THURSDAY, SEPTEMBER 3, 1903.

PSYCHOMETRIC OBSERVATIONS IN MURRAY ISLAND.

Reports of the Cambridge Anthropological Expedition to Torres Straits. Vol. ii., Physiology and Psychology. Part i., Vision. Pp. vi+140. By W. H. R. Rivers, with an appendix by C. G. Seligmann. Part ii., Hearing, Smell, Taste, Cutaneous Sensations, Muscular Sense, Reaction-Times. By C. S. Myers and W. McDougall. Pp. 141–223. (Cambridge: University Press, 1901, 1903.)

IN his short preface to this second volume of the Cambridge anthropological reports, Dr. Haddon remarks that no investigation of a race of people can be considered as complete unless it embraces observations on such psychological phenomena as admit of definite determination. In order to carry this into practice, he appears to have resolved that such branches of study should be efficiently dealt with in the second expedition to Torres Straits. Dr. Haddon is to be congratulated on having framed this comprehensive and truly scientific conception of ethnographical study, and he is further to be congratulated on having secured the services of such efficient psychological representatives as Dr. Rivers, Dr. Myers, and Dr. McDougall. The psychometric observations carried out by these gentlemen have, as was to be expected, been conducted on thoroughly sound lines, and the results described in the reports thus form not only an extremely valuable addition to anthropological knowledge, but an almost unique contribution to the physiology of the special senses. To Dr. Rivers in particular, special praise is due for the thoughtful care which he has bestowed upon the conduct of the inquiry, and for the way in which he has collated and presented the results.

The main part of the work was carried out in Murray Island, where the observers lived for four months. This island was originally selected by Dr. Haddon as being, in his judgment, particularly favourable for the study of a simple primitive people; it is out of the track of commerce, and its inhabitants still retain their simple natural characteristics; it is true that they have come into contact with missionaries and have acquired a certain knowledge of pidgin English, but this was found to be a distinct advantage from the point of view of the expedition, since it facilitated the establishment of a good understanding between the natives and the members of the expedition, besides enabling the observers to converse more freely with those selected for psychometric experiment. The limited population, 450 all told, was an obvious aid to the inquiry, and, judging from the reports, it appears doubtful if any other community, European or Polynesian, has been psychometrically investigated under more favourable conditions as regards both absence of disturbing factors and simplification of method.

The observations discussed in the reports are mainly those involving sensation, their scope being determined by the time at the disposal of the investigators, the available apparatus, and the nature of the individuals on whom the experiments were made. In the first part of the reports Dr. Rivers gives an account of various visual experiments chiefly made on the Murray islanders, but also carried out with the aid of Dr. Seligmann on some of the other small islands in Torres Straits. The chief points aimed at were the determination of visual acuity, of colour vision, and of visual spatial perception. As regards visual acuity, the most trustworthy test seemed to be the well-known E type method, which consists in determining at what distance a given size of this letter can be recognised; the letter was placed in various positions (sideways, upside down, &c.), and recognition was indicated by the observed person placing in a similar position a corresponding E on a card which he held in his hand. The conclusion arrived at by Dr. Rivers is that the visual acuity of the Torres Straits islanders is only slightly more pronounced than that of normal Europeans, and that probably this difference would disappear on taking into account the refractive errors, myopic and other, of the latter class. The unanimity with which travellers ascribe a high degree of visual acuity to savage races does not, therefore, mean that these races have organs which are abnormally sensitive to stimulation by light, but is related to the power of the primitive savage to make correct inferences from comparatively insignificant visual data. This power does not depend on a more perfect organ, but is associated with the close attention which the savage pays to the natural objects which surround him. Dr. Rivers appears to agree with Ranke in believing that this close attention to detail can be acquired by practice, but that in primitive races it is associated with lower mental development and with incapacity to feel any marked æsthetic interest or enjoyment even in scenes which the European regards as of great natural beauty.

A very large number of observations were made upon the extremely interesting phenomena of colour vision. It is well known that the references to colour in classical literature show a limited variety of colour nomenclature as compared with modern colour vocabularies. The view of Gladstone and others that this indicates a difference between the range of colour sensations of the ancients and those of their modern successors has, however, been generally rejected on the ground that sensations may have been undoubtedly experienced even when no special terminology has been framed in order to describe them. It appears, however, from the observations on the Murray islanders that it is precisely those colour sensations which are more or less defective for which there is no definite descriptive word, thus supporting Gladstone's views. In Murray Island 107 individuals were tested for colour, and it is remarkable that not a single case of red-green blindness could be detected, although in Europeans such defects amount to quite 4 per cent.

The colour vocabulary is largely framed from the names of such natural objects as force themselves on the attention; thus the word for "red" is derived from blood, that for "green" from the bile of the turtle, it being common knowledge that if the turtle's gall-bladder was accidentally opened in preparing the

animal for food, then the intensely green bile rendered all parts inedible; only one colour was named from the hue of a flower, in spite of the great variety which tropical flowers show. Points of equal interest are the indefinite character of the word used for "blue," this being applied indifferently to blue-green, dirty yellow, grey, &c., and the complete absence of any word for "brown," the language resembling in this respect Homeric Greek. The Murray islander recognised "red" far more distinctly than any other colour; yellow was the next most recognisable hue, "blue" could only be differentiated when in considerable strength, and brown was merely a dull-looking light.

In this connection the simple experiments made upon peripheral colour vision were extremely suggestive. It is well known that in the European the red-green visual field is the smallest, whilst the blue and yellow fields are far larger, but in the Murray islander the green field was distinctly the smallest, and the red field extended widely into the peripheral regions; the largest field of all was, however, the blue one, these colours being far better recognised with peripheral vision than in vision involving the central macula. Probably, as Dr. Rivers suggests, the defective stimulation of the macula by blue light may be related to the excess of yellow pigment present in the Papuan race, and would not be in itself a sign of defective retinal capacity for excitation by these rays.

Many other points of great interest are detailed in this part of the reports, colour contrast, after-images, visual perception of distance, binocular vision, capacity to bisect lines, capacity to compare the length of vertical with that of horizontal lines, susceptibility to such well-known visual illusions as those of Müller-Lyer, Zöllner's line displacements, &c. In regard to all these points there appears to be little, if any, difference between the Murray islander and the average European; the details of these experiments will well repay the reader, particularly as Dr. Rivers has presented the results and described the methods in such a manner that his account can interest those who have not especially devoted themselves to this kind of work.

The second part of the present volume of reports deals with other sensory phenomena. The investigation of hearing was undertaken by Dr. C. S. Myers; it was rendered difficult by the not infrequent presence of defects in the ears due to the now prohibited practice of deep diving for pearls. The experiments on the younger inhabitants were free from such hampering circumstances, and the results showed that, as compared with Europeans, both the acuity of hearing and the capacity to distinguish differences of tone were distinctly inferior in the case of the islanders; on the other hand, it is remarkable that the range, as estimated by modified Galton whistles, was at least as extensive in the islander as in the European. The investigation of the sensations of smell by Dr. Myers was also extremely difficult, owing to the great objections entertained by the islanders for this class of experiment, but it seems from such observations as could be made that there is no marked hyper-sensitiveness to olfactory stimulation in this primitive race as compared with Europeans.

Dr. Myers also made some limited experiments on tastes; a specially interesting feature brought out by these observations is the complete absence of any word to describe the extremely conspicuous gustatory sensation which we denote as "bitter," although it is certain that the sensation was experienced. In connection with this remarkable omission is the circumstance that, even in Europeans, there is considerable confusion as to the sensory significance of the qualities connoted by the word "bitter." Cutaneous sensations, muscular sense, &c., were undertaken by Dr. McDougall, and here there are some striking, but not unexpected, differences between the Murray islander and the European. In the former the sense of pure contact was twice as delicate as in the average Englishman, whilst the susceptibility to pain through pressure, &c., was far less pronounced. It is somewhat surprising, considering how unfamiliar the islanders were with the necessary procedure, to find that, as regards the estimation of different weights, the average least recognisable weight increment was actually smaller in their case than in the corresponding average of thirty Englishmen, being 3·2 per cent. as compared with 3·9 per cent.

Finally, the very important subject of reaction-time was undertaken by Dr. Myers, who gives most valuable details of the results of his observations. It appears that, as regards auditory reaction-time, the younger Murray islanders give results identical with the average young English townsmen, but that, as regards visual reaction-time, the Murray islanders give distinctly longer results. This lag becomes more perceptible when the attention is definitely fixed on the visual stimulus rather than the preconcerted movement, a procedure which always lengthens the reaction-time of Europeans, but which lengthened that of the islander comparatively more. Further, when the method of choice visual signal was used, involving a complexity of psychical conditions, then the increased lag became still more apparent. The reader is referred to the original for the very instructive and, from a psychological standpoint, most suggestive details of these observations.

In conclusion, the authors are to be heartily congratulated on the appearance of this work, which is a very important contribution to both physiology and psychology. The reports form a lasting memorial both of the activity of Cambridge anthropology and of the genuine character of the scientific spirit which now actuates those who study the various aspects of ethnography; the appearance of the remaining volumes promised by Dr. Haddon will be looked forward to with the greatest interest by a wide circle of biological students. F. G.

A REVISION OF PRINCIPLES.

The Principles of Mathematics. By Bertrand Russell, M.A. Vol. i. Pp. xxviii+534. (Cambridge: University Press, 1903.) Price 12*s.* 6*d.* net.

THE appearance of a book addressed equally to mathematicians and to philosophers, setting forth all the assistance which philosophy can afford in the shape of material for mathematics to work

with, is a remarkable event, and the fact that the criticism, pertinent and lucid as it is, of the work of the great Continental thinkers is adverse on many fundamental points should claim for it the patient consideration of both classes of students. We quote :—

"The distinction of philosophy and mathematics is broadly one of point of view: mathematics is constructive and deductive, philosophy is critical, and in a certain impersonal sense controversial. Wherever we have deductive reasoning, we have mathematics; but the principles of deduction, the recognition of indefinable entities, and the distinguishing between such entities, are the business of philosophy."

In answer to the question, "what is mathematics?" we are told that

"Pure Mathematics is the class of all propositions of the form 'p implies q' where p and q are propositions containing one or more variables, the same in the two propositions, and neither p nor q contains any constants except logical constants."

These logical constants are defined in terms of the fundamental concepts which mathematics accepts as indefinable; the philosophical discussion of the latter occupies part i. of this volume. The remaining six parts are devoted to the establishment of the main thesis, that what is ordinarily known as mathematics is deducible from these fundamental concepts by purely logical processes. This, of course, necessitates a philosophical account of the processes which are admissible; the carrying out of the deductions in their most abstract and rigorous form lies in the province of symbolic logic, and is reserved for the second volume.

The mathematical reader is recommended in the preface to pass over some of the more philosophical portions and begin at part iv., on "Order." We do not endorse this recommendation, for the exact establishment of the notion of order is one of the most tedious pieces of work that the mathematical philosopher has to do; besides, many of the preceding chapters are not only extremely interesting in themselves, but absolutely essential to a correct appreciation of the science of arithmetic subsequently developed. For example, a *number* will be found to be defined as a *class*.

Concerning the notion of class, some slight criticism may not be inappropriate. The distinction between class, class-concept, and concept of class, which is of fundamental importance to exact thinking, is made admirably clear, but the same cannot be said of what is necessary to constitute a class. A class may be defined either extensionally, by an enumeration of its terms, or intensionally, by the concept which denotes its terms. The former method seems applicable only to finite classes; we cannot agree with the author that it is logically, though not practically, applicable to infinite classes, unless some meaning is attached to the word "enumeration" different from what is ordinarily understood. On the other hand, the latter method implies that a class is defined by a predicate, and contains those terms of which the predicate is predicable; but this leads to an apparent contradiction which Mr. Russell has discovered; for consider the predicates which are not predicable of themselves, for example, humanity, which is not human; "not predicable of itself" seems to be a predicate defining a class of predicates, yet to suppose that this defining predicate either is, or is not, contained in that class, leads to a contradiction. A similar contradiction is reached when we consider the class whose terms are all the classes, each of which does not constitute as *one* a term of itself as *many*; for in attempting to form this class, at any stage the terms already obtained constitute a class which must be included as a new term, and so on. This may be compared with the attempt to sum a numerical series each of whose terms is the sum of all the preceding terms; the comparison does not completely explain the paradox, but suggests that a distinction should be made among infinite classes somewhat like that between convergence and divergence.

Leaving the logical side of the subject, we come to the first mathematical idea to be defined, that of number. It was formerly supposed that the notions of "1" and "+1" were fundamental, and that from them all other numbers could be defined. In the present work the number of terms in a class is defined, in a manner slightly differing from Peano's, as the class of all classes similar to the given class. Similarity depends on a one-one relation, which can be defined without reference to number, and indicates by Mr. Russell's "principle of abstraction" the possession of a common property which may be called the number. Various reasons are given for preferring this definition, one of the chief being the inclusion of the infinite numbers introduced by Cantor.

Part iii. deals with quantity and magnitude, between which a subtle distinction is drawn, and contains an introduction to the problems of infinity and continuity, which are to be more fully discussed in part v. Part iv. develops the difficult theory of order and Dedekind's theory of integers. The next part is necessarily based largely on the work of Cantor. To readers unacquainted with the "Mengenlehre," the introduction of transfinite numbers must appear rather startling, but this is perhaps partly due to an unusual weakness in the English language. It must be remembered that by a transfinite cardinal number is meant a certain kind of infiniteness of aggregate, the same number belonging to different aggregates which are similar in the preceding sense; and a transfinite ordinal number is another name for a type of infinite series, or of generating relation.

In the chapters on real numbers and irrationals, we approach controversial ground. The particular object which the arithmetisers of mathematics have here in view is to complete the series of rational numbers by the introduction, without any appeal to intuition, of other numbers, so as to satisfy the abstract definition of continuity. One consequence of this will be that it will then be possible to assign a real number to every point on a straight line. Three great thinkers —Dedekind, Weierstrass and Cantor—have done this, making their definitions of an irrational number depend upon the theory of *limits*. Their methods are explained and criticised, the chief objection being that

there is no adequate ground for assuming that a limit such as that of the series of rationals whose squares are less than 2 does really exist. Instead of this Mr. Russell defines a *segment* as a class of rationals less than a variable term of itself, and shows that segments possess all the usual properties of real numbers. This theory agrees very closely with Cantor's, the point of divergence being where Cantor appears to regard the rational number a as identical with the real number defined by the series $(a, a, a, \ldots)$ whereas Mr. Russell will not admit this. On the one hand it is obvious that the two concepts are as distinct as "man" and "featherless biped," and therefore cannot be identical; but, on the other hand, it seems unnecessary to insist too much on the distinction, because no confusion need arise from using the expression "a" in two different senses. Thus, if b is the irrational number defined as the series $(\ldots a_n, a_{n+1}, \ldots)$ we may write $b-a=(\ldots a_n-a, a_{n+1}-a, \ldots)$ and in this equation a is a series or so-called real number on the left and a rational number on the right. The conclusion is that the series of rational numbers cannot be completed exactly as it stands, but the rationals must first be replaced by series, or, if preferred, by segments, and then by means of other series the continuum of real numbers can be constructed.

Limitations of space forbid detailed comment on part vi., in which, incidentally, Euclid gets some rather hard knocks; and in the matter and motion of part vii. Newton's laws are condemned as confused, worthless, and wholly lacking in self-evidence, while we are told that force is a mathematical fiction, and velocity and acceleration must not be regarded as physical facts.

On the whole the book is very interesting, although somewhat too long. The presentation is admirably clear, and the seriousness of the style is relieved here and there by neatly turned bits of humour. It does not pretend to say the last word on any subject, and, indeed, bristles with unsolved difficulties, towards the correct solution of which a great step is undoubtedly made by its publication. R. W. H. T. H.

ELECTROCHEMICAL ANALYSIS.

Quantitative Chemical Analysis by Electrolysis. By Prof. Classen. Translated by Bertram B. Boltwood. Pp. vii+315. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 12*s.* 6*d.* net.

ELECTROCHEMICAL methods of analysis are now coming into such general use on the Continent and in America, and to a smaller extent in this country, that chemists will be prepared to welcome the latest translation of Prof. Classen's "Quantitative Analyse durch Elektrolyse."

The translation is made from the fourth German edition published in 1897, but, as the translator has been allowed wide latitude by the author, he has brought the book well up to date, and we find several features in this book which are not in the German original.

In chapters xiii. and xiv., for example, which deal respectively with "measurements of current strength" and "sources of current," there are quite a number of new blocks, as, for example, Bredig's amperemanometer and the Weston ammeters and voltmeters. We also find several new diagrams in chapter xvi., which deals with the accessory apparatus employed in analysis. As a matter of fact, we think, considering that the book is devoted to electro-analysis, some of the apparatus described is rather superfluous. A quadrant electrometer is not usually to be found in a laboratory devoted to electro- or any other analysis, the description of such apparatus appertaining more to works on physics or perhaps on general electrochemistry. In chapter xviii. the author gives details as to "arrangements for analysis." The details which are given refer mainly to the very thorough installations at Aachen, and two photo-plates of the laboratories, as they are at present, also one showing the former equipment of the private laboratory, are given. One cannot learn very much from these photographs, but they improve the appearance of the book, and incidentally give an idea of the large number of platinum basins which Prof. Classen possesses.

On p. 153 we come to the analytical portion of the book, the first metal dealt with being iron. For the analysis of iron there is no doubt that Classen's oxalate method is extremely satisfactory, and the analytical results obtained are generally very accurate. At the same time, as Kohn and others have shown, this is really due to a balancing of errors. The iron deposited always contains traces of carbon, but, on the other hand, there is usually a trace of iron left in the solution, and these two errors balance. Classen states that iron, when deposited from solutions containing citrates and tartrates, always contains carbon, but leaves it to be inferred that when oxalates are employed, the metal is deposited free from carbon. Prof. Classen employs the oxalate method not only for iron, but he uses it for almost every metal, very often, too, when other ways are vastly superior, and he seems very much afraid that someone else will take credit for the method, because in almost every case we find a bracket in which it is stated that this is the "method of the author." As a matter of fact, there are only a few cases in which the employment of oxalates has any real advantage, as *e.g.* with iron and zinc. There is certainly nothing to be gained by using it when depositing copper, nickel, or mercury, where there are many much more satisfactory methods. Cobalt, according to the author, when deposited, shows its characteristic metallic properties. Generally speaking, when electrically deposited, cobalt is brownish or smoky in appearance—are these its characteristic metallic properties?

Section ii. of the analytical portion deals with the analysis of nitrates, and section iii. with the determination of the halogens.

Section iv., on the separation of the metals, is perhaps one of the best parts of the book. It may be very easy, and generally is, provided one employs the correct conditions, to analyse from pure salts of the metals, but the electrolytic separation of metals is

not always so simple. Of course, the chief point is to know how and when to combine pure analytical with electro-analytical methods in such a way as to attain the greatest accuracy, and to save as much time as possible.

Section v. is devoted to a short account of a very neat method of determining the halogens in presence of each other. It depends upon the fact that iodine is precipitated from its solutions at a lower potential than bromine. A silver anode is employed, and when at the lower potential all the iodine has been deposited, a fresh anode is placed in the solution, and a higher E.M.F. employed. Part iii. of the book is divided into two sections, the first of which gives some examples of applied electrochemical analysis, as *e.g.* analysis of alloys, such as brass, solder, type metal, &c., and of certain ores, such as cinnabar and molybdenite. The second section gives details for the preparation of reagents.

The book in its present form is a very useful addition to laboratory text-books. The introduction is, perhaps, rather unnecessarily long, but it explains Faraday's and Ohm's laws clearly, and gives a good general account of the theories of electrolysis. At the heads of the chapters very full references to the literature of the subject are given; the references are mainly to German and American authors, the reason being that Germans and Americans have done most of the work.

The translator, Dr. Bertram Boltwood, has carried out his labour with care and discretion, and many of his additions are very valuable. The book is splendidly printed, and the diagrams are very clear and well produced.

F. MOLLWO PERKIN.

TECTONICS OF THE EASTERN ALPS.

The Geological Structure of Monzoni and Fassa. By Maria M. Ogilvie-Gordon, D.Sc., Ph.D. Pp. x + 180. (Edinburgh: For the Geological Society of Edinburgh, Turnbull and Spears; London: Simpkin, Marshall and Co., Ltd., 1902–3.)

IT is indeed satisfactory that the Geological Society of Edinburgh has, with considerable enterprise, published the very detailed observations of Dr. Maria Ogilvie-Gordon. We can easily conceive that, when originally presented to the Royal Society of London, this paper seemed of somewhat local application (prefatory note, p. v.), and it is the privilege of societies with fewer claims upon their funds to do justice to the work of their own members. It rests with the author to see that the circulation of separate copies is judiciously carried out, in which case, from a cosmopolitan point of view, the place of publication has little influence on the judgment of scientific men.

One feels, however, that continuous energy and persistent attention to detail on the part of Dr. Ogilvie-Gordon have brought into an important controversy a feature that may be superficial, but which, none the less, jars upon the reader. One becomes inclined to believe that an observation claims our notice because it was made by the authoress, and not because it furnishes a link in the long chain of argument. The same impression, it is true, is often produced in the works of Ruskin or Carlyle, but does not form their most enduring attraction for posterity. The recognition of Dr. Ogilvie-Gordon's work is manifest from the frequent references to it by Continental writers, notably in the new "Führer für die Exkursionen," issued for the ninth Geological Congress in Vienna. Yet we cannot forget that the authoress attaches so much importance to the views adopted by her as to have introduced disparaging remarks upon a rival school in the "translation" of a work by Prof. von Zittel. The paper now before us the record of some years of devoted and faithful study in the field, describes how the Triassic masses have been broken up by a double series of planes of fracture, along which igneous rocks have crept during the period of earth-movement. Possibly, then, there is some appropriateness in a mode of treatment which causes us to see the lines of weakness in previous descriptions penetrated with an almost intrusive pertinacity.

Not that there is any note of battle in the present treatise. The authoress gives her reading of the very numerous observations made by her in a classic area, and the difficulties to be faced are well realised by Doelter in the "Führer" above referred to, when he says of Predazzo,

"Die Teilnehmer an dieser Exkursion betreten ein Gebiet, welches zu den allerinteressanten Europas gehört, aber auch zu denen, wo der Zwiespalt der Meinungen am grössten ist. Die verschiedensten und widersprechendsten Ansichten haben hier geherrscht und herrschen teilweise heute noch."

Similar caution is shown by Drs. Diener and Arthaber in treating of the "reef-facies" in the Schlern area. With regard to the causes that bring massive limestones into juxtaposition with normal sediments, along surfaces that occasionally interlock, all geologists are aware that Dr. Ogilvie-Gordon has adopted a theory of cross-fracture and faulting (p. 67), and has done so after detailed mapping on the ground. Her views of the Monzoni mass are admirably stated on p. 176 of the present paper.

"I therefore strongly insist upon my observation in the case of Monzoni that the particular band of limestone strata entered by the sill was at the time of inflow *in process of sinking* steeply inward at the inthrow faults . . . While the ascending magma involved and engulfed fragmentary portions of the insinking calcareous rock, it clearly found easiest access amidst the multiplicity of fracture and shear-slip planes in the body of Werfen strata to the south."

The succession of intrusions is then described, and the suggestive conclusion is arrived at (p. 177) that

"during the geological periods when the fault-vent continued intermittently active, the form of the sill-complex was capable of being re-moulded periodically in harmony with the localised crust-stresses."

The Cainozoic age often assigned to the whole eruptive series of Monzoni, which can only be proved to be later than the Lower Trias, is not a vital point in Dr. Ogilvie-Gordon's paper. Its interest lies in its tectonic details, and these are illustrated by a number

of coloured sections and two folding maps. Some of the photographic plates, such as that of the "block-structure" in porphyrite, facing p. 106, are of unusual beauty. G. A. J. C.

OUR BOOK SHELF.

A. Koelliker's Handbuch der Gewebelehre des Menschen. 6te Auflage. Drittes Band. Von Victor v. Ebner. Pp. 1020; 633 illustrations. (Leipzig: W. Engelmann, 1902.) Price 18*s.* net.

THE conclusion of the sixth edition of Koelliker's "Histology" merits more than a passing remark. The first appearance of this well-known handbook about the middle of the last century formed an epoch in the science of which it treats (which it may almost be said to have created), and ever since it has held the foremost rank in works dealing with the subject. But it is now more than thirty years ago that the fifth edition was published, and progress has been rapid in the interval.

The first two volumes of the present edition were edited by the original author, and no work that he has done has been better done than this. But the weight of years must eventually tell, even if one is Koelliker, and the task of editing the third volume was handed over by him to Prof. v. Ebner. A first part of this volume, dealing with the digestive, respiratory, and urinary organs has appeared, and has already been noticed in NATURE; the last part of the work, embracing the structure of the generative organs, the vascular system and the organs of special sense, and comprising also an index of subjects and authors for the whole book, is now in the hands of histologists. Prof. Koelliker's selection of an editor for his great work is amply justified; a better successor to himself could hardly have been found than the eminent Vienna histologist, who has, moreover, been ably assisted by Dr. Joseph Schaffer and Dr. Hans Rabl. It is to all intents and purposes a new book which has made its appearance. Hardly a page but has been rewritten, and of the 633 illustrations, 533 are entirely new—for the most part from original preparations. Nevertheless, the general style of the preceding volumes is singularly well carried out in this one, so that it is difficult at first to recognise that the work is by another hand. Too much praise cannot be given to the bibliographical notices, which are far more complete than are to be found in any other work on histology.

The whole book is a storehouse of information based on personal observations, and must long remain the standard work of reference on the subject.

The octogenarian master, whose own scientific activity is by no means exhausted, must be well content to know that his work has been brought to so brilliant a completion, and in presenting to him our respectful congratulations, we may be permitted to express the desire that he will still continue for many years to enjoy the satisfaction of witnessing the success of his life-long labours. E. A. S.

Building Superintendence. New edition, revised and rewritten. By T. M. Clark. Pp. 306. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 12*s.* 6*d.* net.

THIS is a book which appears to have had an extended circulation in the United States, and, although it contains a good deal of practical information, a large amount would only apply to construction methods on the North American Continent. It is primarily addressed to the young architect, and gives him hints as to the selection of good materials and as to the direction of building operations generally. A knowledge of building construction is therefore assumed, and the book is intended to supplement that knowledge by the practical application to existing buildings.

The subject is divided into three main heads, namely, stone buildings, wooden buildings, and steel-framed buildings, and in each case a typical building is described from the foundations upwards, showing the successive stages of construction and general direction for the judging of the quality of materials. The term "superintendent," which occurs so often, is presumably the American equivalent for the English clerk of works.

The English student should beware of information which may apply in the States, but is not correct as applied to England; for instance, on p. 5 we are told that five courses of bricks commonly equal one foot in height, whereas, as a matter of fact, four courses in England usually equal one foot. Many of the terms and names will also be quite unfamiliar to him.

Chapter i., dealing with stone buildings, takes up the construction of a stone church intended to be erected on elevated ground. This occupies more than 100 pages, and deals with the preliminary staking out of its various parts—foundations, damp in cellars, the making of concrete and mortar, defects common to various kinds of stone, walling, flooring, roofing beams, and plastering. The information is sometimes effected by means of question and answer between the architect and foreman in the manner made familiar in the treatises of Viollet le Duc.

Chapter ii. deals with wooden dwelling-houses, their location and aspect, drainage of site, employment of contractors, the framing of the timber (uprights and sills), chimneys, electric wiring and fitting, roof shingles, plastering, plumbing fittings, doors, windows, stairs and their arrangement and defects, drainage and water supply, and painting. Chapter iii., dealing with the writing of specifications, can be passed over, as essential differences exist between English and American practice. Chapter iv. deals with contracts, and the author rightly dwells on the importance of these, especially with regard to the necessity for protecting the building owner.

Chapter v. deals with the construction of a steel-frame office building, eleven storeys high, on a corner city site 25 feet by 100 feet, in which economy of space has to be carefully studied. This is probably one of the most interesting chapters in the book, and its construction is dealt with in a progressive way, in the same manner as in the stone and wood buildings.

The plan, question of fire escapes, foundation, steel framework, vaults, floors (fire-resisting), elevators, are dealt with in turn. As will be seen, the book is arranged on a sensible and convenient plan, and if it could be written to be suitable for English readers, it would be of greater benefit. As it is, however, it contains a great deal of excellent advice founded upon practical experience, and no architect could read it through without having his wits sharpened for discovering defects in workmanship at the periodical visits which he pays to buildings in course of erection from his designs.

A Key to the Time Allusions in the Divine Comedy of Dante Alighieri. By Gustave Pradeau. Pp. 32. (London: Methuen and Co., 1902.)

THE author, having found that different editions of the great poem of Dante assigned different durations of time for the action supposed to be occupied by it, set himself to investigate the matter by a comparison of all the time allusions until the poet ascends from over Jerusalem to the *primum mobile*. He ingeniously illustrates his argument by a diagram or "dial" in the circumference of which are the signs of the zodiac, whilst in the centre are four points representing respec-

tively Jerusalem, Purgatory, the Ganges, and Morocco. Dante imagined that, with respect to Jerusalem, the Ganges was the extreme east and Morocco the extreme west. The four important divisions of the day, *mezzodi* or midday, *sera* or evening, *mezzanotte* or midnight, and *mattino* or morning, are represented by lines towards the circumference. At the beginning of the poem Gerusalemme must be placed at the top of the circle, with Mattino over it. Now looking southwards, holding the dial straight before us, it will be found that the sun on the dial follows the same course as the real sun. The lines in the Inferno, Purgatorio, and Paradiso which contain the time allusions are given in Italian and in Longfellow's English translation, and the author finds that the whole duration from the beginning of the poem to the final morning in Purgatorio is seven and a half days, *i.e.* seven days from the entrance with Vergil into Hell.

The conceptions of great poets like Dante and Milton must ever be of interest, though we cannot, of course, expect them to be in agreement with modern astronomy. The latter, though constructing the universe according to Ptolemy, yet, living after Copernicus, and being personally acquainted with Galileo, evidently had misgivings with regard to the truth of that system. None such troubled the mind of Dante; to him the earth was the centre of the universe, both in appearance and in reality. But M. Pradeau presents a scheme concerning his views as bearing upon the progress of time in the "Divina Commedia" which is both ingenious and consistent with itself.

W. T. L.

A School Geometry. Part iii. By H. S. Hall, M.A., and F. H. Stevens, M.A. Pp. vii+137 to 210. (London: Macmillan and Co., Ltd., 1903.) Price 1*s.*

IN this volume we have a further instalment of the new text-book of elementary geometry which the authors have in preparation, a school geometry based on the recommendations of the Mathematical Association and the recently adopted report of the Cambridge Syndicate.

The present contribution deals with the geometry of the circle, and contains the substance of Euclid, book iii., 1–34, and a portion of book iv. The authors have omitted some of Euclid's propositions, and have not adhered strictly to Euclid's sequence, but the Euclidean form of proof has been retained.

The conception of a "limit" is appropriately introduced in explaining the nature of tangency, and in establishing some of the propositions.

The exercises, which follow the propositions at short intervals, are partly deductive and partly graphical, the latter requiring the use of compasses and scale, the numerical answers being collected at the end of the volume. The examples are simple and well graduated.

We consider that problem 23 would be better omitted, together with the exercises based thereon. It is of no practical value, and should be consigned to the Euclidean relics. Every draughtsman knows that a line can be drawn with greater accuracy to touch two given circles than to pass through two given points, and if the points of contact are wanted, they can be determined subsequently by drawing perpendiculars from the centres of the circles.

The circumference and area of a circle are briefly dealt with on p. 198. The experimental determination and verification of these quantities might with advantage have been more fully gone into. The book concludes with some propositions on circles and triangles, including a demonstration of the property of the nine-points circle.

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.*]

American Botanic Laboratory in Jamaica.

THE Director of Kew presents his compliments to the Editor of NATURE and requests the favour of his publishing the enclosed letter.

Kew, August 23.

Sir William Thiselton-Dyer,
Royal Botanic Gardens,
Kew,
Surrey, England.

My dear Sir,

The Government of Jamaica has decided to relinquish its use of the buildings at Cinchona. The experimental and botanical plantations are, however, to be maintained as before. The Surveyor-General of Jamaica offered under public advertisement on June 15 the group of buildings known as Bellevue and some land for rental. I have personally accepted this rental for the purpose of saving the station for scientific purposes, and with the plan of establishing there, if possible, the long desired botanical laboratory in the American tropics. At my request, Dr. MacDougal has recently visited Jamaica to arrange details of the lease, and reports that the buildings and their furnishings are already comfortable and well adapted for the use of investigators.

Dr. MacDougal and I decided to take these steps after consultation and correspondence with Prof. Underwood, who spent the early part of the year in Jamaica in the study of ferns, and who is now in Europe; with Dr. Duncan S. Johnson, who has recently returned from Jamaica, where he has been collecting material for embryological studies; with Mr. Wm. R. Maxon, who was with Prof. Underwood there during the spring; and with Prof. Earle, who spent last November in Jamaica in mycological investigations. Dr. MacDougal was already familiar with the locality from his visit there with Prof. Campbell in 1897, and we had discussed the topic with the Hon. Wm. Fawcett, director of the public gardens and plantations of Jamaica, while he was in New York last autumn during the meeting of the Plant Breeding Conference. The aid and cooperation of all who regard the securing of Cinchona as a proper and desirable act will be needed to maintain such a laboratory, and to this end I ask that you write me your opinions on this subject, and to indicate what aid you can render, and whether either you or your students would wish to make use of the station during the next year, and if so, for what length of time approximately.

I may say that the Jamaican Government is heartily in sympathy with the enterprise, and will cooperate to a very important extent, furnishing facilities for growing plants under the widely different climatic conditions offered by the gardens at Cinchona, Hope, and Castleton, the use of the large botanical laboratory and herbarium at Hope, and the use of visitors' tables in the laboratory at Hope.

As regards Cinchona, I quote the following from Prof. Underwood's account of his work in Jamaica from the July issue of the *Journal* of the New York Botanical Garden:—

"Not the least important of the results of the expedition was a possible solution of the problem of a suitable location for a tropical laboratory, which has long been under consideration by American botanists. At the time of the visit of the committee appointed some years ago to investigate the subject, the plant at Cinchona was occupied by the Government botanist, and was consequently out of the question. A one-story six-room house, three or four low buildings suitable for laboratory work, with two greenhouses of sufficient capacity to conduct experimental work under glass, could be had of the Jamaica Government at a nominal rent. Cinchona is nearly a mile above the sea, with a delightful climate (the extremes of temperature for the past twenty years being 45° F. and 79° F.), a delightful outlook, and as closely accessible to virgin forest as could be obtained. Within three miles, nearly on a level, is

Morce's Gap, whose tropical conditions I have described above; close to Morce's Gap you make the ascent to John Crow Peak (6000 feet), through a forest of tropical luxuriance. Below is Mabess River (3000 feet), with similar but lower-level vegetation. At about the same distance from Cinchona (three miles) is New Haven Gap (5500 feet), with a similar but higher-altitude flora. Still higher altitudes are accessible at Portland Gap and Blue Mountain Peak at a distance of eight to ten miles.

"There are no human habitations above Cinchona, so that the Clyde River, which supplies it with water, is pure and without sources of contamination; a more healthful location could not be found in all the American tropics."

Briefly expressed, the above scheme offers the investigator residence accommodations and laboratory facilities at Cinchona under the most pleasant and advantageous conditions, from which place he may quickly transfer his work to more pronounced tropical conditions at Hope in a dry climate, or to Castleton in an extremely humid locality. The marine flora is equally accessible.

The locality furnishes easy access to an immense number of species of plants different from those available at any other similar institution; travelling and living expenses are very reasonable, and Jamaica may be reached at intervals of only a few days by numerous steamers from England, Germany (Hamburg), and nearly all ports of eastern America.

Yours sincerely,
N. L. BRITTON.

New York Botanical Garden, Bronx Park,
New York City, August 13.

Training of Forest Officers.

IN a sympathetic notice in the *Indian Forester* of the late distinguished Inspector-General of Forests in India, Mr. H. C. Hill, Sir Dietrich Brandis stigmatises as "absurd" "the idea which, until a short time ago, was current in England, and which to this day is held by many English botanists, that a good botanist must necessarily be a good forester." I quite agree that the idea is absurd; but as I am probably better acquainted with the English botanical world than Sir Dietrich Brandis, I doubt very much whether the idea was ever current in this country, or is held at the moment by many English botanists. For my part I entirely dissociate myself from it, as I know many accomplished botanists who would probably make very indifferent forest officers.

I am more able to agree with Sir Dietrich Brandis when he says, "A forester, more than almost anybody else, must use his eyes and must be able on the spot to draw conclusions from what he has observed." But the power of observation is by no means possessed by everyone. A further requisite, in which I think Sir Dietrich Brandis also agrees, is sympathy with and pleasure in forest nature for its own sake. It appears to me that neither point is kept in view in the present mode of recruiting the Indian Forest Service.

Sir Dietrich Brandis lays great stress on sport, and unless it becomes too absorbing a pursuit, it undoubtedly fulfils the conditions I have stated. It would, however, be as undesirable to insist that every forest officer should be a sportsman as that he should be a botanist.

But I entertain a very strong opinion that a forest officer will never rise to the highest level of efficiency in his work unless he has a scientific grasp of the principles which underlie it. He should be able to identify the trees which compose the forest vegetation under his charge, and for this purpose he should have such an elementary acquaintance with botany as will enable him to use intelligently the book which Sir Dietrich Brandis has been for several years occupied at Kew in preparing for the purpose. He should further have some knowledge of the nature and conditions of vegetable life; he should grasp the idea that a tree is a living organism the growth and development of which are subject to adverse or favourable conditions. He should further have some idea of the enemies and diseases by which trees are liable to be attacked, and of how these attacks can be met. All this a man of ordinary intelligence can acquire if he possesses a real taste for nature without rising to the level of the professional botanist, which it would be absurd to demand of him.

There is the same fallacy underlying the view that mere administrative efficiency is sufficient for a good forest officer as in thinking that mere mechanical drill, without resource or initiative, will make a good soldier.

As I have felt it my duty to urge these views officially, I should be glad to state them more publicly.

I should like to take the opportunity of expressing my regret at the untimely death of Mr. H. C. Hill, the late Inspector-General. Largely as the result of my personal persuasion he accepted a mission in 1900 to initiate a scientific forest administration in the Straits Settlements. His reports were of the highest value, and will be a permanent basis for the future forest policy of that part of the Empire.

W. T. THISELTON-DYER.

Kew, August 28.

Peculiar Clouds.

CAN any of your correspondents explain the following phenomenon? At 5.20 p.m. to-day, the sky to the W. and S. being covered with a dense and unbroken mass of cloud, and the sun, therefore, entirely obscured, I saw a broad patch of iridescent colours like a piece of a rainbow on the clouds to N.N.E., many points more to N. than a rainbow would have been had the sun been shining. No part of the sky was clear, but the clouds were lighter in the N.W.

I saw a similar phenomenon at Colwyn Bay on December 17, 1898, the iridescent cloud being due E. at 2.45 p.m., the sun shining intermittently. I know true "iridescent clouds" well, but they are generally near the sun.

ALFRED O. WALKER.

Ulcombe, Maidstone, August 30.

THE EARTHQUAKE OBSERVATORY IN STRASSBURG.

NOW that the earthquake observatory in Strassburg has been offered as a centre for the proposed international association for seismological research, at which the work of the world so far as it bears upon earthquakes and kindred phenomena may be concentrated, a short description of this institution and its present output may not be devoid of interest.

The building stands in the back part of the University gardens, and lies between two streets, along which heavy traffic is forbidden. Externally it measures 19×15m., and essentially consists of four rooms, round the walls of which there is a passage or air space 1m. in width, walls, a second air space, and the outer walls. In short, it is a building with its floor 1.50m. below the surface, within two other buildings.

The object of the construction is to obtain rooms which are light tight, free from currents of air, and in which changes of temperature and moisture should be small. For certain classes of observations these conditions may be imperative, but when recording earthquakes, which is the chief work at Strassburg, gloom and a still atmosphere are distinctly undesirable. In the early days of seismometry the proper place for an earthquake recorder was considered to be a cellar, and when we find instruments with complicated parts which frequently require inspection, and which write their records on smoked paper, together with photographic apparatus designed to be used in broad daylight, relegated to darkness, we realise that traditions still survive.

Although it is well known that different results are obtained from similar instruments installed on different formations, the choice of site at Strassburg was apparently governed by the advantages offered by proximity to its University. In consequence of this, town traffic, which includes that of an electric service,

which might influence certain geophysical investigations, and the fact that alluvium might mask small tremors, are conditions that cannot be avoided.

In the *Beiträge zur Geophysik* (vi. Band, 3 Heft) issued "Zur Begrüssung der II. Internationalen Seismologischen Konferenz," Prof. Dr. Bruno Weigand gives an account of the instruments now in use at Strassburg Observatory, and an explanation of the monthly reports issued from the same.

The instruments longest in use are two Rebeur-Ehlert horizontal pendulums. In each instrument there are three pendulums arranged at angles of 120° with each other, the idea being that the three records would enable an observer to determine the direction in which an earthquake motion was propagated. Inasmuch as it has been well known for many years past that the movement of the ground as recorded at a given station may be in any azimuth, we are not surprised when Dr. Weigand tells us that no satisfactory result has been obtained.

The records are photographic, the source of light and the record receiving surface being at a distance of 5 metres from mirrors on the pendulums. This necessitates the use of powerful electric lamps. This condition, the high sensibility due to high multiplication of the instrument, which on certain foundations leads to wandering of the light spot, and the cost of photographic paper, which is run at the rate of 36cm. per hour, preclude the use of this instrument excepting at a few selected stations. Other instruments are Wiechert's astatic pendulum, Vicentini's microseismograph, and Omori's conical pendulum, all of which write on smoked paper, Milne's photographic horizontal pendulum, which is a type adopted by the British Association, and Schmidt's trifilar gravimeter.

Brief references to the records of these instruments are published in a *Monatsberichte*. All that this gives about the Strassburg records of an earthquake is a time for its commencement and its duration as recorded by a Von Rebeur pendulum. The times of maximum or other phases of motion, amplitudes, periods, and other information required by seismologists is omitted. A plus or minus sign indicates whether other instruments did or did not respond to the movement, and the latter signs predominate.

With the object of showing the superiority of the Strassburg type of instrument, particularly as compared with the type adopted by the British Association, which latter, according to his opinion, should cease to exist, Dr. Weigand emphasises the discrepancies between his various registers. As illustrative of the supposed want of sensibility in the British Association type, he points out that the Strassburg *Circular* for August, 1901, shows that the Rebeur pendulum recorded twenty-four earthquakes, whilst a British Association type, in the same building, only recorded seven. This latter number he now raises to ten. As a matter of fact, seventeen of the Strassburg records correspond with seventeen records obtained in Britain, whilst five entries in the Strassburg list refer to very small disturbances peculiar to that place, which therefore may well be regarded as being of doubtful origin. The earthquakes recorded in a given period by the Rebeur and British Association pendulums were therefore nineteen and seventeen. Dr. Weigand published these numbers as twenty-four and seven, and similar discrepancies between the records of the Rebeur pendulum and the records of all other instruments in use at Strassburg appear in each of the Strassburg registers.

That the Rebeur pendulums as installed at Strassburg have a higher sensibility than other seismographs is well known, but it must not be overlooked that this high sensibility is one factor which prevents their general adoption. That the British Association type of instrument is sufficient for the purposes for which it was intended is amply shown in the reports issued by the Association. Experiments are now in progress to increase the speed of the record receiving surface connected with this apparatus about four times, and to reduce the cost of photographic material to about 3*l*. per annum. It now costs 6*l*. 10*s*. per annum, whilst paper for the Rebeur apparatus costs 15*l*.

When Dr. Weigand complains of the want of sharpness in the trace yielded by the British Association instrument, he should evidently look to its adjustments, for it is its pronounced sharpness that compensates for its want of multiplication. In this respect the records it yields are far superior to those obtained from any other form of photographically recording seismograph.

That it should be affected like other instruments with so-called "Mikroseismische Unruhe" is what might be expected if located in a cellar.

Altogether, the institute at Strassburg as "der Kais. Hauptstation" might easily be improved, whilst if its publications took the form of the excellent registers issued in the *Bollettino della Societa Sismologica Italiana*, they would be of greater value to working seismologists.

THE INTERNATIONAL STUDY OF THE SEA.[1]

THE publications mentioned below are the first reports of the International Council for the Study of the Sea which was constituted by the meeting of representatives of the maritime Powers of northern Europe at Christiania in 1901, and now has its seat at Copenhagen. The bulletins deal with what has come to be known as hydrographic work carried out on the quarterly cruises, in which special ships of each of the participating States take part. The word hydrography is not, however, used in the sense made familiar by the hydrographic offices of the various Admiralties; it means, if we may borrow for a moment the terminology of chemistry, scarcely more than inorganic oceanography. We say scarcely more, for in these bulletins it does include the study of the distribution of plankton, but for this purpose plankton are treated rather as current-floats than as organisms.

It will be remembered that the International Council was formally constituted at a conference held at Copenhagen in July, 1902, and that no time was lost in getting to work is plain from the fact that the first number of the Bulletin deals with a series of cruises in August, 1902, the second with a similar series in November or December, 1902, and the third with February, 1903. These cruises have since been continued quarterly, and we understand that they are now more complete, and the results obtained more readily comparable than was possible when the collaboration was only beginning. Viewed from the standpoint of scientific efficiency, the work of the Council is hampered by the very short term for which the various Governments have granted the necessary funds and the stringent conditions as to endeavouring to obtain practical results directly beneficial to fisheries which have been insisted on in some cases. But there is reason to hope that these very difficulties will act as a spur.

The bulletins are mere records of observations, they contain a minimum of explanatory letterpress, and no discussion at all. It might be found desirable to print

[1] Conseil permanent international pour l'Exploration de la Mer. Bulletin des Résultats acquis pendant les courses périodiques. Publié par le Bureau du Conseil avec l'assistance de M. Knudsen, Chargé du Service Hydrographique. Année 1902–1903. Nos. 1, 2 et 3. (Copenhague: A. F. Höst et Fils, 1903.)

a little more information, for instance, as to the constitution of the International Council and its administrative bureau, the address of the office and a brief statement of the objects for which the organisation has been brought into existence. The salient features of the maps of the physical conditions of the surface water might also be expressed in words, and the stations at which observations were made ought to be indicated on the map of each cruise by dots. We are inclined to lay stress on this point, as without some indication of the kind the maps are difficult to interpret, and the scale is not large enough to permit the figures of each observation to appear.

The August and November cruises were carried out in the Baltic by Finland, Sweden, Denmark, and Germany, in the North Sea by Germany and Scotland, and in the North Atlantic and Arctic Sea by Norway and Russia. To these there were added in February observations in the North Sea by Holland, and in the English Channel by England, England and Scotland being separately represented, mainly on account of the different nature of the fishery problems in their respective areas. It may be noted that these bulletins do not touch on the fishery observations, nor on the biological work (the determination of plankton excepted), which occupy the whole time of the various national staffs between the quarterly cruises. They do not refer either to the work of the Central Laboratory at Christiania.

The importance of the bulletin lies in the fact that it gives particulars of the temperature and salinity at a great number of points from latitude 45° to 75° N., observed nearly simultaneously and with comparable instruments of the highest precision, the temperature being determined by means of the Pettersson-Nansen insulating water-bottle and thermometers graduated to the fifth or even the tenth of a degree centigrade, the salinity by estimation of chlorine.

Both for August and November the central part of the North Sea appears to have been left without observations, but this gap was partly filled up in February when the system of quarterly cruises was more complete, and a number of supplementary observations by trading steamers had been added. The indications in the published maps are of a slight freshening along the British coast, a belt of maximum salinity running parallel to the coast towards the middle of the North Sea, increasing in salinity rapidly to the north-west between Scotland and Faeroe, and to the south-west towards the English Channel. The whole of the eastern half of the North Sea shows a rapid freshening towards a stream issuing from the Baltic close along the west coast of Jutland.

Where the temperature observations were sufficiently close and regular to permit of isotherms being drawn, they present a remarkable relation to the isohalines. In August the one isotherm shown is that of 12° C., which runs from Aberdeen to Lindesnaes, cutting the isohalines at right angles. In the November map, however, the isohalines and isotherms exhibit a most striking parallelism, so that the circulation of the water in that month could be studied with equal facility by considering either the temperature or the salinity. Thus at the southern end of the North Sea the isotherm of 13°·5 C. coincides with the isohaline of 35·25 per mille, and the isotherm of 13° C. with the isohaline of 35·00 per mille. At the mouth of the Baltic the two sets of lines though parallel do not correspond symmetrically, while on the north-west side of the Baltic stream 10° lies close to $34^{o}/_{oo}$, on the east side it lies close to $32^{o}/_{oo}$. Still the axis of the Baltic stream is the same whether it is drawn from the one set of lines or the other.

The February map shows the isotherms parallel with the isohalines in the south and east of the North Sea, but cutting them nearly at right angles in the more open waters of the north and west. The difference in the broad action of the Atlantic in the wide part of the sea and the river-like action of the Channel in the southern part is brought out in a most interesting manner.

It is very important to secure a great extension of surface observations, and this, we believe, is now being done by many shipmasters who make regular observations on the various trade routes across the North Sea. Even if these fall short of the high accuracy attained by the special scientific vessels, they will prove invaluable in fixing the general run of the isotherms during the quarterly cruises, and of following the changes which take place between them.

We consider that these bulletins are satisfactory and full of the promise of large results. The too scanty letterpress is printed in parallel columns in German and English; the title only is in French.

ARCTIC GEOLOGY.

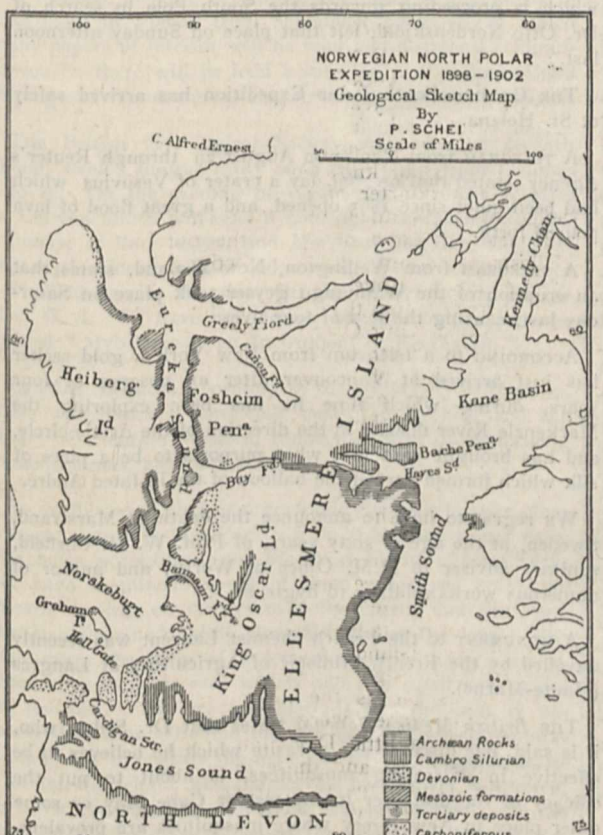
DR. P. SCHEI'S preliminary sketch of the geological work accomplished during Captain Sverdrup's four years' exploration of the region west of Smith Sound, an account of which is given in the *Geographical Journal* for July, makes important additions to our knowledge of Arctic geology.

About a quarter of a century ago Sir G. Nares's expedition examined the northern and eastern coasts of Grinnell Land down to the north-east corner of Ellesmere Island. The collections brought back by the *Fram* continue the geological information from this district round the southern part of that land mass, now named King Oscar Land, and all up its western shore to the north of Greely Fjord, including also the eastern coast of a newly-discovered island called Heiberg Land, and the coast of North Devon, south of Jones Sound, thus filling in the angle between Smith Sound and the group of the Parry Islands. Possibly they complete our general knowledge of this region, for Captain Sverdrup is disposed to think no more land exists to the north and north-west of Heiberg Land.

Previous explorations, summarised by Messrs. Feilden, De Rance and Etheridge in the *Quarterly Journal* of the Geological Society for 1878, proved the existence of crystalline Archæan rocks in the north-east of Ellesmere Island, of ancient sedimentaries, possibly Huronian, along the western coast of Kennedy Channel as far as the north-east angle of Grinnell Land, where they were succeeded by Carboniferous strata (with a little Devonian). West of these were Archæan schists, and those in the south were parted from the Huronians by a tract of Upper and Lower Silurian. Tertiary deposits, presumably of Miocene age, were discovered at more than one spot on both sides of Smith Sound and the channel north of it, and ample proofs obtained of a comparatively recent general elevation of the land, in some cases amounting to a thousand feet. Dr. Schei confirms the existence of the older Palæozoics near the middle of Ellesmere Island. Archæans follow them to the south, and continue along the coasts of Smith and Jones Sounds, appearing also on that of North Devon. On both sides they are succeeded by Cambro-Silurian deposits, and these, just at the western end of Jones Sound, by Devonian, which occur on both sides of the strait and extend some distance up the west coast of King Oscar Land. That formation had been already identified in the Parry Islands, and is now proved to extend over a considerable area. The strait parting Ellesmere Land from Heiberg Land is bordered by Mesozoic strata, which had already been detected in the Parry Islands, and these in the most northern part of

Heiberg Land are underlain by Carboniferous, with some interesting volcanic deposits. Tertiary strata were detected on Baumann Fjord, west of King Oscar Land, containing plant remains in an unusual state of preservation. Towards the western side glaciers are neither frequent nor large, owing probably to a deficient precipitation, and no signs were found of their having had a greater extension.

Thus Dr. Schei's researches corroborate and carry further the work of his predecessors. They show that a plateau-like region of Archæan rocks was submerged —perhaps before the beginning of the Palæozoic—and was buried beneath Cambrian, Ordovician, and Silurian deposits, it may be in orderly succession. These were followed by Devonian and Carboniferous, both marine, and possibly without interruption. After a break, with considerable physical disturbances, some beds of Triassic age were deposited, which are succeeded by Jurassic. Another great break is only



(From the *Geographical Journal*.)

interrupted by isolated Tertiary deposits, and, with the exception of a considerable late or post-Glacial submergence, terrestrial conditions may have been since then generally persistent.

T. G. BONNEY.

FISHERIES INVESTIGATION IN IRELAND.

IRELAND seems to be happier for the moment than either England or Scotland in the organisation and in the results of its official fisheries research. In England the official Fisheries Department has been for some years under the Board of Trade, and is soon, we believe, to be transferred to the Board of Agriculture. It has had no laboratories, no boats, and no scientific assistants, and it is no reflection upon H.M. Inspectors of Fisheries in such circumstances to say that they have carried on no biological, chemical, or other laboratory investigations.

In Scotland there is the well-known Fishery Board, provided with laboratories, vessels, and a sea-fish hatchery, and much good scientific work has been done in the past by Dr. Fulton and his able staff; but it is said that nearly all the available funds (without which practical work cannot be carried on), and the energies of the scientific men, of the Fishery Board for Scotland have now been diverted for several years into the service of the international North Sea investigation scheme.

In Ireland matters seem to be managed better. Competent scientific men are carrying on important investigations having for the most part a direct bearing on the local fisheries, and there seem to be sufficient funds not only to meet the necessary expenses of the work, but also to publish the results in suitable form—with coloured plates and other good illustrations. Across the Irish Sea there is a "fisheries branch" in the Department of Agriculture and Technical Instruction, and the two names that appear prominently in connection with the work—Wm. Spotswood Green and E. W. L. Holt—are ones that command respect from marine biologists and from fisheries experts alike. Mr. Green is Chief Inspector of Fisheries, and Mr. Holt is his scientific adviser, and from what we know of the work accomplished the combination seems a good one. The department in question has now issued the "Report on the Sea and Inland Fisheries of Ireland for 1901," in which, for the first time, as the report of the scientific adviser states, a part ii. on scientific investigations appears as a separate volume. It contains a couple of hundred pages and more than twenty plates, and Mr. Holt—for it is evidently very largely his work—and the department, and all others concerned, are to be congratulated on its appearance. The volume is entitled the report for 1901, but we notice occasional references to work done in 1902, and it contains the translation of a Norwegian paper said to be published in 1902. There is no harm in this, but we may be allowed to hope that the volumes for 1902 and 1903 will follow soon.

After a brief report from the scientific adviser to the chief inspector dealing with sea fisheries, inland fisheries, and the Cork Exhibition (1902), there follows an appendix, which is the main part of the book and contains a number of memoirs by Mr. Holt and his colleagues which are of both scientific and economic value. Amongst these we may note a brief account of a fishing survey of the Porcupine Bank, which is supplemented by a paper on the rock specimens trawled from the floor of the Atlantic and examined by Prof. Grenville Cole and Mr. T. Crook; a paper on Copepoda and one on Nudibranchiata by Mr. G. P. Farran; a useful paper on the British and Irish gobies, by Mr. Holt and Mr. Byrne, which is illustrated by two beautiful coloured plates and a number of figures in the text; an account of an investigation of the oyster beds of Wicklow and Wexford; and a translation of A. Wollebaek's three papers on oyster culture from "Norsk Fiskeritidende." The section on inland fisheries has papers and reports on salmon, pollen, and trout.

It is interesting to notice that Mr. Holt speaks of his oyster investigation as "part of the systematic examination of all our eastern fishing grounds, which is an item in the work of the scientific section of the fisheries branch." That is a programme such as we should expect from Mr. W. S. Green, and we have no doubt it will be ably carried out by Mr. Holt.

W. A. H.

THE SANITARY EXAMINATION OF WATER SUPPLIES.

AN extremely valuable and interesting report[1] has been issued by the sanitary authorities of the City of Chicago on the results of the chemical and bacteriological examinations of the waters between Lake Michigan at Chicago and the Mississippi River at St. Louis for the purpose of determining their condition and quality before and after the opening of the Sanitary Canal. For the diversion from Lake Michigan of the sewage of Chicago and its inoffensive disposal towards the Mexican Gulf, a canal was cut to carry the sewage, much diluted with lake water, into the Illinois River, a distance of 29 miles. From this point the Illinois River, after a course of 289 miles, discharges into the Mississippi at Grafton, which is about 38 miles above St. Louis. The investigations originated from the fact that the State of Missouri and the City of St. Louis had applied for a Federal injunction against the further operation and development of the Sanitary Canal of the Chicago Sanitary District on the ground that the purity of the water supply of St. Louis was endangered thereby. Chicago replied by instituting a commission to examine into the condition of the waters between Chicago and St. Louis, a distance of 356 miles.

The Chicago Municipal Laboratory (Dr. Gehrmann), the University of Chicago (Prof. Jordan), and the University of Illinois (Profs. Palmer and Burrill) collaborated in the work, a common plan of operation was devised, a uniform scheme for the bacteriological and chemical examinations agreed upon, and forty stations were fixed for taking the samples, of which forty were collected weekly and delivered to *each* of the three laboratories. The work extended over a period of about thirteen months, and during that time some 8600 samples were examined. The investigations show that considerable self-purification has taken place before the Sanitary Canal discharges its sewage into the Illinois (29 miles), and that this continues until, before Averyville (159 miles) is reached, all trace of sewage pollution has disappeared from the waters of the Illinois. Since there is still another 188 miles to be traversed before any pollution could reach St. Louis, the possibility of Chicago's sewage endangering the purity of St. Louis's water must be dismissed as impossible. In all probability such an exhaustive series of observations over so extended a stretch of water for so long a period has never before been attempted, and the results obtained are of considerable general interest. A valuable feature of the report is the detailed description of the methods employed for both the chemical and bacteriological portions of the examinations. The report illustrates the proper manner in which a great question, such as it deals with, should be approached and a solution be sought for, and we commend its perusal to hygienic authorities in this country. R. T. HEWLETT.

[1] "Report of Streams Examination." Made under the Direction of Arthur R. Reynolds, M.D., Commissioner of Health, City of Chicago. December, 1902.

NOTES.

THE British Rainfall Organisation, founded in 1860 by the late Mr. G. J. Symons, F.R.S., will henceforth be carried on under the sole charge of Dr. H. R. Mill, Mr. Sowerby Wallis having been compelled by ill-health to retire after more than thirty years' connection with the association.

THE summer meeting of the Iron and Steel Institute was opened on Tuesday last at Barrow-in-Furness under the chairmanship of Mr. Andrew Carnegie, the president of the institute.

THE whaler *Terra Nova*, which has been acquired by the Government and fitted out as a relief ship for the *Discovery*, left Portland on Wednesday of last week for Hobart, Tasmania, where, as has been mentioned in a former issue, she will be joined by the *Morning*. In order that she may reach her destination as rapidly as possible, she will be towed as far as Aden by one of His Majesty's ships; from Aden she will have to depend on her own resources of steam and sail. It is, however, anticipated that the two ships, the *Morning* and *Terra Nova*, will be able to leave Hobart in order to make their way south through the Antarctic ice in search of the *Discovery* by December 1.

ACCORDING to a Reuter telegram from Brest, the steamer *Français*, with the members of the Charcot expedition, which is proceeding towards the South Pole in search of Dr. Otto Nordenskjöld, left that place on Sunday afternoon last.

THE German South Polar Expedition has arrived safely at St. Helena.

A TELEGRAM from Naples on August 26 through Reuter's Agency stated that on that day a crater of Vesuvius which had been quiet since 1895 opened, and a great flood of lava poured forth.

A TELEGRAM from Wellington, New Zealand, states that an eruption of the Waimangu geyser took place on Saturday last, causing the loss of four lives.

ACCORDING to a telegram from New York a gold seeker has just arrived at Vancouver after an absence of four years, during which time he has been exploring the Mackenzie River district in the direction of the Arctic circle, and has brought with him what purports to be a piece of silk which formed part of the balloon of the ill-fated André.

WE regret to have to announce the death at Marstrand, Sweden, at the age of sixty years, of Prof. W. H. Corfield, sanitary adviser to H.M. Office of Works, and author of numerous works relating to hygiene.

A MONUMENT to the French chemist Laurent was recently unveiled by the French Minister of Agriculture at Langres (Haute-Marne).

THE *British Medical Journal* states that Dr. Stiles, who, it is said, has discovered a parasite which he believes to be effective in destroying mosquitoes, is about to put the efficacy of the destroyer to the test at Cape May or some other place in New Jersey where mosquitoes are prevalent. The investigation is undertaken at the request of Prof. Smith, State Entomologist of New Jersey, who has helped Dr. Stiles in his search for a parasite suitable for the purpose.

A REUTER telegram from Lagos states that the Legislative Council has passed a law making it a penal offence to introduce wireless telegraphy into the colony without the sanction of the Governor in Council.

ACCORDING to a telegram received through Laffan's Agency, Mr. Marconi, on his arrival at New York by the *Lucania*, stated that the vessel was never out of communication with either Great Britain or America on any day during the voyage. On Tuesday night of last week a message was received from Poldhu, when the *Lucania* was in mid-ocean, giving the result of that day's yacht race. The Nantucket station gave the result of Thursday's race. Mr.

Marconi added that he was going to consult Mr. Edison on four inventions he has recently made for improving his system, one being a method of reducing by one-half the high power now necessary for transmitting messages.

THE inaugural address of the new session of the School of Pharmacy, in connection with the Pharmaceutical Society, will be delivered on October 1 by Dr. J. W. Swan, F.R.S., and the bust of the late Mr. W. Martindale will be unveiled on the same date, and the Hanbury gold medal presented to M. Eugène Collin for his researches in the natural history of drugs.

THE Swiss Alpenklub will, according to the *Athenaeum*, hold its *Klubfest* at Pontresina on September 12, 13, and 14. The Morteratsch glacier has been chosen for the excursions.

A GENERAL meeting of mining engineers is announced to take place in Vienna from September 21 to 26, at which many papers of interest will be read and discussed. Simultaneously, there will be held a meeting of the Boring and Mining and Metallurgical Engineers for Styria and district.

THE British Mycological Society will hold its seventh annual week's fungus foray at Marlborough from October 5 to 10. On the evening of Wednesday, October 7, Miss A. Lorrain Smith will read a note on *Gloeosporium Tiliae*, a disease of lime leaves, and Mr. Carleton Rea, the hon. sec. of the Society, will read a note on the occurrence of a Phalloid new to Britain. On the following evening the Rev. W. L. W. Eyre will deliver his presidential address, entitled "Mycology as an Instrument of Recreation."

THE fine chemical laboratory of the University of Modena, Italy, was recently completely destroyed by fire, and the library of scientific works in connection with it, comprising 60,000 volumes, also perished.

AN exhibition of electric automobile chairs is to take place in connection with the World's Fair at St. Louis next year. The chairs, according to the *Electrical World*, of New York, will have a uniform speed of three miles per hour, the operator having no control over the speed, and the same rate is maintained uphill, downhill, or on the level. The chair takes the form of a low phaeton without a cover. There are two large rear wheels and two small ones under the foot-rest. All are pneumatic-tyred; the seat is upholstered in cane. Behind the seat is a box which contains the batteries to operate the machine. If two persons desire to occupy the chair, and the service of a guide is wanted, the latter can sit on an adjustable seat at the rear. On the inside of the chair, attached to the arm, is a lever which puts the chair in motion or stops it at the will of the rider. A long lever attached to the front truck has its handle directly in the centre of the chair within easy reach of the driver. A gentle pressure guides the machine in the desired direction. A feature of the machine is a "sensitive rail" which surrounds the chair on all sides save at the rear. This prevents any accidents, for when the rail comes in contact with any object, even though it weighs but 1 lb., it presses against a device that locks the wheels and brings the chair to a dead stop.

WE learn from the *Scientific American* that Prof. Langley's 12-foot aërodrome was tested on August 8. The model flew a distance of 600 yards and then sank in 22 feet of water. When it was finally recovered, all that was left was a tangled wreck of twisted wires. The time consumed in flight was not more than 45 seconds. The course described was a semicircle. According to accounts which have been published, the motor of the machine and the rudders failed to work properly. The altitude of the machine at the time of the fall was not greater than 50 feet. The airship is stated to have been driven by an 8 horse-power hydrocarbon engine connected up with two two-bladed propellers located one on each side of the machine at about its middle point. One four-bladed wind vane rudder was mounted behind the engine; then came the rudder proper. On each side the airship was supported by a pair of white silk wings, 4½ feet long by 2 feet in width. The propellers were located on the side between the wings and turned toward each other. The wings, rudders, engine and other running gear were fastened to a central cylindrical tube of aluminium 18 inches in length and about 4 inches in diameter, and tapering at both ends. The test of the small model will, it is said, be followed at an early date by a trial by the 60-foot aërodrome which is owned by the Government, the cost of which was 70,000 dollars.

WITH reference to the letter which appeared in our issue of August 6 from Prof. C. V. Boys concerning "The American Tariff and the St. Louis Exhibition," Mr. George C. Comstock, director of the Washburn Observatory, Madison, Wis., U.S.A., writes to say that the following letter received by him from the office of the secretary of the Treasury Department, Washington, illustrates the manner in which, in one class of cases, the American customs authorities have apparently overruled the plain intent of the statute cited by our correspondent. "The Department is in receipt of your letter of the 12th inst. in which you inquire whether photographic lenses imported for colleges and universities can be admitted to entry free of duty as scientific apparatus. Paragraph 638 of the Act of July 24, 1897, provides for the free entry of scientific apparatus, &c., when imported for educational institutions and the Department, and the Board of U.S. General Appraisers, have held that photographic apparatus, dry plates, lantern slides and lenses are not scientific apparatus within the meaning of said paragraph of law, and such articles, therefore, when imported for the use of educational institutions would be liable to duty." Whether the above represents a policy of the Treasury Department in cases other than those named it is impossible to say, but it may serve to illustrate the danger of relying upon a lay interpretation of the Tariff Act, and the need for determining in each particular case the policy pursued in the custom house. The possibilities of interpretation presented by a Board of Appraisers that holds photographic lenses not to be scientific apparatus seem unlimited.

A FEATURE of the mosquito as the agent of malaria that has in the past been difficult to understand is that occasionally a locality is found where the physical conditions appear to be such as to favour the development of malaria, susceptible species of anopheles abound, and yet malaria is absent. Not only do such areas exist in some cases in immediate proximity to active foci of the disease, but the introduction of persons whose blood contains the malarial parasite is unattended by the development of malaria in others. The mosquitoes of such immune areas appear, in fact, to be insusceptible, but the cause has been hitherto unknown. The researches of Dr. Schoo, however, to which Lieut.-Colonel Giles directs attention in the April number of the *Indian Medical Gazette*, offer an explanation. Dr. Schoo observed that, so long as they were fed on acid fruits, it was extremely difficult to infect mosquitoes with the malarial parasite, while they were easily infected when the acid food was withheld. This observation accords with a

point noticed by Prof. Celli, who has stated that one of the Italian immune areas is remarkable for an enormous development of the cultivation of the tomato, a fruit rich in vegetable acid, and an attractive food for mosquitoes. The necessity of further investigation of this matter is clear, for if confirmation is obtained, such knowledge may be of much importance in its practical application for the prevention of malaria.

THE micro-balance exhibited by Prof. Nernst at the Berlin congress is described in a recent number of the *Berichte*, and a number of results are given which illustrate its remarkable sensitiveness and accuracy. The control is a stretched quartz fibre, and the pointer moves over forty small divisions, each of which represents 0·03763mg., and can be read to a twentieth part. The scale pan is a tiny platinum tray weighing only 20mg., and in this the analyses are carried out. Three analyses of calcite, in each of which less than 3mg. was taken, gave CO_2=43·80, 43·66, and 43·81 per cent., theory 43·96, and the ignition of a single milligram of yttrium sulphate gave the atomic weight as 88·0 and 87·8, theory 89. The balance is specially suited for the analysis of traces of rare earths, and an attempt was made to carry out a fractional distillation of the chlorides of yttrium, erbium, and ytterbium in a platinum tube, but analysis showed that the sublimate had the same composition as the residue. Even where considerable quantities of material are available, as in the analysis of the salts of organic acids, the use of the micro-balance would lead to a great reduction of time and trouble, as it would only be necessary to read the deflection before and after igniting a trace of the salt. The balance, in a portable form, is manufactured by Messrs. Spindler and Hoyer, at Göttingen, and is sold at 70 marks.

OWING to the growing use of fused quartz in physical and chemical experiments, considerable interest attaches to determinations of the coefficient of thermal expansion of this substance. Several papers on this subject are before us. Messrs. L. Holborn and F. Hemming, in the *Annalen der Physik* (4) x., find an average value for the coefficient of expansion between 0° and 1000° of $5{\cdot}4\times10^{-7}$, but consider that the relation between length and temperature cannot be adequately expressed even by a quadratic formula within these limits. Mr. Karl Sheel, using optical interference-methods, and working with the temperatures 15°, 56° and 100°, obtains between these temperatures the formula

$$l_t=l_0(1+0{\cdot}322.10^{-6}t+0{\cdot}00147.10^{-6}t^2),$$

while for expansion of crystalline quartz parallel to its principal axis he finds

$$l_t=l_0(1+7{\cdot}144.10^{-6}t+0{\cdot}00815.10^{-6}t^2).$$

In the *Bulletin des Séances* of the French Physical Society, M. A. Dufour, in treating generally of the uses and properties of fused quartz, refers to the work of Holborn and Hemming, Le Chatelier and Callendar, and points out the difficulty of forming junctions between the quartz and metal or glass, consequent on the low coefficient of dilatation of the former. Mr. Sheel finds confirmation of his results in a recent paper by Chappuis, who also used optical methods in his determinations.

IN the July issue of the *Quarterly Journal of Microscopical Science*, Dr. R. Evans, of the Georgetown Museum, describes a new species of Peripatus from British Guinea, illustrated with a coloured plate. The species is said to be markedly different from the other members of the group from the same district. The author remarks that measurements and descriptions of colours and markings from preserved specimens are of little value in specific discrimination, and are, indeed, liable rather to cause confusion. In the same journal Dr. G. C. Bourne describes and figures a new ascidian (*Oligotrema psammites*), belonging to the family Molgulidæ, dredged off New Britain. The peculiarities of the new form are twofold. Firstly, it differs in general appearance and structure from the other members of the group, presenting a superficial resemblance to a sea-anemone. Secondly, as indicated by the occurrence of small crustaceans in its interior, it has a different class of nutriment. It is, in fact, "an ascidian which captures and feeds on active crustacea of large size relatively to itself, and is no longer dependent on minute organisms and organic débris swept into its branchial chamber by ciliary currents."

"THE BUILDING OF THE GRAMPIANS" is perhaps about as difficult a geological subject as could be found, but thanks to the labours of James Nicol, Sir A. Geikie, Prof. Lapworth, and others, much has been done, while the memoirs and maps of the Geological Survey form a good basis for further work and criticism. Mr. Peter Macnair has dealt boldly and confidently with the subject (Royal Phil. Soc., Glasgow), his object being to bring out the striking similarity which exists between the structure of the Grampians on the one hand and the Alps on the other, the Grampians being regarded as simply the basal wreck of such a mountain chain as the Alps. He is more confident than others are of the succession of the rock-groups met with in the Highland schists, but when he comes to criticise the belt of supposed Arenig rocks along the southern Highland frontier, he finds that there no reliance can be placed upon the apparent order of succession. He may be right in maintaining that there is nothing to justify the separation of this supposed Arenig belt from the crystalline schists. He may be right also in his criticisms on the structure of the Cowal region, with especial reference to the development of the foliation planes. This much may be said, that while hammering earnestly at the rocks, he has also made a careful study of the work of others, and he attacks the Highland problems with evident enthusiasm for his subject. We must leave to those concerned the defence of the positions which he assails, although in some instances Mr. Macnair has advanced, perhaps, where others fear to tread.

PROF. JOLY has done well to undertake the petrological examination of paving sets. In the first part of his work (*Sci. Proc.* Royal Dublin Soc., vol. x., No. 5) he deals more particularly with certain granites, diorites, and dolerites. In his general remarks he observes that the resistance to wear varies directly, as do the amounts of quartz and felspar, the holocrystalline igneous rocks being as a rule the toughest. Markedly porphyritic, vesicular, and glassy rocks are to be avoided. He deals with the durability and with the character of the surface produced by various paving sets, remarking that mechanical forces are applied on the roads in the most destructive form, the attrition and crushing being combined with the solvent action of impure waters. Fine-grained rocks, such as the diorite of Penmaenmawr, may become too slippery for use on inclined surfaces; a certain coarseness of grain is usually desirable.

WE have received the annual report (vol. xii.) of the Geological Survey of Canada for 1899 (dated 1902), by Dr. Robert Bell, acting director. This is a bulky work made up of various independent reports lettered A to S, and

separately paged. Reference has already been made in NATURE to the more important matters dealt with. A general index is appended, which gives the paging under the reference letter of each report. The volume is accompanied by maps of the Klondike Gold-fields, and of parts of British Columbia, Ontario, Quebec, and New Brunswick.

AN orographic sketch of Korea, with photographic illustrations and an excellent map, has been published by Dr. B. Kotô (*Journ.* Coll. Science, Tokyo, Japan, vol. xix.). He discusses the various faults and folds which have influenced the scenery of the peninsula—a region which, as he remarks, in reference to Suess and Richthofen, "seems to have interested our two masters almost as deeply as it has the political leaders of our times." The Cretaceous Cephalopoda from the Hokkaidō are under description by Mr. H. Yabe. Part i., dealing with Lytoceras, Gaudryoceras, and Tetragonites, is accompanied by seven plates (*Journ.* Coll. Science, Tokyo, vol. xviii.).

MR. F. CHAPMAN AND MR. H. J. GRAYSON contribute an article on "Red Rain" to the *Victorian Naturalist* (vol. xx., June). After discussing the subject generally, they direct attention to falls of red mud in Victoria in February and March of this year. In one case the amount was estimated to equal fifty tons per square mile. The material comprised much limonite, and many mineral fragments and diatoms. The material was probably derived from areas from 30 to 300 miles north and west of Melbourne, being swept up from the borders of swamps and salt lakes during an abnormal season of drought.

IN a monograph supplement to the *Psychological Review* (vol. v. No. 4), Mr. J. B. Miner reports a study of "Motor, Visual, and Applied Rhythms." It has been frequently asserted that rhythmical grouping of sensory impressions is peculiar to auditory and tactual perception, but Mr. Miner shows that a series of similar visual impressions regularly repeated may fall into spontaneous rhythm, and that, in fact, visual impressions obey laws of rhythm very similar to those established for auditory perception. Since rhythm is, as Mr. Miner rightly maintains, a feature of the motor expression evoked by sensory impressions to which the attention is directed, there is no reason to suppose that it should be limited to perception by any one or two of the senses, and it may be hoped that the erroneous statement to that effect will now disappear from the text-books. Mr. Miner shows that subjects seem to fall naturally into two classes, according as their power of concentrated mental work is favoured or hindered by a concurrent rhythmical stimulus to the senses; that those who naturally work most rapidly and concentratedly are most apt to be hindered, while those who work slowly, with less tense concentration, in many cases produce better results under the influence of such stimulus. This unexpected result suggests to the author certain pedagogical reflections.

THE *Barbados Agricultural Reporter* of August 1 contains the text of a petition to the Governor praying that the destruction of mongooses may be authorised in the island. A quarter of a century ago the sugar industry of the island suffered much from the depredations of rats, and about 1878 mongooses were introduced for the purpose of thinning their numbers. These carnivores discharged their task with conspicuous success, but at the same time they cleared off much of the indigenous fauna. The destruction of the lizards has led to a large increase in the number of moth-borer caterpillars, which perforate the sugar-canes and thus give entrance to the spores of noxious funguses. These cause a serious loss, which it is hoped may be in some degree mitigated by the destruction of the mongooses. All this shows the danger of attempting to interfere with the equilibrium of nature.

IN the annual report of the Indian Museum, Calcutta, for 1901–2, Major Alcock, the director, states that a bronze medallion portrait and inscribed brass tablet have been placed in one of the verandahs of the old museum building in memory of the late Dr. J. Anderson, the first superintendent of that institution. During the period under review the museum has acquired by purchase the valuable de Nicéville collection of Oriental butterflies, which includes a large number of type specimens.

THE *Journal* of the Straits branch of the Royal Asiatic Society contains two important communications on the language of the Sakais and Semangs of the Malay Peninsula. Mr. H. N. Ridley describes some new Malay orchids, while Mr. P. Cameron continues his account of the Hymenoptera collected by Mr. R. Shelford in Sarawak. To the *Zoologist* for August, Mr. Shelford himself contributes some highly interesting notes on the habits of Bornean species of mantises, with illustrations reproduced from photographs of these insects.

IN the journal last mentioned, the Rev. F. C. R. Jourdain records the occurrence of an example of the harp-seal (*Phoca groenlandica*) at Teignmouth on March 10, on what appears to be sufficient evidence. The carcase was seen on a fishmonger's barrow, but it is not known how it was disposed of. The species is a very rare straggler to the British shores.

THE recent additions to the Municipal Museum of Hull are made known to the public by means of illustrated notes and short articles in the *Eastern Morning News*. These are subsequently reprinted as penny pamphlets under the title of "Hull Museum Publications." By this means the local public are kept in touch with the growth of the museum, and it certainly must benefit the museum, as well as interest and instruct the public. This system might with advantage be copied by other local museums. The fifteenth publication, entitled "Quarterly Record of Additions, No. 5," has just been published.

THE report of the Trivandrum Museum for the year 1901–2 contains a reprint, with two coloured plates, of a paper from the *Journal* of the Bombay Natural History Society, on a couple of cetaceans recently stranded on the beach near that city. One of these has been identified by Mr. Lydekker with the widely spread *Pseudorca crassidens*, while the second is made the type of a new species, *Tursiops fergusoni*, named in honour of the director of the museum.

IN a third museum report just to hand, that of Manchester for the year 1902–3, special attention is directed to the acquisition of the interesting series of mammalian remains from a cave of Pliocene age at Doveholes, Derbyshire. These remains, which it will be remembered were exhibited at the soirée of the Royal Society in the spring, have recently been described by Prof. W. B. Dawkins in the Geological Society's *Quarterly Journal*.

THE *Zoological Society Bulletin*, published by the New York Zoological Society, is a brightly written, well illustrated periodical, and the July issue, which has just reached us, contains quite a number of interesting contributions, notably one on "Training Orangs and Chimpanzees," in which particulars are given of the acquired accomplishments of past and present members of the New York Zoological Park collection. The training of the orang-utan

and the chimpanzee, remarks the writer of the article, closely approaches the management of an untaught child. These creatures do not seem as much like lower animals as do the majority of the so-called "dumb brutes." Coaxing and perseverance have been responsible for the exhibitions which from time to time have taken place.

In the *Journal of Botany* (August) Dr. G. Murray publishes a short note on Atlantic diatomaceæ. Some few species were obtained in all the captures, even far out at sea, but an increase in the quantity of the take was generally found to indicate the proximity to land. Miss A. L. Smith describes some interesting microfungi, and Dr. W. G. Smith refers *Nidularia dentata* to the genus Sphærobolus. Biographical notices of the botanists L. A. Deschamps and F. Noronha are contributed by the editor.

The number of the *Minnesota Botanical Studies* published in July is mainly given up to articles dealing with flowerless plants. Mr. Bruce Fink presents a list of lichens collected on the northern boundary, and Mr. H. L. Lyon catalogues the pteridophyta which grow in the State. Contributions to the algal flora are furnished by Dr. H. F. Schrader, who describes a new species of Alaria, and by Mr. Skinner, who discusses the tide pool vegetation at Port Renfrew. The distribution differs considerably from that found on our coasts, seeing that a Corallina extends throughout the whole tidal range, while a Codium is associated with it in the higher pools.

The *Agricultural News* of Barbados for August 15 reprints from the *India Rubber World* an interesting article on the subject of the preparation of Para rubber in Ceylon, in which full and detailed instructions are given for collecting and coagulating the rubber. The text is elucidated by illustrations.

A pamphlet on "The Boiling Lake of Dominica," by Mr. F. Sterns-Fadelle, has lately been published (office of the *Dominican*, price 1s.). It gives an historical and general account of this well-known geyser, which will be useful to travellers in the West Indies.

The annual report of the Yorkshire Philosophical Society for 1902 contains part ix. of a catalogue of British plants in the herbarium of the Society, and a popular article on "Sea Sand," by Mr. Hugh Richardson, in which the characters and origin of the grains of sand are discussed.

In the *Proceedings* of the Nova Scotian Institute of Science (vol. x. part iv.) Dr. H. M. Ami shows that the slates yielding *Dictyonema Websteri*, and which were regarded by Sir J. W. Dawson as Upper Silurian, belong to the Upper Cambrian.

A pamphlet entitled "A Historical Sketch of the Experimental Determination of the Resistance of the Air to the Motion of Projectiles," by the Rev. Francis Bashforth, has recently been published by the Cambridge University Press.

Messrs. Charles Griffin and Co., Ltd., have published a second edition of "Animal and Vegetable Fixed Oils, Fats, Butters, and Waxes," by the late Dr. C. R. Alder Wright. The new edition has been revised and partly rewritten by Mr. C. Ainsworth Mitchell, who, though he has retained the general arrangement of the original work, has, especially in the chapters dealing with the manufacturing processes, modified the text and brought it up to date.

A ninth edition of Bloxam's "Chemistry" has been published by Messrs. J. and A. Churchill. The book has been rewritten and revised by Prof. J. M. Thomson, F.R.S., and Mr. A. G. Bloxam. A change has been made in the present edition in the order of treatment of the non-metallic elements, and carbon is now considered after hydrogen, oxygen, and nitrogen. The plan of making no division, in the portion of the book dealing with organic chemistry, between the treatment of the fatty and aromatic compounds has again been followed.

A new edition—the twelfth—of "The Art of Retouching," by Mr. J. Hubert, has just been issued by Messrs. Hazell, Watson and Viney, Ltd.

Messrs. George Routledge and Sons, Ltd., announce for early appearance a series of "Nature-Study Readers" for general school use, under the editorship of Mr. John C. Medd. The aim of the books is to present varied aspects under which nature may be most conveniently studied alike in urban and in rural districts. Each subject is to be treated by a different writer, who has devoted special attention to it, and knows from personal experience what is within the capacity of, and calculated to interest, children of from nine to thirteen years of age.

Mr. R. Lydekker, F.R.S., will shortly issue, through Messrs. Hutchinson and Co., a volume of zoological essays entitled "Mostly Mammals."

The additions to the Zoological Society's Gardens during the past week include a Himalayan Bear (*Ursus tibetanus*) from East Asia, presented by Lady Constance Mackenzie; a Common Otter (*Lutra vulgaris*) from Scotland, presented by Mr. J. B. A'Deane; a Rock Thrush (*Monticola saxatilis*), European, presented by Mr. W. H. St. Quintin; a Delalande's Gecko (*Tarentola delalandii*) from West Africa, presented by Mr. P. C. Challice; a Black Lemur (*Lemur macaco*), a Black-headed Lemur (*Lemur brunneus*) from Madagascar, a Black Sternothere (*Sternothoerus niger*) from West Africa, seven Dalmatian Lizards (*Lacerta mosorensis*) from Dalmatia, twelve Sharp-headed Lizards (*Lacerta dugesi*) from Madeira, an Indian Eryx (*Eryx johni*) from India, a Black-tailed Snake (*Ungalia melanura*), a Black-spotted Snake (*Ungalia pardalis*), a Cuban Snake (*Liophis andreae*) from Cuba, deposited.

OUR ASTRONOMICAL COLUMN.

Spectrum of Comet 1903 *c*.—Observations of the visual and photographic spectra of this comet were obtained at the Meudon Observatory, and were communicated to the Académie by M. Deslandres, whose communication appears in the *Comptes rendus* for August 17.

A spectrograph containing a 60° heavy flint glass prism was especially constructed for these observations, and was used in conjunction with the large double telescope. The faint light of the comet was concentrated from a wide slit by having the collimator of the spectroscope 55cm. long, whilst the focal length of the observing telescope or camera was only 12cm.

The spectrum generally is of the characteristic hydrocarbon type, but near to the nucleus of the comet it contains several extra faint lines; the brightest bands are those at λλ 3881, 4681, 4314 and 4052, their relative intensities being 10, 8, 7 and 7 respectively. The blue bands at λ 473 are separated into their several groups, thus affirming the presence of the hydrocarbon spectrum; this separation was also noticed in the spectrum of Rordame's comet (1893 *b*) obtained by Campbell at Lick in 1893, with which Deslandres's spectrum is practically identical.

M. Deslandres proceeds to note the similarities and differences of the cometary spectrum and the cyanogen spectrum as obtained in laboratory experiments, and suggests, as an explanation of the differences, that, although

the temperature of the comet is of the same order as the laboratory temperature, and high enough to produce incandescence, yet it is not sufficiently high to dissociate the compounds and thus produce the hydrogen and nitrogen spectra as obtained in the laboratory.

In the concluding portion of his communication M. Deslandres describes some experiments, similar to those by which he has obtained such excellent results in determining planetary rotations, whereby the differential movements of a comet's various parts may be determined from the inclination of its spectral lines to the lines of two comparison spectra photographed alongside the spectrum of the comet.

THE SPECTRUM OF NOVA GEMINORUM.—A telegram from Prof. Pickering, published in No. 3895 of the *Astronomische Nachrichten*, announces that the spectrum of Nova Geminorum was observed by Dr. H. D. Curtis at the Lick Observatory on August 17, and was seen to be of the nebular type which is characteristic of the spectra of declining temporary stars.

UNITED STATES NAVAL OBSERVATORY.—Vol. iii. (second series) of the United States Naval Observatory *Publications* has been received, and contains some 550 pages of useful observational details and results.

Part i. is devoted to observations of Eros made with the twenty-six inch equatorial and the Clark micrometer "No. ii," during 1900–1901, by Messrs. T. J. J. See and G. K. Lawton. After a description of the instrument, which has recently been supplied with an entirely new mounting by Messrs. Warner and Swasey, Dr. See proceeds to give details of the instrumental constants and their determination, and then gives the results of the individual observations for each night.

Assistant-astronomer King has used the nine-inch transit circle for observations of Eros and the reference stars suggested by the Conférence Astrographique Internationale of July, 1900, and, in part ii. of the report, gives the individual results of his observations.

Part iii. is a detailed description of the observations of 495 zodiacal stars made with the nine-inch transit circle by Prof. Eichelberger in accordance with Sir David Gill's catalogue of 2798 zodiacal stars which it was intended to observe, but in November, 1900, it was found that the pivots of the instrument were badly worn, and therefore the work is suspended until the necessary repairs have been effected.

In part iv. Mr. Updegraff gives a description, a photograph, and a diagrammatic sketch of the six-inch steel transit circle, and in a lengthy introduction gives minute details of the determination and reduction of the instrumental constants, followed by the separate observations of 130 comparison stars for the planets, including a large number of observations of reference stars for Eros. This section is concluded by two catalogues of stars and their positions, the first containing 139 zodiacal stars, and the second the Eros reference stars.

Part v. concludes this publication, and contains the individual observations made with the prime-vertical transit instrument from 1882 to 1884 by Lieutenants Ingersoll and Bowman and Ensign Taylor, all of the U.S.A. Navy.

THE WHITE SPOTS ON SATURN.—In the *Astronomische Nachrichten*, No. 3894, Señor J. Comas Solá, of Barcelona, publishes his observations of Barnard's white spot and the smaller white spots which have been recently observed on Saturn.

Using a six-inch equatorial, he easily observed Barnard's spot and several smaller ones. On June 26 the former crossed the central meridian at 13h. 19m. (G.M.T.), and was seen to be double, whilst in contact with it, and on the left side (reversed image) a small spot was observed. On July 1d. 13h. 55m. ± a feebler spot, which also appeared double, was observed to cross the central meridian in the same zone as the larger one. By July 20, when it crossed the meridian at 11h. 32m., the large spot was seen to be much feebler and apparently elongated, and on July 28 (time of transit = 11h. 15m.) it was yet feebler, and a rather difficult object for the six-inch.

Several other spots were observed, and their times of transit recorded, by Señor Solá, and, as a first approximation, he finds the rotation period of the planet to be 10h. 38·4m.

THE TEACHING OF PSYCHOLOGY IN UNIVERSITIES OF THE UNITED STATES.[1]

A TRUE estimate of the position of psychology in the curriculum of American universities can hardly be formed without a brief survey of the general system of education which prevails there. In earlier years, one need hardly say, the training was far narrower and less liberal than it is now. The candidate for the B.A. degree had his educational career as carefully prescribed for him as if he were still at school, and he had little or no opportunity to deviate from it. At the present day, the various universities of the United States offer every gradation between relatively elective and relatively non-elective systems of study. In most universities the undergraduate will find his course of work strictly defined during at least his first or freshman year. Little by little, however, the elective is gradually replacing the non-elective system. Quite recently, Harvard, for example, determined to allow a very considerable measure of optional subjects, from which the student has to make his choice from the moment he is admitted to the university.

The danger of such a system is increased by the absence of any special *ad hoc* examination for the B.A. degree. As a rule, this degree is conferred solely on the results of the terminal examinations held biannually, so that, unless proper precautions were taken, it would be possible for a student, after having passed his three or four years at college, to graduate on the basis of a superficial and very elementary knowledge of many subjects, and a detailed knowledge of none. This drawback American universities have largely succeeded in overcoming by a series of appropriate regulations concerning the relative number of elementary and advanced lectures at which attendance is required, and concerning the conditions of admission to advanced lectures. At Yale, for example, undergraduate studies are ranged under three heads:—(1) Languages and literature; (2) mathematics, physical and natural science; (3) philosophy, history and the social sciences. Every student is required to have attended advanced courses in at least one of these departments, and to show at least an elementary knowledge of subjects in the two other departments.

It will now be evident why subjects which in English universities are studied by the few are in America taken up by the many. Take Yale, for instance, with her department of philosophy, history and the social sciences. Every undergraduate has to show at least an elementary knowledge of some subject in this department, *i.e.* of philosophy, psychology, ethics, pedagogics, logic, ancient, mediæval and modern history, economics, politics or sociology. Large numbers of American students take a course of economics. At one university I was told that, on an average, every student takes two courses of economics during his undergraduate career. This fact may be ranged beside another, viz. that there are twenty-four professors, lecturers and instructors of political economy at Harvard.

So also it comes about that a great number of students take up psychology, either by itself or with allied subjects. 250 students, chiefly in their second or sophomore year, attend the year's course at Harvard, which is equally divided between the study of logic and the study of elementary psychology. At Yale a similar year's course on ethics and psychology was attended this year by 225 students. At Cornell the year's course on psychology, logic and ethics is attended by 200 students. Princeton goes so far as to make psychology a compulsory subject, without which the B.A. degree cannot be obtained. The popularity of psychology is also shown in that it is taught in the upper forms of some of the better schools.

Experimental work in the laboratory is only performed by students who intend to proceed further in psychology. Their number is a very small fraction—from one-tenth to one-fifteenth—of those who attend the preliminary course. At Columbia they are expected to have attended either a general course on experimental psychology or a special course, in which no less than eight lecturers take part, each being responsible for a few lectures in his own department of psychology, be it physiological, genetic, comparative,

[1] Paper read before the Psychological Society at Cambridge, July 25, by Dr. C. S. Myers

pathological, experimental, historical or philosophical. By this means the student comes into relation with most of the teaching staff of the department in which he is interested. Later, more advanced courses are open to him in analytical psychology, educational psychology, the philosophy of mind, genetic psychology, and so on. At Pennsylvania the student spends two years at psychology, devoting the first half-year to analytical psychology, the second half-year to physiological psychology, the third half-year to synthetic psychology, and the fourth half-year to experimental psychology. Each of these half-courses comprises lectures and practical work, of an hour and two hours' duration respectively per week.

It would be wearisome to follow out at further length the various lines of undergraduate study pursued in psychology at the several universities visited by me. You will, however, hear with interest that men are offered at Yale a course of recent German psychology in their fourth or senior year, the class reading extracts from the works of Brentano, Wundt, Stumpf, Külpe, and others, while the different attitudes of these psychologists are explained by the instructor. At Harvard a half-year's course on the mental life of animals is offered, accompanied by lectures and demonstrations. At Cornell a course on the history of the psychophysical work of Weber, Fechner, and others is given.

This brings me to the more detailed consideration of experimental work in the United States. The laboratory in Harvard University has eleven rooms, in Yale it has seven, in Columbia nineteen, in Princeton five, in Cornell ten, and in Clark ten; these numbers generally include all public and private rooms of the department. Cornell has undoubtedly the best equipped laboratory, so far as human psychology is concerned. Two rooms here are devoted to vision, one to acoustics, one to touch, one to taste and smell, one to chronometric apparatus, one is a special research room, and there is a lecture room and a workshop. Both Clark and Harvard have rooms devoted to experiments on animals. Partly for this reason the Harvard laboratory suffers from lack of space; a new one will be built in the near future. Most laboratories have a departmental library, or at least a seminary, in which the students can read or meet for discussion. Practically all the laboratories have a workshop, and employ a trained mechanician, who is able to turn out even complicated and expensive apparatus.

The methods of conducting the experimental work naturally differ in the various laboratories. At Harvard and Columbia lectures are given in connection with the experiments, but at many other universities lectures and practical work are wholly independent. At Yale, Harvard, Princeton and Cornell, students work together in pairs, each member of a pair serving alternately as subject and as experimenter. At Pennsylvania students work together in groups of three, the third recording the results obtained by the two others. Stress is laid in most laboratories on the careful keeping of note-books. Many of those in Cornell are models of neatness and diligence; there they are inspected, marked and initialled monthly by the assistants. At Princeton, the times are so arranged that only a single pair of students is working in the laboratory at any one hour; they thus secure the undivided attention of the instructor. At Harvard and Pennsylvania the entire class is engaged upon the same kind of experiment simultaneously; the Pennsylvania students are each provided with lockers containing the simpler apparatus they are likely to use. At Yale and Cornell, on the other hand, students are simultaneously engaged at different experiments; one pair, for instance, is working on colour-vision, another on reaction-times, another on tactile sensibility, and so on. Save at Cornell, the students are each taken through all the laboratory experiments commonly described in the text-books. But at Cornell it is held sufficient for the student to devote himself to the investigation of a single sense, working over perhaps fifteen experiments therein, and then to proceed to one or two experiments on the expression of the affective states, thence to some of the experiments in attention and reaction, and so on, whereby he acquires a practical experience, less extensive, but probably more thorough than that usually obtained. He works four and a half months in qualitative, and four and a half months in quantitative, experimental work during his third year. His fourth year is devoted to some special problem, and he writes an essay on his results.

If, having taken his B.A. degree, the graduate determines to pursue his studies further, he enters the post-graduate school in order to proceed to his doctor's degree. After two or three years' post-graduate study, he may present himself for examination in a chosen division, *e.g.* philosophy, and within the division he must name some special field of study, *e.g.* psychology, in which he is liable to minute examination and must offer a thesis, showing evidence of independent research. In psychology, as in all subjects, advanced lectures are delivered to suit his requirements. At Cornell during his first year of post-graduate study, the student does not start any special research work; he reads and roams about the laboratory, observing what his senior fellow-students are doing. A very large proportion of post-graduate students at Yale and Harvard consists of graduates from smaller universities. At Harvard I found no less than sixteen students engaged in the psychological laboratory at original work for their Ph.D. degree. They attended there at fixed times in the mornings only, working in pairs alternately as subject and as experimenter. Weekly seminary meetings are held at Harvard, Yale, and Clark for post-graduate students. At Harvard three papers are read at each evening meeting by the students, and are discussed by themselves and their professors. At the Yale seminaries, a post-graduate student presents a paper weekly, dealing with the system of some well-known mental philosopher. At Clark, the students meet each week at the professor's house to narrate and criticise their progress in research work.

A very large proportion of theses, written for the Ph.D. degree in psychology, sees light in the pages of American psychological journals. In many instances this must turn out to be the one piece of original work such men have performed in their life. They drift away in various directions. The best are chosen by their professors to be laboratory instructors for a year or more. Thence they go to become assistant professors in other universities, or depart earlier to teach educational psychology in the State normal schools or in other teachers' training colleges. Mainly through lack of leisure, the majority put forth little in the way of further and mature research. There is a strong tendency, too, for psychologists in America to turn to editorial or literary work, to become busy with the organisation of science, or to deal with purely philosophical, ethical, or religious problems.

But apart from such drawbacks, which are the result rather of American ways of life and character than of deficient interest or training, I have said enough, I hope, to show what a living subject of education psychology is in the United States. It is becoming recognised there that a man of culture should know something, not only of the works, but also of the working, of the human mind. Psychology in the United States is not a subject of the philosophical few, as it is in our country. If it pays the penalty for, it also reaps the advantage of, its position. Numbers of undergraduate students acquire a notion, however dim and imperfect, of the range and importance of psychology, so that, if ever they become successful business men, as many of them do, they are prepared to lend it financial assistance in later life. Future medical students take up psychology during their academic career, and turn their knowledge of it to account when they come to deal with the problems of insanity. Zoologists pass from their museums to study it, and return to work out the psychology of animal life. Teachers obtain a useful smattering of it, sufficient to interest and improve them in their arduous career. At Pennsylvania, for example, they have the opportunity of attending a "pedagogical clinic," at which children with various mental disorders are brought before their notice, so that they may recognise them hereafter.

From these facts it will be seen that America provides us with a lesson in the organised teaching of a subject the success of which we have so much at heart, and with an example which we should do well to follow.

AMERICAN ETHNOLOGY.

IT is with melancholy interest that we receive the nineteenth annual report of the Bureau of American Ethnology, as this was the last report that was edited by the late director; Major Powell's name for so many years has been associated with the publications of the bureau which he initiated that the two have come to be irresistibly associated in our minds. We can only say that his last report fully maintains that high standard to which he has accustomed us.

Sociologists as well as ethnologists will be interested in Mr. James Mooney's historical study of the Cherokee, forming part i. of the nineteenth report. The title "Myths of the Cherokee" is misleading, as the memoir includes oral and documentary history, legendary history, legends and myths, with a valuable appendix of notes and parallels to the myths. The true history of Sequoya, the inventor of the Cherokee alphabet, is given, and the remarkable effect of this innovation on the Cherokee nation is admirably sketched, but the promise of progress was ruthlessly destroyed by the action of the Georgia Legislature. In the temperate language of a scientific historian, Mr. Mooney narrates the invariable fate of a native population when the white man wants his country, and now the five civilised tribes are meditating wholesale removal from the Indian territory where they are still being harassed. There seems a determined purpose on the part of many full-bloods to emigrate either to Mexico or South America, and there purchase new homes for themselves and families.

The second part of the report contains one or two studies of the Hopi, or Moqui, Indians of Arizona. These pueblo Indians are among the few surviving tribes of American aborigines which still retain an ancient ritual that is apparently unmodified by the Christian religion. The importance of a careful investigation of these people is fully realised by American anthropologists, and the bureau has in Dr. J. Walter Fewkes a trained observer of the first rank. It is impossible to interpret the Hopi ritual without a clear idea of the present relationship between the existing clans and of their connection with the religious societies. The growth of the ritual has increased with the successive addition of new clans to the pueblo, and its evolution cannot be comprehended without an understanding of the social development and clan organisation of the pueblo. Appreciating this, Dr. Fewkes deals with Tusayan migration traditions, and unravels the history of the accretion of the clans into a community. The localisation of these clans in various pueblos is described by Cosmos Mindeleff, and mapped in several plans; the localisation of clans was rigidly enforced in ancient times, but it is now breaking down. May we suggest to American workers in the field that valuable sociological results would be obtained if they adopted genealogical methods devised by Dr. Rivers (*Journ.* Anthrop. Inst., xxx., 1900, p. 74). Dr. Fewkes also gives some details of the famous Snake dance; this dance was primarily a part of the ritual of the Snake clan, and ancestor worship is very prominent in it, indeed, Dr. Fewkes suggests it is "totemistic ancestor worship." There still remain to be investigated various episodes and the sacred songs. The Flute ceremony, which lasts for nine days, is one of the most complicated in the Hopi ritual. Three elements appear to be prominent in the Flute observance—sun, rain, and corn worship, symbols of which are the most prominent on the altars and their accessories. The same is true of the Snake dance; but in both rites the cultus heroes and clan mothers are special deities to which the supplications for rain and corn are addressed. This is interpreted as a form of totemism in which the ancestors of the clan take precedence. The Sun as the father of all cultus heroes, and the Earth as the mother of all gods, ancestral and otherwise, necessarily form an important part of the worship. The relation between religion and sociology is brought out by the author.

"The Wild Rice Gatherers of the Upper Lakes," by Dr. A. E. Jenks, is a sociological study of great interest and value, and should form a model for other researches on sociological economics. The Indians in the wild-rice district exhibited some social aspects that were quite unique. Their superior physique and peaceful disposition were frequently spoken of. The wild rice led to the peaceful massing together of various tribes and to love for a common country, but being a precarious food-supply, much progress in culture was impossible to these barbarians.

Other papers in the report are "Mounds in Northern Honduras," by Thomas Gann; "Mayan Calendar Systems" and "Numeral Systems of Mexico and Central America," by Cyrus Thomas. The number 20 is the base of the numeral system of the Mexican and Central American tribes, but it does not appear to have been used as a mystic number in rites. There are other peoples who use the vigesimal system, but no others are known who adopt the twenty-day month or eighteen-month year. We cannot conceive how a twenty-day period could have grown out of a lunar count; probably two time systems, a secular and a sacred one, were in use at the same time, and the latter finally obscured the former. The author's conclusion is that the priests adopted a method of counting time for their ceremonial and divinatory purposes which would fit most easily into their numeral system, and this system, in consequence of the overwhelming influence of the priesthood, caused the lunar count to drop into disuse. Prof. W. J. McGee publishes a characteristic essay on "Primitive Numbers." The memoirs in these two volumes are copiously illustrated with numerous excellent plates, some of which are coloured. A. C. H.

AGRICULTURAL NOTES.

FROM a recent number of a Scotch agricultural newspaper it appears that the Earl of Rosebery has a private station for agricultural research on his home farm near Edinburgh, but the gratification which this information might otherwise have afforded is tempered by a perusal of an account, given by the newspaper, of a visit paid by a party of agriculturists to the place. The experiments, we gather, have been in existence for several years, but no reports on the station's work have been published, and we are left to glean something of its character from the statements made by the estate agent and the district analyst, who respectively represent practice and science in the control of the work. In speeches which are reported at some length, first the agent and then the analyst proceeded to ridicule the work done at other experiment stations. Rothamsted, Woburn, the East of Scotland Agricultural College, and the Highland and Agricultural Society were singled out for condemnation, and one is dismayed to find that "great laughter" was evoked by a quotation of what purported to be the words of the late Sir Henry Gilbert, whose fifty years' devoted service has earned the respect of all right-minded agriculturists. The claims made for Dalmeny—the experiment station—were as amusing as the references to others were offensive. We hear, for example, that "the Dalmeny station was the only agricultural experiment station in the world where the research work was carried out on biological lines," and that "if imitation was the sincerest form of flattery, Dalmeny had been very sincerely flattered of late years, for so-called new lines of investigation were being taken up and books were being written which were simply plagiarisms of Dalmeny work and its results." Until some change is made in the management of Dalmeny experiment station it is clear that no serious consideration need be given to the work being done there.

For the past three years Mr. S. H. Collins, agricultural chemist at the Durham College of Science, has been investigating the composition of the Swedish turnip, the chief root crop of the north of England. A large number of varieties have been grown under identical conditions and also under different conditions of soil, climate, and manuring. The work is still in progress, but certain conclusions which have been come to are stated in the eleventh report of the college agricultural department. They are (1) the higher the percentage of dry matter in swedes the greater the feeding value; (2) swedes are very variable in composition, and not less than fifty roots should be sampled for the purpose of analysis; (3) the average composition of some varieties is much better than that of others; (4) the varieties which are best at one farm will also be best at

other farms; (5) next to variety, season, and then soil, most affect the composition of swedes; the influence of manuring is not marked. The fourth conclusion is warranted by the facts which Mr. Collins brings forward, but this point is one on which further information is wanted, for it seems probable that the relative position of different varieties might change if the varieties were exposed to markedly different conditions.

A *Bulletin* recently issued by the U.S. Department of Agriculture, entitled "The Mango in Porto Rico," discusses the prospects of mango cultivation on the island. Porto Rico grows mangoes in abundance; the climate is very favourable, and the trees are free from disease, but hitherto seedling trees only have been grown, and one is not surprised to read that the mangoes have met with but little favour in the American markets. The fame of the Bombay mango is due to the fruit of grafted trees, and it is rarely that trees raised from seed produce fruit worth eating. Seedling trees abound in every village, but first-rate trees are very uncommon. The short list given in Woodrow's "Gardening for India" shows how rare really good seedlings are. When the Americans import fine strains and take to growing grafted mango trees the industry is certain to make rapid progress. We gather from the *Bulletin* that this subject is likely to engage the attention of the local experiment station. We hope it may, for if the matter is taken up with the energy characteristic of the American stations, there is every prospect of a great increase in the supply of the finest of tropical fruits.

REPORT OF THE MALARIA EXPEDITION TO THE GAMBIA.

THE Liverpool School of Tropical Medicine has just issued a most important and practical report upon the prevention of malaria in the tropics.[1] Dr. Dutton, who conducted the expedition with conspicuous success, shows with striking clearness how a great deal of disease is due to the want of knowledge of the nature of malaria, and that during the dry season the residents are largely to blame for the appearance of the disease. It is one of the most hopeful reports ever issued by the school, and it shows that the governors and others in authority upon the coast are fully alive to the importance of stamping out malarial diseases. The report is an immense step forward in preventive medicine.

The object of the expedition was to investigate the conditions under which mosquitoes were propagated in the town of Bathurst and at the principal stations of the colony, and to suggest methods of destroying these insects. Malaria was found to be prevalent in the colony; 80 per cent. of the native children examined harboured malaria parasites in their blood. The liability to infection of the Europeans commences soon after the rains are established, lasting up to the end of November. The various breeding places of mosquitoes are described in detail in chapter iv. of the report, particular mention being made of the wells, canoes, boats, lighters, cutters on the foreshore, and of the grass-clogged trenches in many of the streets, which together supply Bathurst with the majority of its mosquitoes during the wet season and for part of the dry season. The number of mosquito breeding places present in compounds was found to vary with the social position of the occupier. They increased in extent and number in proportion to the wealth and position of the occupier.

An account of the examination of one of the large compounds illustrates to what extent mosquitoes are bred by the white man in the tropics on his own premises.

In one factory yard were found six barrels, and in the garden there were seventeen tubs and eight small wells, all breeding quantities of Culex, Stegomyia, and Anopheles mosquitoes. Besides these dry season breeding places, discarded domestic utensils were scattered about the yard and garden which, in the wet season, would have acted as breeding places. It is pointed out that during the dry season, from November to May, natural breeding places for mosquitoes in Bathurst cease to exist, and from this period the people breed mosquitoes solely in their own compounds.

In chapter v., which deals with the prevention of malaria in Bathurst, a campaign against the mosquito is advocated; the town is judged especially suitable for its success. Thus Bathurst is situated on a practically isolated piece of land surrounded on nearly all sides by a broad expanse of sea water. The amount of land to be dealt with is comparatively small, viz. about a square mile. The surface is fairly level, sandy, absorbing water readily. In this area the breeding places of mosquitoes are a known quantity, the artificial, or those made by man, being in excess of the natural. The rainfall is very small, and rain occurs only during four out of the twelve months of the year.

The probability of the introduction into Bathurst of yellow fever from Senegal is pointed out as another reason for attacking the mosquito. The expedition was informed by His Excellency the acting Governor, H. M. Brandford Griffith, of the intention on the part of the Colonial Government to enter upon a crusade against the mosquito, and on November 18 the preliminary removal of rubbish from houses and compounds began; a sanitary inspector was appointed, and received special instruction in the work. Under him worked a gang of labourers, and at the time of the departure of the expedition (January 10) 363 houses and compounds had been inspected. From these 131 cartloads of old tin pots and other rubbish were removed. On the return of His Excellency the Governor, Sir George C. Denton, the inspector and a sufficient staff of labourers were appointed permanently, and a grant of 200*l.* per annum was given for the special anti-mosquito work. Anti-mosquito regulations have been drawn up by the Colonial Government. These are given at the end of the report.

An appendix, by Mr. F. V. Theobald, is attached to the report; in it are described the various species of mosquitoes collected by the expedition, many of which were new to science.

1 "Report of the Malaria Expedition to the Gambia, 1902, of the Liverpool School of Tropical Medicine and Medical Parasitology." By J. E. Dutton, M.B., and an appendix by F. V. Theobald, M.A. Pp. 46+xi. (Liverpool: University Press, 1903.)

ZONES IN THE CHALK.

IN NATURE for August 8, 1901, attention was directed to the second part of Dr. A. W. Rowe's researches on the zones of the White Chalk. We have now had the satisfaction of receiving the third part of this most interesting and important work, which deals with the Chalk of Devon (*Proc.* Geol. Assoc., vol. xviii. part i., 1903).

Working the palæontology with such aids as can be gathered from the local stratigraphy and lithology, the author, assisted as before by Mr. C. D. Sherborn, has added extensively to our knowledge of the successive forms of life that are met with in the Chalk between Sidmouth and Lyme Regis. Whether or not the limits of the zones happen to coincide with definite stratigraphical limits, these latter afford useful data, and one marl band to which the author directs special attention, forms the plane of division between the zones of *Terebratulina gracilis* and *Holaster planus*. Such definite and continuous bands of rock (so far as they can be traced) must afford even more precise evidence of contemporaneity than the presence of this or that fossil. Even a tabular flint-band has proved "an almost constant feature throughout the coast"—an interesting fact, and one that was not to be expected. It is admitted that the name-fossils are not always confined to their zones. *Holaster planus* is found by Dr. Rowe throughout the zone of *Terebratulina gracilis*. But the guide-fossils, the general assemblages associated with the name-fossils, while they exhibit here, as elsewhere, local variations, tell the same story of the successive zones or stages of life, and indicate their approximate limits. Perhaps too much importance is given to the effort to fix a precise divisional plane between zones. When such divisions depend on the forms of life, and the succession of life is continuous though gradually varying, there can be no absolute planes of division, except through the absence or erosion of strata belonging to a particular period of time.

The work before us is rich in its stores of interesting facts. The zone of *Rhynchonella Cuvieri* presents noteworthy features in the presence of *Micraster cor-bovis* and *M. leskei*, the zone of *Terebratulina gracilis* is "singularly rich in fossils," while in the zones of *Holaster planus* and

Micraster cor-testudinarium the group-form of Micraster is almost wholly absent. Nor are the lithological deviations less noteworthy, for the particular characters of the Chalk vary at different stages, and the same division may be nodular or smooth, and have many or no belts of flints. The value of a detailed palæontological study of our strata is abundantly manifested in this essay, and not the least interesting part of it is in the light it throws on the geographical as well as geological distribution of the fossils.

A most excellent series of plates of cliff-sections, from photographs taken by Prof. H. E. Armstrong, accompany this work. H. B. W.

THE PHYSIOLOGY OF BREEDING.[1]

IT is a remarkable fact that the system of organs in the animal body to which they are themselves indebted for their existence is very largely neglected by physiologists; that a number of secretory, vascular and nervous phenomena intimately concerned with fertility, with the power of conception and the ability to bear young are neither understood nor investigated; and that a wide field of research as to the influences of various kinds of food supplied to the mother both on her capacity for breeding and on the growth, constitution, and variation of the embryo is as yet untouched. As a contribution to the subject of "breeding," therefore, this paper is specially welcome, and the author is to be congratulated both upon the careful work he has done and the treatment he has accorded the subject.

The wide variations in the power of breeding which different breeds of sheep and different individuals of the same breed are subject to is shown, and the effect of altitude, climate and food referred to.

The histological changes which take place in the uterus of the sheep during the œstrous cycle are carefully described and figured, and the homology of these changes with those elsewhere described for the bitch and monkey clearly established. A brief *résumé* of the author's work on the same phenomena in the ferret is given, and their essential similarity with that of the bitch shown.

Suggestive information follows on the question of ovulation in sheep and other mammals, on the stimulus necessary to bring about that process under various conditions, on the artificial methods adopted by some flock masters to stimulate breeding in their ewes, and on the effect of these methods on fertility. Here a subject is touched upon which is of vital importance to breeders, and one which requires and deserves careful study. Atresia among the follicles of the sheep's ovary is then studied, and its relation to the proportion of twins and to barrenness examined.

The remainder of the paper is occupied with a description of the formation of the corpus luteum of the sheep and an examination of the views of the most recent writers on that subject. The lutein cells are stated to be the much hypertrophied epithelial cells of the undischarged follicle, while the connective tissue element is supplied by ingrowth from both theca interna and externa.

Finally, the relation between the development of the corpus luteum and the changes which take place in the uterus during pregnancy is touched upon, and the view expressed that, while the functions of ovulation and œstrus do not represent cause and effect, they are primarily connected, inasmuch as each is dependent largely upon the same cause.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE new prospectus of the department of dyeing and tinctorial chemistry of the Yorkshire College, Leeds, shows that special facilities are provided for the study of the chemistry of the colouring matters and for research work upon coal tar products. An effort is being made to combine the standard of scientific teaching of a university with the practical training of a technical school, and to encourage the prosecution of original investigation in what is certainly the most scientific, yet unfortunately, in this country, the least studied branch of applied chemistry. The dyeing department was built, equipped, and endowed by the Clothworkers' Company, and is provided with lecture-rooms, pattern and diagram rooms, museums, experimental and practical dye-houses, as well as with adequate provision for research work.

THE Great Western Railway Company now offer facilities, in conjunction with the Swindon Education Committee, to their apprentices to enable them to gain technical scientific knowledge. A limited number of selected students may attend day classes at the Technical School. They must have spent at least one year in the factory, and must have regularly attended for at least one session in the preparatory group of evening classes at the Technical School. The number of studentships will be limited to thirty at any one time. For each year's course there will be a competitive examination, successful students passing on from one year's course to the next. The course of study for each year will consist of practical mathematics, practical mechanics, geometrical and machine drawing, heat, electricity, and chemistry. Those attending the classes will have their wages paid as if at work in the factory, and the Great Western Railway Company will pay their school fees. The students attending the day classes will be expected to give some time each evening to private study. Students who distinguish themselves will be allowed to spend part of their last year in the drawing office and chemical laboratory. The whole of the arrangements will at all times be under the direction of the chief mechanical engineer.

THE report on the secondary and higher education of the City of Sheffield, prepared by Prof. Michael E. Sadler, has been published in pamphlet form by the Education Committee of Sheffield. The schools and colleges now in existence in Sheffield are described and their work passed in review. A series of recommendations is then made with a view to equip the city with a complete educational system. Prof. Sadler says that the weakest spot in the educational arrangements of Sheffield is in the secondary education provided for boys. A promising boy ought to have the best educational opportunities within his reach, but at present the equipment of such higher education in Sheffield is very much behind the standard in the progressive cities of Germany and the United States. Dr. Sadler also recommends a development of the work of the Technical College. He remarks, "the work of the Technical College, admirable as it is, would greatly gain in force and depth if it were supported by a strong department of pure science." As the report rightly insists, what is wanted is that a workman should be able to deal with new problems, and in order to do this he must have, as a foundation for his technological skill, a thorough knowledge of the pure science which it is his task to apply to practical problems. The probable additional net annual cost to Sheffield of carrying out Prof. Sadler's chief recommendations is estimated at about 8500*l.*, which would mean a rate of less than three halfpence. It now remains for the Education Committee of Sheffield to put into practice some of the excellent suggestions in the report.

THE volume of "General Reports on Higher Education for 1902," just published by the Board of Education, contains with other information of importance an account of the secondary schools, science classes, art classes, and evening schools of the southern and eastern divisions of England, the former by Mr. Buckmaster and the latter by Dr. Hoffert. Speaking of the evening schools in London, Mr. Buckmaster says "the impression formed in early visits has not been removed on more complete acquaintance, and the School Board, in its laudable anxiety to throw the educational net as wide as possible, has secured quantity at the expense of quality. As missionary agencies the schools abundantly justify their existence, they bring the opportunities for improvement near to all in all parts of the metropolis, but as centres for real solid work they are not so successful, in spite of the best efforts of the teachers, the majority of whom are most enthusiastic and devoted to their work." Several methods for the improvement of these schools are suggested, such as the alteration of the rule that, where the average attendance falls below 25 per teacher, a reduction in the number of teachers should be made; that

[1] "The Œstrous Cycle and the Formation of the Corpus luteum in the Sheep." By Francis H. A. Marshall. (*Phil. Trans.*, vol. cxcvi., 1903.)

means should be taken to improve the attendance; and to encourage homework. The polytechnics are to some extent fed by students from these evening classes, and it is of importance that their work should be as serious as possible. Dr. Hoffert is able to report considerable progress in the organisation of higher education in the eastern division of England, especially the increased attention now being paid to the improvement of secondary education. In another place Dr. Hoffert refers to the question of higher elementary schools, and expresses the opinion that schools of this type might very profitably be distributed at suitable intervals over London. "They appear destined to fill an important place in any future organised scheme of elementary and secondary education, and to form the natural completion of the elementary system."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—"Radiation in the Solar System: its Effect on Temperature and its Pressure on Small Bodies." By J. H. **Poynting**, Sc.D., F.R.S., Professor of Physics in the University of Birmingham.

PART I.—*Temperature.*

We can calculate an upper limit to the temperatures of fully absorbing or "black" surfaces receiving their heat from the sun, and on certain assumptions we can find the temperatures of planetary surfaces, if we accept the fourth power law of radiation, since we know approximately the solar constant, that is, the rate of reception of heat from the sun, and the radiation constant, that is, the energy radiated at 1° abs. by a fully radiating surface.[1]

The effective temperature of space calculated from the very uncertain data at our command is of the order 10° abs. Bodies in interplanetary space and at a much higher temperature may, therefore, be regarded as being practically in a zero temperature enclosure except in so far as they receive heat from the sun.

The first case considered is that of an ideal earth, more or less resembling the real earth, and it is shown that the temperature of its surface is, on the average, 325°, 302°, or 290° abs. according as we take for the solar constant Ångström's value 4 cal./min., Langley's value 3 cal./min., or a value deduced from Rosetti's work 2·5 cal./min. The lowest value found, 290° abs., is very near the average temperature of the earth's surface, which may be taken as 289° abs. As the earth's effective temperature must, if anything, be below this, and cannot differ much from that of the ideal planet, Rosetti's value for the solar constant, 2·5 cal./min. or $0{\cdot}175\times10^7$ ergs./sec. is probably nearest to the true value, and is therefore used in the following calculations.

The preceding calculations may be turned the other way. It is shown that, on certain assumptions, the effective temperature of the sun is 21·5 times that of the ideal earth. If we consider that the real earth with a temperature 289° abs. sufficiently resembles the ideal, we get a solar temperature $21{\cdot}5\times289=6200°$ abs.

The upper limit to the temperature of the surface of the moon is determined and is shown to be 412° abs. when no heat is conducted inwards. But Langley finds that the actual temperature is not much above the freezing point on the average. This leads us to the conclusion that it is not higher than four-fifths the highest possible value, the reduction being due to inward conduction.

The temperature of a small body, dimensions of the order of 1 cm. or less, but still so large that it absorbs radiation, is shown to be nearly uniform, and at the distance of the earth from the sun about 300° abs.

Under otherwise similar conditions temperatures must vary inversely as the square root of the distance from the sun. Thus Mars, if an earth-like planet, has a temperature nowhere above 253° abs., and if a moon-like planet, the upper limit to the temperature of the hottest part is about 270°.

PART II.—*Radiation Pressure.*

The ratio of radiation pressure due to sunlight to solar gravitation increases, as is well known, as the receiving body diminishes in size. But if the radiating body also diminishes in size, this ratio increases. It is shown that if two equal and fully radiating spheres of the temperature and density of the sun are radiating to each other in a zero enclosure, at a distance large compared with their radii, then the radiation push balances the gravitation pull when the radius of each is 335 metres. If the temperature of two equal bodies is 300° abs. and their density 1, the radius for a balance between the two forces is 19·62 cm. If the density is that of the earth, 5·5, the balance occurs with a radius 3·4 cm. If the temperatures of the two are different, the radiation pressures are different, and it is possible to imagine two bodies, which will both tend to move in the same direction, one chasing the other, under the combined action of radiation and gravitation.

The effect of Döppler's principle will be to limit the velocity attained in such a chase. The Döppler effect on a moving radiator is then examined, and an expression is found for the increase in pressure on the front, and the decrease in pressure on the back of a radiating sphere of uniform temperature moving through a medium at rest. It is proportional to the velocity at a given temperature. The equation to the orbit of such a body moving round the sun is found, and it is shown that meteoric dust within the orbit of the earth will be swept into the sun in a time comparable with historical times, while bodies of the order of 1 cm. radius will be drawn in in a time comparable with geological periods.

"The Phenomena of Luminosity and their possible Correlation with Radio-Activity." By Henry E. **Armstrong**, F.R.S., and T. Martin **Lowry**, D.Sc.

The possibility of regarding *luminous manifestations* generally—including radio-activity—as the outcome of oscillatory changes in molecular structure was pointed out by one of the authors more than a year ago in a communication to the Society in which the kind of change contemplated was exemplified by reference to the case of nitrocamphor. As the phenomena of radio-activity are exciting so much interest, it is thought desirable to enter somewhat more fully into an explanation of the argument underlying this conception of the origin of luminous appearances.

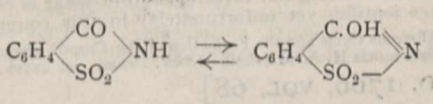
In the note referred to, it was suggested that *triboluminescent* substances, *i.e.* substances which become luminous at the moment of crushing, might conceivably, at the same time, manifest radio-activity. Sir William Crookes, at Dr. Armstrong's request, has recently examined saccharin from this point of view.

His remarks are described; they seem to show that saccharin is slightly radio-active towards barium platinocyanide when crushed. The authors have been unable hitherto to detect any effect on the electrometer.

Triboluminescence.—The authors consider the nature of the change involved in the production of the luminous flash, in order that it may be clear why, in their opinion, if radio-activity were observed in such a case, it would have been as the concomitant to chemical change.

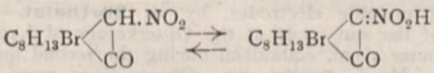
There is distinct evidence, they think, that the phenomena of triboluminescence may be correlated with the occurrence of the form of isomeric change which attends the passage of a compound into the isodynamic form of lower potential. Tschugaeff, who has examined more than 500 inorganic and organic compounds, found that about 25 per cent. of the latter gave a more or less intense flash when crushed; of these a considerable proportion appear to be such as could exist in isodynamic forms. Only about 5 per cent. of the inorganic substances flashed.

To take the case of saccharin, the two conceivable forms are:—



[1] W. Wien ("Cong. Int. de Physique," vol. ii. p. 30) has pointed out that Stefan's law enables us to calculate the temperatures of celestial bodies which receive their light from the sun, by equating the energy which they radiate to the energy which they receive from the sun, and remarks that the temperature of Neptune should be below −200° C.

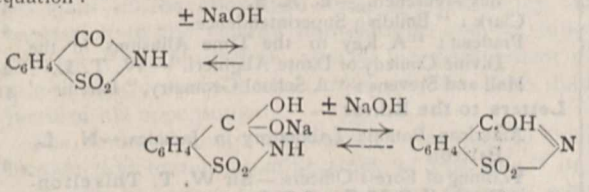
Comparable with these are the two isodynamic forms of π and β-bromonitrocamphor, for example :—



Normal neutral form. Pseudo-acid form.

In the solid state, both forms of π-bromonitrocamphor are stable; when either form is dissolved in a liquid, isomeric change sets in; sooner or later, it may be only in the course of a few hours or even days, a state of equilibrium is established, about 6 per cent. of the material being present in the pseudo form, and 94 per cent. in the normal form. The change, however, does not occur spontaneously, but is undoubtedly dependent on the presence of a catalyst, as equilibrium is established with great rapidity if a trace of alkali be added; acids have only a slight, although definite, accelerating effect. In the case of β-bromonitrocamphor, solutions in benzene of the neutral as well as of the acid form which have been kept during several days without undergoing change, when transferred to another vessel, have rapidly passed to a condition of equilibrium—doubtless because this vessel had been less successfully cleansed than that first used. It can, therefore, scarcely be doubted that the change occurs within a complex system—one which, it is only reasonable to suppose, constitutes an electrolytic circuit. The process is reversed when crystallisation sets in; if the evaporation of the solvent take place sufficiently slowly, the whole of the material is converted into and crystallises out in the less soluble form; if, however, evaporation take place rapidly, the isomeric change may lag behind the crystallisation and both forms may separate. In the case of nitrocamphor, the normal form is the one that separates from the solution; but in the case of π- and β-bromonitrocamphor, although the pseudo form is the minor constituent in the solution, being much less soluble than the isomeride, it is one to separate on crystallisation.

The passage of the one form into the other in the case of saccharin, for example, may be pictured as involving the occurrence of changes such as are represented in the equation :—



Supposing the stable form of lower potential to crystallise out, the crystals, in almost every case, would contain a minute and variable amount of the isodynamic form entangled, as it were, in the mass. In the solid, reversion to the stable form would take place very slowly. Presumably, however, sudden crushing of the crystals would afford opportunity for the change to take place and for the sudden *liberation of energy*—hence the momentary flash.

It is not, at present, necessary to assume that the phenomena are limited to cases of isomeric change; obviously, changes such as those considered may be regarded broadly as dissociative or reversible changes; and from this point of view, it is sufficient to regard the phenomena as the outcome of a loss of potential consequent on the passage from an unstable to a stable system.

From the point of view here advocated, it would be impossible to construct a condenser from a *pure* dielectric; and if the dielectric of a charged condenser were suddenly smashed under suitable conditions, it might exhibit the phenomenon of triboluminosity and perhaps radio-activity.

Fluorescence.—It was originally suggested by one of the authors, in discussing the origin of visible colour, that fluorescence is the "beginning of colour." Subsequently, Dr. J. T. Hewitt, in a paper on the relation between constitution and fluorescence, published early in 1900, took the important step of associating the appearance of fluorescence not with the mere occurrence of the quinonoid type of structure, but with the continued *development* of such a structure—in other words, he has regarded it as the outcome of oscillatory changes in the course of which a non-quinonoid compound undergoes conversion into the isodynamic quinonoid compound.

According to Hewitt, "all the molecules will be undergoing tautomeric change continuously and frequently, and energy absorbed when the molecules have one configuration will be, to an appreciable extent, emitted when they correspond to the other configuration. It is practically certain that the vibration frequency of fluorescein is different in the two states, and hence every opportunity is offered for energy of a rapid vibration frequency to be largely transformed into energy of greater wave-length."

Hewitt obviously does not regard fluorescence as a "flash phenomenon," but as a form of colour, as it were.

While agreeing with Hewitt that the origin of the effect is to be sought in the occurrence of reversible changes involving the production of dynamic isomerides, the authors think that fluorescence is to be regarded as something apart from colour, which, more often than not, is superposed upon colour. The character of the colour effect in fluorescence is quite distinctive; it is not only remarkable on account of its intensity, but there is in it an indefinable qualitative difference which seems to separate it from ordinary colour. If regarded as a "flash phenomenon" this difficulty disappears.

Hewitt appears to regard fluorescence as the outcome of mere intramolecular wobble. To the authors it seems likely that the change is conditioned by a catalyst, and that it occurs within a complex electrolytic circuit.

Phosphorescence.—The phenomena of phosphorescence need to be considered with reference both to cases in which the manifestation attends oxidative or other kinds of chemical change (the glow of phosphorus, the glow-worm, phosphorescent bacteria) and to those in which it is induced by exposure to light (luminous sulphides). The former might well almost be regarded as cases of fluorescence, as a continual supply of energy is derived from the continued occurrence of a chemical change involving loss of energy. With regard to the latter, it would seem that it is not a property of pure substances.

The phosphorescent medium may be pictured as a complex system capable of undergoing "electrolytic" deformation under the influence of light of high refrangibility; as the changes thus induced are reversed, the energy stored up during insolation becomes liberated, and the persistence of the effect is but a consequence of the fact that the change takes place under restraint in a viscous medium.

Dewar's remarkable observations on phosphorescence at low temperatures clearly foreshadow the conclusion that the property is to be correlated with structure.

Radio-Activity.—Pursuing the argument a stage further, it appears to the authors justifiable to regard the activity of radium tentatively as but an exaggerated form of fluorescence in which radiations unnoticed by substances generally—capable of penetrating substances generally—become absorbed and rendered obvious. Such an explanation, from the chemist's point of view, is at least as rational as one which assumes that nature has endowed radium alone of all the elements with incurable suicidal monomania.

There seems to be no good reason for assuming that in fluorescent and other ordinary substances we possess screens capable of arresting rays of every conceivable kind; it may well be that our knowledge of solar radiations is not yet complete.

With regard to "thorium and thorium X," the facts, as stated by Rutherford and Soddy, do not seem to be incompatible with the view that these are but isodynamic forms of thorium or their equivalent, their behaviour being very similar to that of the isodynamic forms of nitrocamphor. In any case, it appears desirable to approach the problem from this point of view, and to investigate the phenomena far more thoroughly on the chemical side.

Whatever the ultimate value of the considerations advanced in the note, they at least serve to show that much may be learnt by further study of the extent to which luminous phenomena generally are to be correlated with structure and structural changes.

July 21.—"On the Oxidising Action of the Rays from Radium Bromide as shown by the Decomposition of Iodoform." By W. B. **Hardy**, F.R.S., Caius College, Cam-

bridge, and Miss E. G. **Willcock,** Newnham College, Cambridge.

A solution of iodoform dissolved in chloroform rapidly becomes purple owing to the liberation of free iodine. This reaction, which seems not to have been previously described, takes place in all the solvents tried, namely, chloroform, benzene, carbon bisulphide, carbon tetrachloride, pyridine, amyl alcohol, and ethylic alcohol, but oxygen is always necessary to the change.

The decomposition of iodoform in solution is not, as it at first sight appears to be, a spontaneous change. It is due ordinarily to the action of light. The solvent has a great effect on the rate of decomposition—the solution in chloroform is very sensitive, that in benzene relatively stable. The solution in chloroform furnishes a delicate test for oxygen and for obscure radiations. It suffers change in gas light, faint daylight, and in X-rays or radium rays. The intensity of the action can easily be measured in time units by choosing some standard colour and matching the fluids under examination with it.

The action of light is due to the ordinary light waves, that is to say, any opaque screen completely arrests the action even of sunlight. Solutions in chloroform enclosed in opaque cardboard boxes have remained unchanged near a window for four days.

The action of radium is due to the more penetrating rays. By screening off the various rays, it can be shown that the α rays have no influence—the oxidation appears to be due solely to the β and γ rays, that is, to the negative electrons (β rays) and to the very penetrating ethereal waves (γ rays), which are said to be identical with X-rays. The action of the radium rays, therefore, will take place through as much as 8mm. of lead, though, of course, relatively very slowly, owing to the stopping of the β rays.

Some idea of the intensity of the action of radium may be obtained from the fact that a solution in chloroform in an ordinary test tube is changed to deep purple in twelve minutes by resting the point of the tube upon a mica plate covering 5 milligrammes of radium bromide. Radium rays, however, are much less active than daylight, as is shown by the fact that the more stable solution of iodoform in benzene resists their action for forty-eight hours, though it becomes purple in about fifteen minutes in the least lighted part of an ordinary room. Seeing that the thinnest opaque screen seems completely to stop the active rays of sunlight, it is obvious that sunlight, as it reaches the surface of the earth, can contain at the most exceedingly few β and γ rays.

M. Blondlot has described recently the presence in sunlight of certain rays which traverse metals but are arrested by water (N rays). These rays have no detectable action upon iodoform; the action of sunlight is not delayed appreciably by interposing a water screen many inches in thickness, and the action is completely arrested by even an opaque deposit of lampblack or by aluminium foil.

The fact that light waves [1] exert a chemical activity more intense than that of radium rays compels us for the present to refer the profound, and often lethal, physiological action of the latter to their power of penetration rather than to any novel or peculiarly intense action upon the tissues. They reach parts which ordinarily are shielded by a cuticle impervious to light waves.

One of us has already shown that the α rays profoundly modify the *physical* state of colloidal solutions (*Journal of Physiology*, vol. xxix. p. 29). If the colloid particles be electrically negative, the α rays act as coagulants; if the colloid particles be electrically positive they act as solvents, that is to say, the rays decrease the average size of the particles.

As a provisional basis for the investigation of the physiological action of radium rays, we may therefore regard the α rays as altering the physical state of the living matter, the β and γ rays as altering the chemical processes, especially, perhaps, the oxidation processes of the tissues.

[1] Including, of course, the ultra-violet waves. Hardy and D'Arcy have shown that the production of "active" oxygen by light falling upon a moist surface is limited in the spectrum to rays from the ultra-violet to the blue end of the green (*Journal of Physiology*, xvii. 1894, p. 390).

PARIS.

Academy of Sciences, August 24.—M. Albert Gaudry in the chair.—Batteries with several different liquids, but identical metallic electrodes, by M. **Berthelot.**—Observations of the sun made at the Observatory of Lyons with the Brünner 16cm. equatorial during the second quarter of 1903, by M. J. **Guillaume.** Observations were possible on sixty-seven days during the quarter: the results are given in three tables showing the number of sun-spots, their distribution in latitude, and the distribution of the faculæ in latitude.—On the problem of S. Lie, by M. N. **Saltykow.**—On the Fourier-Cauchy integrals, by M. Carl **Störmer.**—On the function of the metallic core in induction coils, by M. B. **Eginitis.** The effect of the core varies with its shape, material, the temperature of the sparking poles, their nature and explosive distance, and also on the self-induction of the coil.—On the constitution of the phospho-organic acid in the reserve material of green plants, and on the first reduction product of carbonic acid in the act of chlorophyll assimilation, by M. S. **Posternak.** The acid, heated with dilute mineral acids, is quantitatively hydrolysed into inosite and phosphoric acid. From this, and its cryoscopic behaviour in aqueous solution, the formula $O[CH_2.O.PO(OH)_2]_2$, the anhydride of oxymethylene-diphosphoric acid, is given to the substance, and conclusions are drawn from this as to the nature of chlorophyll assimilation.—On the general equation of curves of fatigue, by M. Charles **Henry** and Mlle. J. **Joteyko.**

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