference between high and low water was 5 feet.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of the Senate reports that it has had under consideration the position of the study of astrophysics in the University in connection with the offer of the Royal Society to give to the University the equipment of Sir William Huggins's observatory. It is of opinion that the time is opportune for giving further recognition in Cambridge to astrophysics. With the approval of the general board of studies, the council recommends to the Senate the establishment of a professorship of astrophysics, without stipend and limited to the tenure of office of the first professor.

Mr. H. O. Jones, of Clare College, has been approved as deputy for Sir James Dewar, the Jacksonian professor of experimental philosophy, during the Lent term of 1909.

An examination for minor scholarships in natural science and mathematics will be held in Downing College on Tuesday, March 2, and subsequent days. The examination in natural science will consist of paper work and practical work in (1) chemistry, (2) physics, (3) biology, (4) comparative anatomy, (5) botany. No candidate will be examined in more than three of the above subjects, and great weight will be given to proficiency in some one subject.

The qualifying examination for the mechanical sciences tripos is now held in June and at the end of November. The majority of the students take the examination in June, and experience has shown that the November examination is not much used. It is proposed to substitute for this latter an examination in November at which the best students—those who desire to take the tripos in two years—may pass the examination immediately on coming into residence.

MR. W. MORGAN has been appointed professor of motor-car engineering at the Merchant Venturers' Technical College, Bristol.

IT is announced in *Science* that Mr. G. M. Laughlin, of Pittsburg, has bequeathed 20,000*l*. to Washington and Jefferson College.

Prof. A. L. Lowell, professor of political science in Harvard University, has been selected to succeed Dr. Eliot as president of the University. Prof. Lowell was born in Boston in 1856, and represents a family which has been prominent in Massachusetts affairs for a century.

A Reuter message from Berlin states that a professorship of aëronautics has been instituted at Göttingen University. The Minister of Education has appointed Prof. Prandtl, professor of applied mechanics at Göttingen, to lecture on the whole field of aëronautics.

Captain H. G. Lyons, F.R.S., Director-General of the Survey of Egypt, has been appointed lecturer in geography at the University of Glasgow from the beginning of the next academic year. Captain Lyons, who was vice-president of the geographical section of the British Association last year, has also been appointed by the West of Scotland Provincial Committee to be lecturer in geography to teachers in training.

As an instance of practical science at universities, the New York correspondent of the *Times* states that the Columbia Wireless Club, composed of students of the scientific department, will soon be prepared to inaugurate inter-collegiate wireless telegraphy with the students of Princeton University, New Jersey, and with the University of Pennsylvania. The novel experiments will be watched with interest as a method of teaching practical developments of science.

The Board of Education has issued as a Blue-book (Cd. 4440) the reports from those universities and university colleges in Great Britain which participated in the Parliamentary grant for university colleges in the year 1906–7. The present volume is the first of a series in which all the reports in any one volume relate to the same academical year. It is much to be regretted that the Board of Education makes no attempt to collate the particulars provided concerning the seventeen institutions participating in the annual grant, which now amounts to 100,000*l.* It is at present a long and tedious process to compare, say, the income, the endowments, number of staff, and students of one institution with those of another. The arrangement of the volume, in fact, compares very unfavourably with the similar report of the U.S. Commissioner of Education published at Washington. The Board of Education may earn very easily the gratitude of students of the progress of higher education in this and other countries by including in the report of next year a series of tables summarising and comparing the educational condition of things in the universities and university colleges here concerned. It would then prove possible to understand more precisely why certain institutions are selected to receive a Treasury grant while others are precluded. For instance, we have before us the report for the session ending in August last of the East London College, which the Senate of the University of London recognises as a school of the University. The Treasury appears to be the only body which as yet has not accorded full recognition to the East London College of its status as the University College for East London. During the session 1905–6 the governors made a formal application for the college to participate in the Treasury grant. The inspectors appointed by the advisory committee of the Treasury visited the college and a favourable report was published. Yet no grant was awarded. If the tables suggested were available, it might be easier by careful comparison to understand this and other decisions. At present it is possible only to puzzle over the question. The number of students of university standing, the number of university successes, and the output of research work at the East London College seem to compare favourably with those of several of the university colleges receiving grants.

The annual meeting of the Mathematical Association was held at King's College, London, on January 12. The association now consists of 496 members, representing an increase of more than 20 per cent. on the preceding year. The year which has just ended has been characterised by unusual activity. The formation of local branches has for many years been considered desirable, and a first move in this direction has been made by the formal recognition of a North Wales branch under the local secretaryship of Mr. T. G. Creak, of Llanberis. The association has appointed representatives on a joint committee with the Public Schools Science Masters' Association to consider the best means of coordinating teaching in mathematics and science. Dr. Bovey, F.R.S., read a paper on the mathematical training of technical students, in the course of which the necessity was pointed out of teaching such students to realise the value and utility of the theoretical training which they were receiving. Dr. Bovey considered the influence of the teacher, the text-book, the mental powers of the student, and carefully planned courses. The question further arose as to whether the teaching of technical students should be in the hands of mathematicians or engineers. While favouring the latter choice, Dr. Bovey quoted the opinion expressed by Prof. Slichter, who considered that the most competent teacher should be an engineering graduate, but that it would be necessary for him to have at least three years of post-graduate study in advanced mathematics. It was, however, impossible to induce graduates of technical schools to give this amount of time to preparation for instructional work when other fields of work offered such far better and more immediate prospects. Dr. Bovey thinks that in these circumstances the best plan at present is to secure an excellent mathematician, and to induce him to fit himself for the post by making himself in some degree familiar and sympathetic with the engineer's point of view and with the class of problems with which his students will have to deal in after life. Papers were subsequently read by Prof. Alfred Lodge on homography and cross-ratio, and by Prof. Bryan on the need of a new symbol, in approximate calculations, to denote digits the values of which are unknown, and which at present are represented by zeros. In his retiring address the latter directed attention to the serious danger of the extinction of the English mathematical specialist, and the necessity of fighting against this tendency. Engineers and others had plenty of problems for which all the resources of the mathematician were needed, but the latter found that this work interfered with his means of earning a livelihood. In defending the specialist against the attacks of the outside public—attacks essentially peculiar to Great Britain—Prof. Bryan pointed out that men who had specialised in part ii. of the mathematical tripos were prominently to the front on all committees appointed by the association for reforming mathematical teaching on common-sense, practical lines.

SOCIETIES AND ACADEMIES.

London.

Royal Society, Received August 10, 1908.—"Reciprocal Innervation of Antagonistic Muscles. Twelfth Note. Proprioceptive Reflexes." By Prof. C. S. **Sherrington**, F.R.S.

Whereas most reflexes are excited by environmental changes acting directly as agents on the receptive organs, by proprioceptive reflexes are meant reflexes excited habitually by the organism acting as agent upon itself, and thereby applying its own organs or parts as stimuli to its own nerves. In propioceptive reflexes the organism applies itself as a stimulus to itself. By its own act and in its own substance it excites one or more of its own receptor organs. In the bending of the knee, the organism, by executing the movement of a part of itself, supplies by that means an alteration of the condition of that part, and so stimulates certain reflex arcs, propioceptive arcs, arising in that part. The reaction thus excited is causally less directly related to the environment than are reflexes excited directly by the surrounding world. In other words, an important difference between propioceptive and other reflex reactions is that the former stand only in secondary relation to the external world, whereas the latter stand always in primary relation to it. One outcome of this is, as has been previously[1] pointed out, that the proprioceptive reflexes tend to ally themselves to, fuse with, and habitually reinforce other reflexes of exteroceptive and interoceptive origin.

It is shown in the present paper that the bending of

[1] Sherrington, "Integrative Action of the Nervous System." (London and New York, 1906.)

the knee causes, by stretching the extensor muscle of the knee, a reflex inhibition of the contraction of that muscle; the muscle assumes, in consequence, a greater length. This reaction is termed in the paper "the lengthening reaction." It is shown that the afferent nerve of the extensor muscle itself is absolutely indispensable for this reaction.

Conversely, there is "a shortening reaction." When the extensor muscle is either passively or by its own active contraction shortened, there occurs a change in the reflex arc of the muscle itself which makes its tonic length less. The result is that a transient contraction of the muscle becomes prolonged by a persistence of the tonic contraction, and this latter is the shortening reaction which appends itself to the transient contraction, however induced. The shortening reaction is, like the lengthening reaction, brought about by the afferent nerve-fibres of the muscle itself; these in some way regulate and adjust the reflex tonus of the muscle. If the afferent nerve-fibres of the muscle itself are severed, the "shortening reaction" and the long, persistent after-contraction which it effects are entirely wanting in the reactions of the muscle. This is so whether the afferent fibres have been severed only a few days or for three months.

Attention is directed to the similarity between these proprioceptive reflexes of the extensor muscles as studied in cat and dog and the reactions observed by v. Uexküll and others in tonic preparations of various invertebrate muscle, *e.g.* the retractor muscle of Sipunculus. The similarity is close enough to leave little doubt that the phenomena achieve the same practical end.

Mathematical Society, January 14.—Sir W. D. Niven, president, in the chair.—The canonical form of a linear substitution: H. **Hilton**.—Researches concerning the solution of the quintic equation: J. **Hammond**.—Octavic and sexdecimic residuacity: Lieut.-Colonel A. **Cunningham**.—Change of the variable in a Lebesgue integral: Dr. E. W. **Hobson**.—Abel's extension of Taylor's series: Rev. F. H. **Jackson**.—Note on the evaluation of a certain integral containing Bessel's functions: Prof. H. M. **Macdonald**.

MANCHESTER.

Literary and Philosophical Society, December 15, 1908.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The volatility of radium A and radium C: W. **Makower**. The experiments described were carried out with a view to determine the volatility of radium A, and also of re-determining that of radium C under different conditions to see whether the volatility of this product was influenced by its environment. The volatilisation point of radium A was found to be 900° C. Radium C was found to begin to volatilise at a temperature between 700° C. and 800° C. When deposited on a platinum or nickel surface the volatilisation was found to be complete at 1200° C., whereas when deposited on quartz the volatilisation was still incomplete even at 1300° C. The same result was found whether the deposit had been previously dissolved in hydrochloric acid or not. Finally, experiments were made to see whether radium C is charged at the moment of its production from radium B. Experiments in which the emanation exposed to an electric field was contained in a furnace at 950° C. failed to reveal any evidence of a charge carried by radium C.—Note on the production of white ferrous ferrocyanide: R. L. **Taylor**. A little solution of either hydrosulphurous acid or of sodium hydrosulphite, added to a solution of ordinary ferrous sulphate, frees the solution so completely from any trace of a ferric salt that it gives a pure white precipitate with potassium ferrocyanide, instead of the light blue precipitate usually obtained. The white precipitate rapidly turns blue when exposed to the air, and it is also instantly turned blue when ordinary tap-water is added to it, owing to the oxygen which is dissolved in the water. Water which has been previously well boiled to expel dissolved air does not alter the colour of the precipitate. Hydrosulphurous acid or sodium hydrosulphite will turn Prussian blue perfectly white.

January 12.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The influence of light on the coloration of certain marine animals (Hippolyte, Wrasses): Dr. F. W. **Gamble**. The author gave an account of his work on the colour-physiology of Hippolyte (the Æsop-prawn), and of one of the common British wrasses (*Crenilabrus melops*). Hippolyte is a variably coloured prawn, each colour variety agreeing closely with the tint of the weed on which it is found, and upon which it feeds. Previous experiments made jointly by the author and Prof. Keeble have shown that this remarkable sympathetic coloration is in all probability not inherited—*i.e.* the colour varieties do not necessarily breed true, but that the harmonious motley exhibited by this varying species is the outcome of a very special colour adaptation undergone by each individual, and that the coloration is controlled largely by the colour of the weed at the time when the young prawn settles down upon it, after a brief free-living larval existence. The results of more recent researches by the author on this subject have shown that the amount of pigment in the larva varies, in all races but the green one, with that in the parent. The more there is of it in the parent, the more highly coloured is the offspring. Green parents, however, gave rise to three kinds of broods:—(1) highly coloured ones like those of brown parents; (2) pale ones; and (3) a mixed brood, containing coloured to colourless in the proportion of 3 : 1. Coloured light experiments yielded an unexpected result, namely, a complementary colour to that of the light employed. Thus, under the influence of green light for a month, Hippolyte lost its yellow pigment and became brilliantly scarlet, while under red light it became green. In both cases the animal at starting was of a transparent and almost colourless appearance. The value of this complementary colour production (which does not appear to have been recognised in animals previously) upon the problem of the coloration of Hippolyte was briefly discussed.

PARIS.

Academy of Sciences, January 11.—M. Bouchard in the chair.—The families of Lamé resulting from the displacement of a surface which remains invariable in form: Gaston **Darboux**.—A general method of preparation of the monoalkyl, dialkyl, and trialkyl-acetophenones: A. **Haller** and Ed. **Bauer**. The ketone (methyl, ethyl, or propylphenylketone) is dissolved in pure dry benzene, an equimolecular proportion of finely divided sodium amide added, and heated on the water bath until a clear solution is obtained. The alkyl bromide or iodide is added drop by drop to this solution. By this method the following ketones have been prepared and their properties given in detail:—trimethylacetophenone, ethyldimethylacetophenone, methyldiethylacetophenone, triethylacetophenone, methylethylpropylacetophenone, and allyldimethylacetophenone.—Dirichlet's series: Harald **Bohr**.—The double integrals of the first species attached to an algebraic variety: Francesco **Severi**.—A theorem on differentials: W. H. **Young**.—A particular critical point of the solution of the equations of elasticity, in the case where the forces on the border are given: A. **Korn**.—The theory of the moon: H. **Andoyer**.—A dynamometer for testing motors with large angular velocity: M. **Ringelmann**. The defects of the Prony brake for testing high-speed motors are reviewed, and a new form of dynamometer described, by means of which the total energy furnished at each instant by the motor can be read off, and is at the same time recorded.—A formula for velocity applicable to propulsion in air: Alphonse **Berget**. A modification of a formula devised for the velocity of steam vessels. $V = C\sqrt[3]{\frac{F}{S}}$, where V is the velocity in myriametres per hour, F the horse-power, S the surface of maximum section of the balloon in square metres, and C the coefficient of utilisation. The latter is shown to vary between 3·0 and 5·0 for various types of steerable balloon.—The radiation of cerium oxide: M. **Foix**. Some experiments are cited in support of the theoretical relation given in an earlier paper.—A modification of the phonograph: M. **de Pezzer**.—Aqueous solutions of pyridine: E. **Baud**. The freezing points of aqueous solutions of pyridine varying in concentration from 5 per cent. to 100 per cent. are given. The densities and refractive indices of these solutions were also measured, and also the heat of solution of pyridine in a large excess of water. Only two hydrates of pyridine, with two and six molecules of water, are indicated by these experiments.—Lævo-campholic acid: Marcel **Guerbet.** A good yield of this acid is obtained by heating *l*-borneol with dehydrated caustic potash in sealed tubes. The acid has a rotation $\alpha_D = -49 \cdot 1$.—The alkaline reduction of *o*-nitrodiphenylmethane: P. **Carré.** Reduction with zinc dust and caustic soda gives *o*-hydrazodiphenylmethane and *o*-aminodiphenylmethane.—The influence of aëration on the formation of volatile products in alcoholic fermentation: E. **Kayser** and A. **Demolon.** The amounts of aldehyde, acids, and esters are all modified by access of air to fermenting liquids. The presence of air, therefore, is an essential condition for the production of bouquet in wine.—The anatomy of the human thymus: Henri **Rieffel** and Jacques **Le Mée.** The two lobes of this gland are not united, but are easily separable, at least in the case of newly born infants. The contact of the thymus with the thyroid gland is not exceptional; this contact has been observed in 20 per cent. of the glands examined.—The rudimentary organs of the larvæ of the Muscidæ: J. **Pantel.**—Contribution to the study of the singing voice: M. **Marage.** Curve tracings are given showing the changes taking place in the transition stage between chest and head notes.—The action of ink on the photographic plate: Guillaume **de Fontenay.** A criticism of some experiments by M. Darget.—The treatment of Baleri in the horse by orpiment: A. **Thiroux** and L. **Teppaz.** It is now shown that there are three forms of trypanosomiasis, curable by treatment with orpiment, infesting horses in Gambia, Souma, and Baleri. The diseases caused by *T. congolense* and *T. brucei* still have to be studied from this point of view.—Studies of cancer in mice. The different types of tumours appearing in the same growth: L. **Cuénot** and L. **Mercier.**—An enormous urinary calculus in man: A. **Guépin.** This calculus was removed from a man sixty-eight years of age, measured 8·5 cm. by 6·8 cm. by 4·5 cm., and weighed 220 grams.—The source of the Bise at Thau: MM. **Chevallier** and **Sudry.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 4.30.—Syntonic Wireless Telegraphy; with Specimens of Large Scale Measurements: Sir O. Lodge, F.R.S., and Dr. A. Muirhead, F.R.S.—The Leakage of Helium from Radio-active Minerals: Hon. R. J. Strutt, F.R.S.—The Mobilities of the Ions produced by Röntgen Rays in Gases and Vapours: E. M. Wellisch.—Determination of the Surface Tension of Water by the Method of Jet Vibration: Prof. N. Bohr.—The Photo-electric Fatigue of Zinc, II.: H. Stanley Allen.

LINNEAN SOCIETY, at 8.—The Genus Nototriche, Turcz: Arthur W. Hill.—The Longitudinal Symmetry of Centrospermeæ: Dr. Percy Groom.

ROYAL INSTITUTION, at 3.—Mysteries of Metals: Prof. J. O. Arnold.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Theory of Volcanic Action and Ore Deposits, their Nature and Cause: Hiram W. Hixon.—An Instance of Secondary Impoverishment: H. H. Knox.—The Silver Islet Vein: Walter McDermott.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—The World of Life: as Visualised and Interpreted by Darwinism: Alfred Russel Wallace, O.M., F.R.S.

PHYSICAL SOCIETY, at 5.—The Effective Resistance and Inductance of a Concentric Main, and Methods of Computing the Ber and Bei and Allied Functions: Dr. A. Russell.—(1) The Luminous Efficiency of a Black Body; (2) The Use of the Potentiometer on Alternate Current Circuits: Dr. C. V. Drysdale.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Experiments on a Diesel Engine: W. E. Fisher and E. B. Wood.

MONDAY, JANUARY 25.

ROYAL SOCIETY OF ARTS, at 8.—Electric Power Supply: G. L. Addenbrooke.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Proposed North Polar Expedition: Captain Roald Amundsen.

INSTITUTE OF ACTUARIES, at 5.—On an Approximate Method of Valuation of Whole-life Assurances, grouped according to Attained Ages, with Allowance for Selection, on the Basis of O[M] Mortality: E. H. Brown.

TUESDAY, JANUARY 26.

ROYAL INSTITUTION, at 3.—Albinism in Man: Prof. Karl Pearson, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting. President's Address: The Relation of Anthropology to Classical Studies: Prof. W. Ridgeway.

MINERALOGICAL SOCIETY, at 8.—On the Identity of Poonahlite with Mesolite: Dr. H. L. Bowman.—Contributions to the Study of Parallel Growths: Dr. S. Kreutz.—Note on the Spontaneous Crystallisation of Solutions in Spherulites: J. Chevalier.—On a Method for Studying the Optical Properties of Crystals: the late Dr. H. C. Sorby, F.R.S.—Some Additional Localities for Idocrase in Cornwall: G. Barrow and H. H. Thomas.—Detrital Andalusite in Tertiary and Post-Tertiary Sand: H. H. Thomas.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: High Speed on Railway-curves: J. W. Spiller.—A Practical Method for the Improvement of Existing Railway-curves: W. H. Shortt.

WEDNESDAY, JANUARY 27.

GEOLOGICAL SOCIETY, at 8.—The Conway Succession: Dr. Gertrude L. Elles.—The Depth and Succession of the Bovey Deposits: A. J. Jukes-Browne.

ROYAL SOCIETY OF ARTS, at 8.—The Part played by Vermin in the Spread of Disease: J. Cantlie.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Locust Bean, and its Practical Application: M. C. Lamb and F. J. Farrell.—Chlorinated Wool: H. P. Pearson.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Action of the Venom of *Sepedon haemachates* of South Africa: Sir Thomas R. Fraser, F.R.S., and Dr. J. A. Gunn.—The Colours and Pigments of Flowers with Special Reference to Genetics: Miss M. Wheldale.—The Variations in the Pressure and Composition of the Blood in Cholera; and their Bearing on the Success of Hypertonic Saline Transfusion in its Treatment: Prof. Leonard Rogers, I.M.S.—The British Freshwater Phytoplankton, with Special Reference to the Desmid-plankton and the Distribution of British Desmids: W. West and G. S. West.

ROYAL INSTITUTION, at 3.—Mysteries of Metals: Prof. J. O. Arnold.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Parallel Operation of Alternators: Dr. E. Rosenberg.

ROYAL SOCIETY OF ARTS, at 4.30.—Some Phases of Hinduism: Krishna Gobinda Gupta.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—Improvements in Production and Application of Gun-cotton and Nitro-glycerine: Sir Frederick L. Nathan.

SATURDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—Sight and Seeing: Sir Hubert von Herkomer.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Romford Road, Stratford).—Subsidence of Eastern England and Adjacent Areas: W. H. Dalton.—Some Notes on "Moorlog," a Peaty Deposit dredged up in the North Sea: H. Whitehead and H. H. Goodchild.

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