THURSDAY, JUNE 17, 1909.

EXPERIMENTAL EMBRYOLOGY.

Experimental Embryology. By J. W. Jenkinson. Pp. viii+341. (Oxford: At the Clarendon Press, 1909.) Price 12*s.* 6*d.* net.

EMBRYOLOGY as a branch of science is usually taken as dating back to the publication, by Caspar Friedrich Wolff, of the "Theoria Generationis," in 1759. Experiment, as an aid to the study, is of more recent date, and may be considered as commencing with Prof. Wilhelm Roux in 1883, twenty-six years ago. The coming-into-being of any living thing is a cycle beginning at a certain point and ending at a similar one, the starting-point of a new round. Primarily the studies of the embryologist are concerned with the elucidation and explanation of the phenomena included within this. Wolff tried to demonstrate, in the instance of the chick, how from an apparently undifferentiated mass, what we should now term the cleavage-products of the egg, part was gradually added to part, much in the manner that any day one may witness the building of a house from a heap of materials. He thus founded what is known as the doctrine of *epigenesis*. As Dr. Jenkinson remarks, this theory was "tacitly accepted by all the great embryologists of the nineteenth century—Pander, von Baer, Reichert, Bischoff, Remak, von Kölliker, Kowalewsky, Haeckel," and "the epigenetic idea continued to control the progress of research."

As initiated by Prof. Roux, the experimental study of embryology is based on a modification of the doctrine of epigenesis, little or no consideration being paid to any rival theory of development. Following on the work and theories of Wilhelm His, Roux raised "what in His's hands had been merely a principle to the rank of a theory, the 'Mosaik-theorie,' or theory of self-differentiation," under which "every separately inheritable quality of the body has its own representative in the germ."

In this there has always been included implicitly the belief that it was the main, if not the sole, task of the fertilised egg to give rise to a new embryo. In this way the importance of "the embryo" in the embryological mind has been greatly exaggerated, and little or no weight has been laid upon other phenomena of the life-cycle prior to its appearance. As research so often has revealed in recent years, the cycle from egg to egg is possibly, even probably, nothing like so simple as the upholders of *epigenesis* in the nineteenth century and earlier believed and taught. It appears, therefore, of prime importance that, prior to operative interference with, say, the egg-cleavage of any particular form, a complete knowledge of the normal life-cycle be obtained. How necessary this is to the investigator is evident from the consideration that in many of the best investigated cases most of the cleavage-products are concerned, not in forming by *epigenesis* portions of an embryonic body, but in producing structures of an evanescent character, unrepresented in any way in the adult animal, or even in the embryo.

Then, as a perusal of the present ably-written book reveals, the experimental embryologist seldom has anything of the nature of an embryo before him. He may, and often does, speak of the Pluteus of a brittle-star, or the Bipinnaria of a starfish, indifferently as a larva or as an embryo. But there is no homology between the Pluteus and the brittle-star; neither as a whole nor as to its parts is the one converted or "metamorphosed" into the other, as mythologically Jupiter turned himself into a bull. In short, direct development is also assumed.

Modern forms of the doctrine of evolution or unfolding are usually supposed to be the "Mosaik-theorie" of Roux and the "Germplasm-theory" of Weismann. The former has much in common with epigenetic doctrine, and the latter, with the ids, determinants, &c., really only transfers the powers of the builder, epigenesis, to the cell-nucleus of the fertilised egg. There is a theory of development, not mentioned in the present book, and which had its most recent advocacy in the last presidential address to the British Association for the Advancement of Science. This is Ewald Hering's theory of (unconscious) memory of germ-cells (1876), which in recent years has been elaborated by Richard Semon (and by the writer). This theory of "Die Mneme," to use Semon's term, along with an actual continuity of germ-cells from generation to generation, would appear to be in better accord with the facts of animal development than that of *epigenesis*. Unlike the latter, it explains, for instance, how from a single egg two embryos (identical twins), or even as many as eleven (an armadillo, *Praopus hybridus*), may arise.

If in first principles investigation be based erroneously, as experimental embryology would appear to have been hitherto, it cannot be wondered that the results have been discordant, or that no really fundamental advances have been made. There is still another point to be emphasised, that is, how difficult, even impossible, it is in any experimental study of development to be sure what has actually been done in any operation. In a sense the results always border on pathology, although a recent writer, Prof. H. H. Wilder, has given good reasons for the opinion that, as a rule, monsters, as they occur in nature, cannot be produced experimentally, at all events by mechanical means. It is also a feature of practically all researches in experimental embryology that the organisms dealt with never revert to the normal, never resume or continue for any appreciable period the normal life-cycle.

The difficulties in the way of estimating the results, as well as of determining what has actually been done in the operations, throw light on other conclusions, such as Driesch's speculations on neo-vitalism, and on mechanical theories of the nature of life.

The investigations hitherto made in experimental embryology and their results, as given with an excellent critical discussion in this book by Dr. Jenkinson, remind one of "die Sieben Welträthsel" of Emil du Bois Reymond. No doubt the study is a fascinating one, for the unexpected is always happening in it, but it is questionable whether any investigations yet made

in experimental embryology have furnished the solution of any important scientific problem. For more reasons than one it has appeared desirable to take into account in embryological teaching recent experimental researches, such as those described in this book, which, therefore, may be welcomed as of great value to the student and the teacher alike. It is well illustrated, clearly written, and the material is treated critically. Author and publishers may be congratulated upon the production of a work, which is everything that a text-book should be, though its price (12*s.* 6*d.* net) appears to be excessive. B.

ELEMENTARY BOTANY.

(1) *Plants and their Ways. An Introduction to the Study of Botany and Agricultural Science.* By E. Evans. Pp. viii+171. (London: J. M. Dent and Co., 1908.) Price 1*s.* 4*d.*

(2) *Mikroskopischer und physiologischer Praktikum der Botanik für Lehrer.* By G. Müller. Zweiter Teil. Kryptogamen. Pp. xii+165. (Leipzig and Berlin: B. G. Teubner, 1908.) Price 4 marks.

(3) *A First Book of Botany.* By Elizabeth Healey. Pp. viii+142. (London: Macmillan and Co., Ltd., 1909.) Price 1*s.* 6*d.*

(4) *Familiar Swiss Flowers.* Figured and described by F. E. Hulme. First Series. Pp. 56; with 24 coloured plates. (London: Cassell & Co., Ltd., 1909.) Price 1*s.* net.

(1) IT has always been recognised that with the extension of natural-history teaching to schools under the designation of nature-study there was a danger lest the requirements of an exact science should not be maintained. The first of these books gives grounds for such apprehension, because, although it contains much good matter and observational study is made the keynote throughout, there is a lamentable amount of loose writing, some unsatisfactory deductions, several uncertain experiments, and a few mistakes. For instance, the definitions of bulb and epiphytes require emendation; in section 31 it is not shown *why* roots bend downwards; in section 34 there will certainly be an error in the amount of soil washed away; in section 105 flower buds are required, and in section 107 the word "nearly" vitiates the instructions. With regard to loose writing the following are a few selected quotations:—"When the pollen tube enters the ovule, the tip breaks off"; "pollen grains are cells to the botanist and each is a reproductive body"; "the reason why plants vary is not fully understood at present, but it may be largely due to *adaptation*, to *environment* or surroundings"; "the plants which come between the xerophytes and hygrophytes are known as mesophytes." Nevertheless, as the general scheme of the course is well conceived, it would seem worth while to correct the quoted and similar passages, to revise or replace unsatisfactory experiments, and amplify the information where it is often insufficient.

(2) The first part of Müller's "Praktikum" dealing with phanerogams followed conventional routine, but in the second part he has pursued a somewhat irregular course The pteridophyta, *i.e.* lycopods and horsetails, as well as ferns, are confined to a dozen exercises; the thallus of Marchantia and the growing point of Metzgeria are the only features noted for liverworts, but several sections are devoted to mosses; further, in these groups the reproductive organs are entirely left out. Among the algæ, diatoms receive very ample consideration, although the red and brown seaweeds are almost entirely neglected. The fungi receive scant treatment, while a full quarter of the book is devoted to bacteria. Thus the book is exceedingly weak in taxonomy and is not of much value to the embryo teacher, although it contains a certain amount of information useful to the amateur botanist, especially if he is interested in mosses or diatoms; also there is that amount of information on bacteria which would enable him to grasp their general import, make a few personal experiments, and understand the general methods of culture. There is little fault to find with the actual information on individual points, as the author is exact and explicit. Excepting the experiments with bacteria, it may be inferred that the author bases his instructions on his own personal experience.

(3) The elementary book by Miss Healey provides a useful book for school teaching; it is well planned, is not overloaded with information, and is written in simple language. Each chapter contains a short lesson, and is followed by instructions for practical work in which due attention is paid to the necessity for careful observation and drawing. The course is arranged for morphology in the autumn, followed by physiology, and the chapters on classification would be reached in the spring. There are some doubtful points in the chapter on the root, notably the statement heading a paragraph that roots always grow downwards, but otherwise there are very few statements to which one can take exception.

(4) The volume on Swiss flowers forms part of the book published last year and already noticed in NATURE; it is now being published in five series. The illustrations are the chief feature, and, on account of the magnificent beauty of Alpine flowers, represent some of the most charming illustrations executed by the late Prof. Hulme. The absence of a systematic arrangement and the grouping of plants bearing no relationship to one another on the same plate are defects in an otherwise pleasing work.

AN ESSAY IN PALÆONTOLOGY.

The Transformations of the Animal World. By Charles Depéret. Pp. xvi+360. (London: Kegan Paul and Co., Ltd., 1909.) Price 5*s.*

THIS book, well known in its French original, deals with the geological evolution of animals. It contains discussions on the phenomena of variation, extinction and migration, and is sufficiently modern to include a brief notice of the discoveries of early forms of elephants in the Fayum district.

The first part of the book, forming about one-third of the whole, consists of summaries of the chief work associated with names famous in geological and

evolutionary literature. The geological work of Darwin himself is passed over with the remark, "the only fossil animals he had personally studied were the Cirripedes." The post-Darwinian writers alluded to are Gaudry, Neumayr, Cope, and Zittel. This section will be of considerable interest to those who are beginning palæontology.

The second part of the work deals with the nature of variation both in recent time and throughout the ages. The phenomena chosen are those exhibited by certain helices, and the discussion is inadequate to the extent and importance of the subject. The author subsequently passes on to another group of Mollusca, the ammonites, in order to discuss the relationship between species in successive formations. Throughout this section and the following one, dealing chiefly with the evolution of certain Ungulata, the author is at pains to discriminate between the laborious work of Neumayr in tracing out the branches of one phylum from the parent stem, and the more brilliant but (according to him) less permanent work of Gaudry in piecing together the fragmentary records of several phyla or orders into a continuous history.

The two following sections give a short summary of the factors that accompany extinction, and of the events that constitute migration. Under the first of these the questions of size and complexity, of appendicular growths, and of senility are illustrated by examples, but are, of course, not answered. We miss any reference to the suggestive work done by Beecher on old-age problems in palæontology.

Between the discussion on extinction and that on migrations the author has intercalated a couple of chapters on the very kernel of his subject, *i.e.* the relation between individual and racial development and the nature of that variation which provides material for the development of new species. The treatment of these topics will probably be considered as very inadequate to their importance. In regard to mutations (for which the author has the phrase "explosions"), an extremely brief reference only is given to de Vries and Nillson, and none whatever to Mendel or to recent discoveries in genetics.

The work concludes by suggesting that earliest forms of fossils will be found at the poles, where "the earliest sediments may have escaped metamorphism by reason of their rapid incorporation into continents and the absence of a heavy superposition of later deposits." Let us hope that Lieutenant Shackleton will confirm this supposition.

As the quotation suggests, this book suffers from inadequate translation. Not only is the rendering obscure, but the author's use of terms such as polyphyletic, mutations, &c., to say nothing of stratigraphical terminology, is not that accepted in this country. Undoubtedly a general work of this kind is a need of the times, but we fail to see that this volume is an adequate rendering of the factors that accompany evolution. The book suffers from entire lack of references and illustrations, and in its English dress it contains many serious mistakes, *e.g.*, "chiroptera like the squirrel" (pp. 315, 351); "narrow cuttings" (evidently intended for "thin sections," p. 329); "eaters" (p. 315) is possibly intended for "rodents." To those who are familiar with the fossils and the authors referred to in the text, the volume may be not unacceptable as an attempt to deal in a continuous narrative with many and complex problems; but for the larger public that is anxious to obtain the latest verdict of science on the mode of origin of that splendid diversity that has accompanied animal evolution, the author assumes, we fear, too much detailed knowledge both of zoology and of geology.

TWO BOOKS ON THEORETICAL CHEMISTRY.

(1) *Vorlesungen über chemische Atomistik.* By Dr. F. Willy Hinrichsen. Pp. viii+198. (Leipzig and Berlin: B. G. Teubner, 1908.) Price 7 marks.

(2) *First Principles of Chemical Theory.* By Dr. C. H. Mathewson. Pp. vii+123. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 4*s.* 6*d.* net.

(1) DR. HINRICHSEN explains that in composing these lectures he has expanded and completed two earlier works of his, (*a*) "Chemische Atomistik" (1906), and (*b*) "Über den gegenwärtigen Stand der Valenzlehre" (1902). The main topics are the usual ones of the atomic theory, the periodic system of the elements, valency, solution, and the relations between electricity and matter. Quite the best parts of the book are those dealing with the subject of valency, on which the author is an authority.

The lectures were delivered to audiences which did not consist entirely of chemists, and they begin and end with the relation between science and philosophy. In leading up to the atomic theory, the author makes a very suggestive quotation from Kant, of date 1786, to the effect that chemistry could not become a genuine science, and must remain a mere schedule of empirical knowledge, until the possibilities by number and measure of chemical action between different kinds of matter should be deduced from a theory. The author, instead of pointing out that Dalton did arrive at the law of multiple proportion by deduction from the atomic theory, adopts the erroneous view that the formation of the theory was a consequence of the discovery of the law.

J. B. Richter's work (1791–1802) is cited as a response—intentional or unintentional—to the stipulations of Kant. Actually Richter, with his hypothesis that the equivalent amounts of different acids fall into a geometric series, and of the different bases into an arithmetical, was much less fortunate than William Higgins, who explained the composition of different compounds of the same elements in terms of atoms. For instance, he supposed that sulphur dioxide consists of compound atoms, each made up of one atom of sulphur and one of oxygen, whilst the compound atom of the trioxide is made up of one of sulphur and two of oxygen. Higgins published his ideas in the year 1789.

The author states that he regards the historical development of chemistry as revealing the best order for studying and teaching the subject. Quite a number

of chemists now profess this belief without realising that the use of the historical method presupposes that the teacher has a grasp of history. Ostwald's dictum—"a most remarkable and praiseworthy thing in scientific literature is that almost every word is written conscientiously"—can hardly be applied to the usual treatment of the history of science. The historical conscience is somewhat blunt in the scientific man. In the present book, for instance, the statements are made that Lavoisier introduced the use of the balance into chemistry (p. 12), and that Dalton discovered the law of multiple proportion on consideration of marsh gas and olefiant gas, and then of carbon monoxide and dioxide, confirmed his discovery by the oxides of nitrogen, and then arrived at his atomic theory (p. 24). These statements are mere fiction.

In discussing solution, the author says nothing of the hydrate theory, and instead of pointing out that the theory of ions is extremely useful and extremely vulnerable, remarks that it can be regarded as one of the best-founded hypotheses of modern chemistry (p. 151). There is a curious statement on p. 40 to the effect that the practice of writing chemical formulæ, such as H_2SO_4, instead of H^2SO^4, is more common in Germany than elsewhere.

(2) This book is evidently the outcome of a keen interest in the teaching of chemistry. It is intended to be used by first-year students at a university, in connection with a course of lectures on chemical theory. There are chapters (in addition to what is to be expected on molecular and atomic weights, the periodic system, &c.) on the theory of electrolytic dissociation, the law of mass action, the phase rule, and thermochemistry.

Surely it is a mistake in policy to state Avogadro's hypothesis and to proceed without a moment's delay to apply the hypothesis to prove that the molecule of oxygen can be halved (pp. 11–12). Again, it would be much better to omit the proof on pp. 47–48—not a very clear one—that the "molecular weight of a gas is equal to twice its density compared to hydrogen." Once the student realises that under similar conditions the molecular weights of different gases occupy the same volume, it is obvious to him if it is only pointed out that he can find the density of a gas relative to hydrogen by dividing the molecular weight of the gas by 2 (the molecular weight of hydrogen).

A. N. M.

OUR BOOK SHELF.

Malleable Cast Iron. By S. Jones Parsons. Pp. xi+171. (London: A. Constable and Co., Ltd., 1909.) Price 8s. net.

THAT malleable cast iron has been given a work to itself is an index of its growing importance in the world of iron and steel. The methods of its manufacture are so closely allied to the other parts of foundry work that it is doubtful whether it is not better dealt with in a general work on the foundry, where its special features may be pointed out in a section devoted to this subject.

The present work deals with the whole of the foundry aspects of malleable cast iron, melting, moulding, annealing, cleaning and straightening, design, patterns, inspection and testing, supplementary processes such as galvanising, and applications. The practical part of the work seems well done and needs little comment, but it is very unfortunate for those who are endeavouring to promote the application of science in the foundry that the compositions given on p. 9, if such pigs could be procured, would yield disastrous results. This is particularly unfortunate as the number of what are called "practical men" seeking the assistance of science in the foundry is steadily increasing, and these men are very keen on the quest after they have proved its first benefit. Anything misleading which would give them a feeling of distrust should be avoided if possible.

The analyses on p. 9 show pig-irons with from 0·145 to 2·52 per cent. sulphur and 0·93 to 1·50 per cent. phosphorus as suitable for the manufacture of malleable cast iron, whereas good specimens of this material do not contain more than about 0·1 per cent. phosphorus.

The definition of shrinkage is not good, and the author fails to grasp the essential differences between the manufacture of Réaumur and Blackheart malleable iron. Many other points have been noted, such as "that theorists regard the pyrometer as indispensable, but in practice it is less trustworthy than the trained eye," &c. W. H. Hatfield, whom he praises, would tell the author that this statement is quite out of date. This work as a whole is untrustworthy so far as the science underlying the manufacture of malleable cast iron is concerned. A. McW.

A Manual of Infectious Diseases. By Dr. E. W. Goodall and Dr. J. W. Washbourn, C.M.G. Second edition, revised and enlarged by Dr. E. W. Goodall. Pp xii+426. (London: H. K. Lewis, 1908.) Price 14s. net.

THE second edition of this well-known book has been prepared by Dr. Goodall, who expresses the loss sustained by pathology and clinical medicine by the untimely death of Dr. Washbourn, which occurred since the first edition appeared.

Little but praise can be expressed for the work. The descriptions of the diseases dealt with, their symptomatology and treatment, are clearly and concisely stated, and the differential diagnoses are excellent. All recent work seems to be incorporated, and the pathology and bacteriology of the diseases are given so far as is known. Thus, under small-pox, we find descriptions of the *Cytoryctes variolae* of Guarnieri and of the intracellular bodies of Councilman, Calkins, and Tyzzer.

We think that in a few instances the arrangement of the subject-matter might with advantage have been altered, or at least cross-references inserted. For instance, dealing with the "dissemination" of enteric fever, the part played by "bacilli carriers" is just noted, this portion of the subject being elaborated later under "Protection and Duration of Infectivity." Similarly the presence of virulent diphtheria bacilli in "well" persons as a mode of spread of the disease might have been emphasised, and membranous rhinitis should have been more clearly referred to in the section on "nasal diphtheria." The reviser believes that an attack of enteric fever confers almost complete protection; in this he is at variance with other recognised authorities. "Slop" diet is advocated for enteric fever, rightly so, we think; but some mention ought to have been made of more generous dieting as advocated by some, particularly in prolonged cases.

The authors doubtless had to set some limitation on the number of diseases dealt with, but as chapters are devoted to relapsing and typhus fevers and

plague, diseases rarely seen in this country nowadays, we think that brief accounts of Mediterranean fever and cholera might have been included with advantage.

The book is profusely illustrated, and some of the photographs, though only in black and white, give a remarkably good idea of the characters and distribution of rashes. R. T. H.

Beschrijving en Onderzoek van den gyroscopischen Horizon Fleuriais (Model Ponthus et Therrode). By L. Roosenburg. Pp. 94; 3 plates. (Utrecht: Kemink & Zoon, 1909.)

IN this pamphlet the author describes some improvements introduced into the form of gyrostatic horizon proposed by Fleuriais. In the original construction, a top rotated in a chamber from which the air had been removed, and the whole could be fixed to a sextant in front of the horizon glass. Upon the top was placed a glass scale, with arrangements for reflecting the divisions of the scale into the sextant telescope in a direction parallel to the equator of the top. The angle subtended by the divisions of the scale was ten minutes, and the position of the object was estimated on this scale.

In the new form here described, a temporary vacuum only is made, and the chamber can be opened for the inspection of the parts, and renewal of the top point and the cup in which it rotates. The top is set in motion by an air-pump, which also creates the vacuum. Observations are possible for fifteen or twenty minutes. After the top has been rotating some six or seven minutes and the precessional effects rendered negligible, the sextant is clamped with the sun or star in the field of view, and a considerable number of readings taken of the position of the object on the scale. Lastly, the reading of the sextant is taken.

The author insists on the necessity of a large number of readings in order to get good results, apparently to eliminate the effect of irregular motion, which in unfavourable circumstances can amount to 13′ in three seconds. It is contended that though practice with the instrument is necessary, it is not difficult to use, is, in fact, easily mastered, and is equally available for stars as the sun. The results of more than 200 observations are given, and, with a few exceptions, the errors of altitude are always less than 3′. The author concludes that it is a trustworthy and very serviceable instrument for the determination of position at sea, preferable to other forms of the same class.

Revue de Géographie annuelle. Publiée sous la Direction de M. Ch. Vélain. Tome ii., Année 1908. Pp. 730. (Paris: Ch. Delagrave.) Price 15 francs.

THIS volume of the "Revue" ranges no less widely than the preceding one. As regional geography we find classified "Étude analytique du Relief de la Corse," by J. Deprat, and "Le Pérou," by C. Guibeaud. In the mathematical department G. Perrier deals with the figure of the earth and important geodetic operations, and A. Berget writes on "Les Méthodes et les Instruments du Géographe Voyageur." M. Zimmerman provides a review of half a century of European colonisation, and P. Girardin studies the subject of glaciation in the most recent geological epoch.

The first of these papers, that on Corsica, is an important contribution to the geography and geology of an island which has not been as closely studied as might be supposed from its accessibility. M. Perrier deals principally with the new measurement of the arc of the meridian of Quito which is in the hands of the Service géographique de l'Armée. It has been in progress for nearly ten years, of which the field work alone occupied five, and its results are far from complete as yet.

The article on Peru by M. Guibeaud is a general geographical study, most useful in its way. First it provides a short survey of the country according to natural regions, and then passes on to a consideration of its chief economic, ethnographical, and political aspects. This article is particularly well illustrated. M. Zimmerman's study of colonisation is a careful collection of facts and theories, with copious references to authorities, which should form an excellent foundation for the investigation of this subject of world-importance. The volume, judged on French standards, is particularly well printed and produced. It is heavy and bulks large, and not a few readers would no doubt like to be able to obtain one or other of its component articles separately.

Notes on Dynamics. By Sir G. Greenhill. Second Edition. Pp. 221. (London: His Majesty's Stationery Office, 1909.) Price 3*s*.

THIS cheap issue from His Majesty's Stationery Office of a second edition of Sir George Greenhill's notes, prepared for the advanced class of the Ordnance College, Woolwich, will, we hope, become known to teachers and students. The title is modest, the book has never been advertised, and few people are aware of its great value and originality. It contains many excellent numerical examples, rather different from those which teachers usually set in elementary dynamics classes, but the reader will be even more interested in letting the author carry him occasionally into problems which are quite outside any ordinary curriculum. When he deals with problems which are dealt with in the text-books, he takes a way of his own in each case, and gives us new ideas. The end sections dealing with the stability of rigid bodies moving in fluids are of great interest. J. P.

LETTERS TO THE EDITOR.

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

The Temperature of the Upper Atmosphere.

LIKE Dr. Chree (NATURE, June 3), I do not think the term "stratosphere" a suitable one, and isothermal layer is obviously open to criticism. We should all be indebted to Dr. Chree if he would suggest a better and more accurate term. Isothermal column appears to me sufficiently accurate to describe the phenomena over a single station, but cannot be applied to the whole upper part of the atmosphere. Some single word implying the absence of vertical circulation is required.

There is no reasonable doubt that the daily temperature variation becomes insignificant at a height of 1 km., and hence one is apt to infer that it is negligible at 10 km.; but the observations are not sufficiently well distributed, and in my opinion the effect of solar radiation on the balloon, if not on the instruments, is too uncertain for us to speak positively about a daily variation at such heights. The two years' observations in England have shown no annual temperature variation above 10 km., and I do not believe that there is any definite change from summer to winter. It is probable that the mean monthly temperatures at 10 km. do not differ greatly either with latitude or with the season, although all the observations yet available at 15 km. show lower temperatures over the tropics than over temperate latitudes at that greater height.

I am glad to see that Dr. Chree does not assert that errors of ±10° F. are the usual thing. Probably few of those who use the instruments would assert that such an error might not occasionally occur. If the figures for

November 11, 1907, quoted by Dr. Chree, stood alone, one would readily accept his explanation, but since that date many similar differences, though not quite so large, have been recorded. In fact, the noticeable point about the so-called isothermal layer is the very large differences of temperature that are found at the same time over places a few hundred miles apart, and over the same place within a period of twenty-four hours. Because we cannot explain the phenomena, are we, therefore, to doubt their existence? It is perfectly natural to do so; the question is simply one of the credibility of the evidence.

The evidence is of various kinds. If one of the instruments used in England be completely immersed in a bath of liquid by an observer A, the temperature of the bath being, say, between +30° C. and −50° C., a second observer B having the record and the instrument can ascertain within 1° C., or at the most 2° C., the temperature of the bath used by A. Why, then, cannot B equally well ascertain the temperature of the air through which the balloon has carried the instrument? Secondly, these instruments are carried up by a balloon travelling through air that has been in contact with the balloon; the balloon in general bursts, and they fall, moving now at a much greater speed, since in England we use no parachute. Two traces are made, the one showing the temperature during the ascent, the other during the descent, but it is not often possible to say which is which. As a rule, the two traces are quite distinct; mostly, one indicates a temperature of from 1° C. to 3° C. below the other throughout, but sometimes the traces cross and re-cross each other. However, the point is that the two traces are practically identical; any peculiarity of gradient shown on the one is reproduced at the same height on the other. Now I think it lies with those who imply that our instrumental records are untrustworthy to explain this. If the temperatures shown by these two traces are not the approximate temperatures of the air, what are they? Systematic errors could not be the same in the different circumstances of the ascent and descent. It is inconceivable that casual errors could always so combine as to give errors of the same magnitude in pairs time after time. It is even less likely than that a man, drawing coloured balls from a bag, should draw the same colour in every two consecutive draws, for not only is the general trace reproduced, but every peculiarity in it is also reproduced.

Thirdly, the results obtained on the Continent and in America agree perfectly with those obtained with different instruments and a different system in England. This alone is not a good argument against the possibility of large casual errors, since casual errors are eliminated in the means, but the two sets of observations are as yet not very numerous—about 100 in England—and they show the same general relation between the temperature and height of the isothermal column and the height of the barometer at the surface.

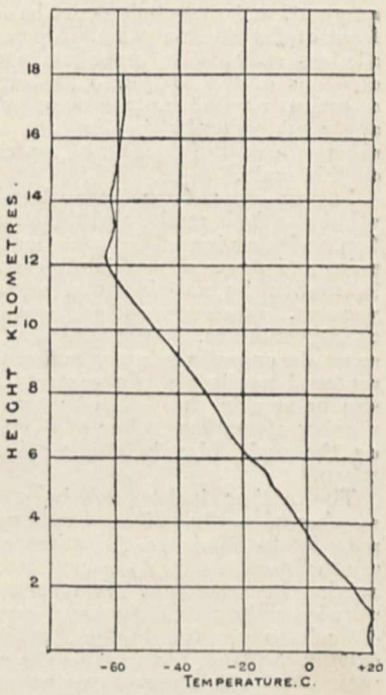
Dr. Chree, from the last paragraph of his letter, appears to think that the instrument makers supply the scale. This is not the case in England, and I do not think it is abroad. Almost every instrument sent up in England to the present time has been made here. The University of Manchester is responsible for the scales of those that it sends up, and I am responsible for the scales of the rest. These scales are verified before and after each ascent. The lag in our instruments is very small, since we depend on the expansion and contraction of a strip of very thin German silver, but I do not see that the lag affects the general question, since it will be largely eliminated if we take the mean of the ascent and descent.

W. H. DINES.

Pyrton Hill, Watlington.

As one who subscribed to the "Confession of Monaco," may I be allowed to say that no definitions of the names stratosphere and isothermal layer were supplied at the conference as those present understood the terms? The meaning of a word has often divided the orthodox from the heterodox, and for the benefit of Dr. Chree, and also of "heretics in England," I will endeavour to make the matter clearer. Balloon ascents show that, apart from irregularities near the surface, the temperature of the air decreases with height fairly regularly up to a certain point; above this point the regular decrease ceases, and for still greater heights the temperature changes are very small; sometimes there is a small increase, sometimes a small decrease, and sometimes the temperature remains almost constant up to the greatest height reached by the balloon. At any one place and time it thus appears that the atmosphere is divided into two layers, which differ markedly from one another in their vertical temperature distributions.

A diagram from an actual ascent made here on October 1 of last year shows the two characteristic temperature gradients. To the upper layer the names isothermal layer and stratosphere have been given; the latter name is due to M. Teisserenc de Bort, who surmises that the lower layer, or troposphere, is the part of the atmosphere concerned in the vertical circulation associated with cyclones and anticyclones, while the stratosphere lies above such movements. The name isothermal layer is not a fortunate one; certainly none of the orthodox who were assembled at Monaco would maintain that the upper layer is isothermal either in time or in a horizontal direction. Some less misleading term might have increased the number of the "elect." Both terms, however, are now in general use, and give definite names to a definite thing, which, as Huxley said, is the object of nomenclature.



The characteristic temperature gradient of the upper layer has been found over all parts of Europe, over the Atlantic, and over North America, but near the equator, if it exists at all, it is at a much higher altitude than in temperate latitudes. Its absence over the equator, and the fact that lower temperatures have been recorded there than in any other part of the atmosphere, seems to me to be a further proof, if such were needed, that the temperature gradient of the upper air recorded in other places is not the result of instrumental error.

CHARLES J. P. CAVE.

Ditcham Park, Petersfield, June 6.

The Sense of Proximity.

IN NATURE for March 11 there is an interesting account by Dr. McKendrick of some investigations by Kunz, of Mülhausen, and Prof. Griesbach, on the senses of the blind. Among other points that he refers to and discusses is the question of the ability of the blind to avoid obstacles and find their way about. This calls to my mind some observations and experiments which I made upon myself some eleven years ago with reference to my ability to find my way about with my eyes shut or in the dark. These I had intended to extend and amplify, but up to the present these further experiments have been crowded out by press of other work.

Many people have the feeling that if, for instance, they are in a room in the dark, they have some perception of their relation to objects in the room, and particularly can appreciate when they are near one of the walls. I can remember having had this feeling for many years, but never had the opportunity of putting it to scientific test

until the date I mention, when I was resident medical officer to a large London hospital.

Working as I was frequently until a late hour in the pathological laboratory, which opened off the entrance hall, I had, in order to reach my room, to cross the hall obliquely and enter the corridor by a wide door, some 6 feet wide, with folding glass doors, which were, as a rule, fastened back. The hall and corridor were unlighted. I usually walked well out into the hall from the door of the pathological laboratory, turned to the right when I thought I was opposite the door opening into the corridor, and then walked straight forward between the doors. I found, a good deal to my surprise, that though in the dark (even though I shut my eyes) I could judge as I walked through, very accurately, to which of the two doors I was nearest. I made a large number of observations, and the constant result was sufficient, I think, to preclude any idea of mere coincidence. I found I could even form a trustworthy estimate if I was only a few inches nearer one side than the other; and, further, if I gradually moved towards one or other side, when I got within a few inches of the door I "felt" that I was getting very close to it. The way in which I felt this is difficult to describe, but the sensation of "nearness" was situated in my face, on my forehead and cheeks, and seemed to be particularly keen on turning my cheek in the direction of the surface that I was approaching. The conclusion that I came to was that there were two different processes involved; in the first case (1) the nearness of a solid body was made evident by difference in the reflection and resonance of my footsteps as I walked, and in (2) the differences in the reflection of the heat of the face from a surface at varying distances were the cause of the sense of nearness or farness. It will be seen that I had arrived at almost precisely the explanation which Dr. McKendrick puts forward as the explanation of the power of the blind to recognise their relation to externals.

(1) To test my theory of sound reflection I tried the effect of walking in stockinged feet, and found that it sensibly diminished my power of recognising my position; this is, of course, quite analogous to the difficulty, which Dr. McKendrick describes, experienced by the blind when there is snow upon the ground. A still more conclusive test of the correctness of the theory would be to go through the same experiments with the ears effectively stopped.

Since I made these first observations I have noted many other occasions on which minute sound changes have given rise to a correct idea of relationship. Anyone may readily prove for himself in walking in the dark or with the eyes shut along a corridor with doors opening off it, some of which are open and others closed, how easy it is to recognise when one comes opposite one of the open doors, and a very little consideration will convince him that the explanation lies in the difference in resonance from the walls of the corridor and from the space into which the open door leads. Again, I have more than once noticed, when riding on top of a tram-car in the crowded city, that I have been "sensible" of another passenger sitting quietly down on the seat behind me, not through any sound that he has made, but by his cutting off from my ears a portion of the general roar of traffic. It is the finer sound indications of this type, to which we customarily pay little heed, since our eyes yield us more rapid and more complete information, that convey so much information to the blind, whose ears, if not more keen, are more intent, and the blind man's stick undoubtedly serves, not only to feel his way with, but by its tap to supply a source of sound the resonance of which may be noted. There is still much haziness, even among those who have to do with the management of the blind, as to their psychology, and one superintendent of a blind asylum with whom I am acquainted, indulging in that mysticism which at the present day is so fond of explaining phenomena, of which by experiment one may learn something, by theories of which we know nothing, would drag in that blessed word "telepathy" to explain the blind man's knowledge of surrounding objects.

(2) The second principle involved, viz. the reflection of the heat of the face from adjacent surfaces, is not so easily verifiable. I feel fairly confident, however, that accurate observations with a delicate surface thermometer would show that the cheek was receiving a certain amount of reflected heat as it was approached near to a solid object. That the skin of the cheek is peculiarly sensitive to the degree of temperature will be readily admitted by anyone who has seen a laundress testing the proper heat of her iron by holding it to her face. Further, the repetition of the experiment with the use of a mask, which would minimise the sensitiveness of the skin to changes of temperature, has struck me as likely to give conclusive results, and I am particularly interested to find this supposition supported by Dr. McKendrick's statement that the blind do not so readily avoid an obstacle if the face is covered.

CHARLES H. MELLAND.

Manchester, May 29.

The Pollination of the Primrose.

IN NATURE of May 20 the reviewer, in the course of his appreciative and interesting notice of my book, "Life-histories of Familiar Plants," states:—"We notice that, without stating definitely what insect pollinates the primrose, the author refers to the bee or moth as doing it, in a misleading way. He would have been wiser to ask readers to notice what insect is really effective in the case of this plant. Neither honey-bees nor moths are known to be so." Regarding this point, on p. 78 I have written as follows:—"Now, watch the occasional bee that makes a visit to these two different types of flowers. Here is one alighting. With the sudden weight thus imposed upon it the flower sways," &c. This passage, of course, refers to a humble-bee, as the reference to "the sudden weight" clearly implies. It is true that I did not definitely state that it was a humble-bee, but, on the other hand, I have nowhere in the chapter referred to the honey-bee.

Probably the reviewer, and also readers of NATURE, will be interested in the two following notes from my diary for this year:—April 21: "Saw the first small white butterfly of the season, in garden, about 2 p.m. It was sipping nectar from a primrose flower." (Amongst the photographs illustrating the book referred to above it will be remembered that there is one showing a green-veined white butterfly feeding amongst primrose flowers.) May 3: "A species of large, black humble-bee in garden visiting only primroses and polyanthuses. Saw five of them within the space of two yards. One was a large female (the largest humble-bee that I have ever seen), and was apparently entirely black. In some of them, the pollen baskets stood out distinctly as yellow patches on their legs. One other specimen had an orange-coloured thorax." I could not at the time make a capture of one of the bees, and as cold weather followed, and the primroses had nearly done blooming, I did not see the bees again.

While possessing very little knowledge of the species of humble-bees, I am inclined to think that the species I saw was *Bombus harrisellus*, the large specimen being a queen, the one with the orange-coloured thorax a male, and the remainder neuters. Perhaps some of your readers can give some information regarding these bees, and may have observed them on primroses. So far as my observations went, the bees confined their attention exclusively to the primrose family.

JOHN J. WARD.

Rusinurbe House, Somerset Road, Coventry, May 25.

REFERRING to a question raised in NATURE of May 20 (p. 345), the writer of the article "Recent Studies on Animal and Plant Life" may accept it as a fact that the primrose flowers are visited both by humble-bees and by moths, among which may be particularly named the humming-bird and bee hawk-moths. The flowers are also frequented by dipterous insects, a specimen of one of which is enclosed, by which, for the long-styled form at least, pollination may perhaps be sometimes effected.

W. E. HART.

Kilderry, Londonderry, Ireland, May 24.

THE determination of the insects that pollinate the primrose is an old problem, and my remarks in the review under consideration were made with the view of eliciting

more observations on this point. The hawk-moths mentioned by one correspondent are scarcely sufficiently common to serve as the usual pollinating agencies, and the dipterous insect (apparently a Volucella) arrived in too fragmentary a condition for identification. The Bombi certainly visit these flowers, but the vague "bee" used in the book under review would certainly lead to confusion with the true honey-bee, which is not known to visit primulas. I may add that in the Manchester Museum there is a series of insects taken by Prof. Weiss on the primrose. No moths are included amongst them.

THE REVIEWER.

An Optical Phenomenon.

Is your correspondent "V. P." (NATURE, June 3, p. 398) perfectly sure that there is not in the glass pane in question one of those flattened oval air bubbles so common in window glass, which he may have overlooked? The phenomenon of the dark disc of shadow with the bright edge so exactly corresponds with the effect produced by these common flaws in glass that, in spite of his assurances, I cannot help suspecting that he may have misjudged the angle of incidence of the sun's rays. A window is before me as I write which presents identically the same phenomenon, and I was nearly being misled until, with a pencil point laid on the pane, I tracked the shadow to its source, which was much higher up on the window than I should have judged.

CHARLES E. BENHAM.

28 Wellesley Road, Colchester.

Dew-Ponds.

IN the recent correspondence on this subject several rival theories have been put forward to account for the supposed fact that certain ponds situated on the tops of hills have a plentiful supply of water. It seems to me that no satisfactory solution of the question can be expected until much more definite data are at hand.

What is wanted is a detailed, contoured survey of a typical "dew-pond" with its drainage area, and a year's observations of the height of water in it, an estimate of the number of cattle using it, rainfall and hygrometric observations in the neighbourhood, and a section showing the construction of the bed of the pond and adjoining slopes. If someone interested in the question and resident in the neighbourhood of one of these ponds would undertake the work, it would be of far more value than twice the labour spent in founding theories on insufficient data.

Wirksworth, June 12. L. GIBBS.

SPRUCE'S TRAVELS IN SOUTH AMERICA.[1]

DR. ALFRED RUSSEL WALLACE has rendered a great service to the scientific world, not only in having consented to rescue from oblivion the account of Spruce's remarkable travels, but also by the admirable way in which he has edited the manuscripts placed in his charge. Spruce's journal, which forms the substance of these volumes of about 1040 pages, has been carefully edited and considerably condensed. Passages of no particular interest have been omitted, and short summaries by the editor take their place. Several letters to Sir William Hooker, Mr. Bentham, and personal friends have been inserted which carry on the narrative and give a more life-like impression of Spruce himself.

These letters, which are keenly alive and full of human interest, form some of the most interesting portions of the book. Those to Mr. Bentham show the ardent botanist fired with enthusiasm for his work, whilst those to his friend Mr. Teesdale reflect the character of the man himself, and give a vivid picture of the every-day occurrences and of the perils which he experienced.

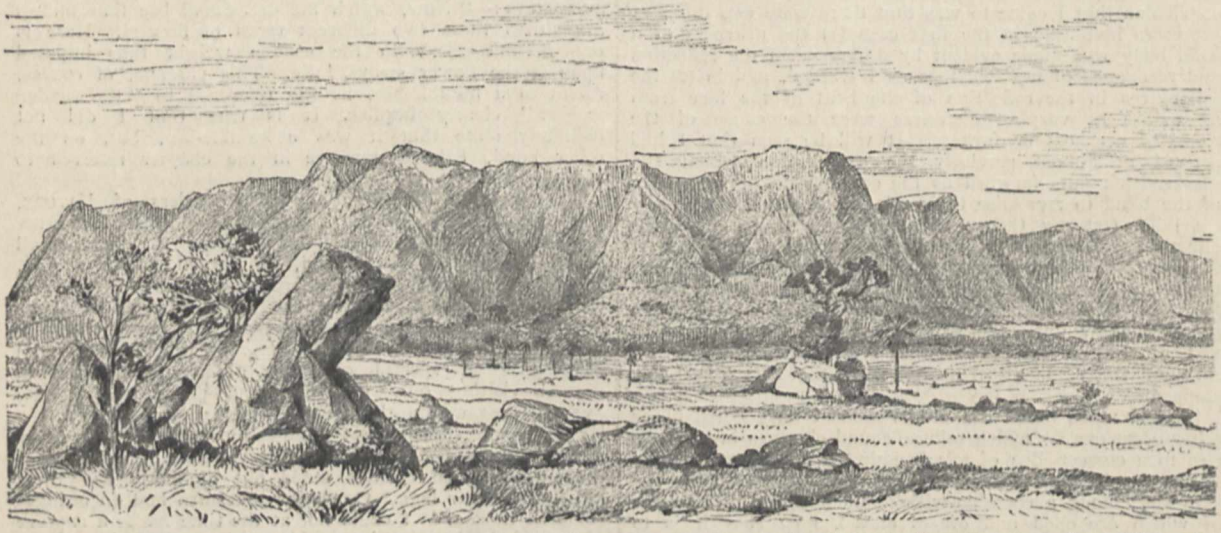


FIG. 1.—Cerro Duida (8000 feet), from the Cross near the Village of Esmeralda. Looking north. (R. Spruce, December, 1853.) From "Notes of a Botanist on the Amazon and Andes," vol. i.

At times the reader is inclined to complain of an occasional want of continuity and of abrupt changes of subject, but such blemishes are not common, and, owing to the necessity for condensation, could perhaps hardly have been avoided.

The first volume, covering the period from July, 1849, to January, 1855, deals with Spruce's travels on the Amazon and Rio Negro, including a journey along the Casiquiari and to the Orinoco cataracts.

The second volume opens with the account of the voyage from Manaos to Tarapoto, and continues his travels in the eastern Andes of Peru from that place, his excursions in Ecuador and in the Cinchona forests, and his last years on the western side of South America. There are also botanical and historical notes, which conclude with a highly exciting story of a hidden treasure of the Incas. The period spent in South America covered by this volume is from March, 1855, to April, 1864.

[1] "Notes of a Botanist on the Amazon and Andes." By Richard Spruce. Edited and condensed by Dr. Alfred Russel Wallace, O.M., F.R.S., with a Biographical Introduction, Portrait, 71 illustrations and 7 maps. 2 vols. Vol. i., pp. lii+518; vol. ii., pp. xii+542. With a Glossary of Native Names and Index. (London: Macmillan and Co., Ltd., 1908.) Price 21s. net.

The first volume has for frontispiece an excellent portrait of Spruce, and the biographical introduction by the editor which follows is of great interest. That a man so feeble in health as Spruce was in his earlier years could have endured the privations he experienced on the Amazon, or could have ever recovered from his illness at Maypures, or, again, could have carried on his work in the Cinchona forests with dogged determination when crippled with rheumatism, seems little short of marvellous; and yet his botanical work, which was of the highest order, was pursued with unflagging zeal, in spite of every difficulty either natural or physical.

The two volumes are full, both of well-ordered botanical information of great value, and contain also tales of peril and adventure of stirring interest. The voyage up the Rio Negro and the frequent passages of the rapids show how often Spruce was in imminent danger of his life. In the first volume one of the most interesting portions of the book is that dealing with the little-known region of the Casiquiari, the channel which unites the Rio Negro with the Orinoco. Here, in the country where Humboldt travelled, Spruce explored some rivers hitherto unmapped, and made extensive collections. He was much harassed by the mosquitoes, which, at the time of his visit, were making the region of Esmeraldas almost impossible for human habitation. The slopes of Duida and the Esmeraldas country are said to be magnificent, and Spruce's sketch, which is here reproduced, confirms his description. In addition to his sketches of the scenery, he gives some interesting drawings of the natives in this region, with good accounts of the different types of Indians with whom he met. After the excursion to the Duida mountains Spruce returned to the Rio Negro, and, going up stream, made the short portage of Pimichin, and then travelled down the Atabapo and Orinoco rivers as far as the falls of Maypures. Thence he retraced his steps a short distance; but fever was upon him, and so severe was the attack that for thirty-eight days he was unable to move.

On the return to Manaos from the Rio Negro, Spruce continued his journey up the Amazon to Tarapoto, where he spent a year and three-quarters making various difficult excursions. His letters at this period are full of graphic detail. While here he was able to effect a cure for a serious case of snake-bite, but had he failed his life would probably have been taken by the Indians.

Throughout his journeys on this side of the Andes, Spruce encountered exceptionally heavy rains, which severely hindered his botanical work, and rendered his voyage up the Amazon, particularly from Tarapoto to Canelos, very dangerous. He vividly describes the storm at Puca-yacu, where the river, normally only three feet deep and twenty-five yards wide, rose eighteen feet during the night, and they had to hold on to every creeper to prevent the canoes from being swept away, and were in constant danger of being dashed to pieces by the trees borne along by the surging waters. The journey from Canelos to Banos through the Montana, over a route which has hardly been traversed since, was attended with many perils, which were increased by the adverse weather conditions. Despite difficulties, however great, Spruce never ceased to add to his collections. Few people, we venture to think, would have dared to cross the foaming torrent of the Topo on improvised bridges of three bamboos, too slender to bear the weight of a man with his burden. The luggage and collections, therefore, had to be left, but, fortunately, they were recovered later.

FIG. 2.—Chimborazo, from the Paramo of Sanancajas. From "Notes of a Botanist on the Amazon and Andes," vol. ii.

On this journey Spruce describes how he walked through forests of giant Equisetums, 18 to 20 feet high, with stems as thick as one's wrist; to quote his own words, "a wood of young larches may give you an idea of its appearance. . . . I could almost fancy myself in some primeval forest of Calamites, and if some gigantic saurian had suddenly appeared . . . . my surprise could hardly have been increased."

After a stay of some length in the Ecuadorean Andes at Riobamba and Ambato, whence numerous

excursions were made, Spruce then crossed to the western side of the Cordillera to explore the Cinchona forests, being commissioned to obtain seeds and young plants of Cinchona for India. It was fortunate that such a man as Spruce was on the spot to undertake the work. As his first visit to the forests of Alausi proved unproductive, he moved further north to the red-bark forests on the lower western slopes of Chimborazo, where the red-bark region extends from 2000 feet to 5000 feet above sea-level. Here he, with Mr. Cross, in the face of extraordinary difficulties, and in the midst of a revolution, collected seeds and raised plants of *Cinchona succirubra*. After a perilous voyage, they brought their cargo of Wardian cases safely to Guayaquil, whence they were shipped to India. The story of this enterprise is a remarkable narrative of energy and determination overcoming innumerable obstacles.

An interesting chapter in this second volume is occupied by Spruce's paper entitled "Ant agency in plant structure, or the modifications in the structure of plants which have been caused by ants, by the long continued agency of which they have become hereditary, and have acquired sufficient permanence to be employed as botanical characters." The paper was rejected by the Linnean Society in the form sent in in 1869, and was never printed, but it is worthy of careful perusal.

Other chapters deal with narcotics, the Amazons, and the interesting rock-pictures of the Amazon valley. The volume concludes with an account of the hidden treasure of the Incas, including a translation of one of the few existing copies of Valverde's guide to the Llanganati Mountains—the locality of the treasure—and the Royal warrant of the King of Spain discovered by Spruce after persistent search. It would spoil the exciting interest of the narrative to enter into particulars, but attention must be directed to the original and wonderfully exact map of the country, which is reproduced with the tracks of former treasure-seekers indicated. As Dr. Wallace offers an ingenious and apparently correct explanation of the reason why everyone has diverged from the right path at a certain point, there seems now to be every inducement for someone filled with the spirit of adventure to set out, chart in hand, on the five days' journey from Pillaro, and solve the question of the treasure of the Incas. A. W. H.

AN ANTARCTIC ALBUM.[1]

AMONG the most valuable assets of the National Antarctic Expedition were the artistic ability of Dr. E. A. Wilson and the photographic skill of Engineer-Lieut. Skelton; and a large selection from their sketches and photographs, supplemented by those taken by other members of the expedition, has now been issued in a sumptuous volume and portfolio containing 165 plates. The illustrations included in this collection have been selected and arranged by Dr. Wilson, and he has also written the introduction and the description of the plates; he gives full acknowledgment to Captain Scott and other of his colleagues for their help in this respect.

FIG. 1.—Mount Sabine. From a telephotograph by Lieut. R. W. Skelton; looking S. from Cape Adare to Mount Sabine, at the head of Robertson Bay, January 9, 1902. From "National Antarctic Expedition, 1901–4 Album of Photographs."

Sir Archibald Geikie contributes the preface, in which he states that the album has been printed by Messrs. Oliver and Boyd, of Edinburgh, and many of the photogravures are the work of the Swan Electric Engraving Company, by whom the pencil drawings were produced by a new process invented by Mr. Donald Cameron Swan. The sketches of the aurora and various meteorological effects are reproduced as

[1] "National Antarctic Expedition, 1901–4." Album of Photographs and Sketches; with a Portfolio of Panoramic Views. Pp. xvi + 303; 165 plates, 2 maps. (London: Royal Society, 1908.

lithographs by Messrs. West, Newman and Co. The two key-maps were prepared by Dr. Wilson and Lieut. Skelton.

The illustrations deal with most branches of the work of the expedition, and they are naturally of most importance in connection with the topography, and Dr. Wilson's outline sketches are an invaluable supplement to the maps previously issued by the expedition, and his pictures of the aurora, clouds, and earth shadows represent features for which photography is useless. The characters of the scenery are especially well shown in the long panoramas by Lieut. Skelton, some of which are reproduced as folding plates three feet long. Some of the most interesting photographs were taken by Lieut. Skelton with a telephotographic lens, and he thus brings out the general outlines of Mount Sabine (Fig. 1) from a distance at which the ordinary photograph is comparatively useless. The album includes many zoological photographs illustrating the whales, seals, and especially those most attractive of photographic subjects, the penguins.

The illustrations of the geological details are less numerous. Photographs of the glaciers are of especial value owing to the changes which take place in the distribution of the ice. There are many excellent illustrations of glacier tables, sastrugi, and icebergs; but the album would have been more useful had it contained more photographs showing the detailed intimate structure of the ice. There are several photographs of the Great Ice Barrier, but they add little to the evidence of that by Bernacchi, which was reproduced in the review in NATURE of Captain Scott's book. The photographs of the chasm between the Barrier and the land ice help to indicate the great difference between the rapidly moving barrier ice and the more stagnant ice along the shore.

The album is a more useful addition to the literature which has already appeared in connection with the expedition, and is to be regarded as a supplement to the works by Captain Scott and to the volumes of the scientific reports noticed already in NATURE, vol. lxxiii., 1905–6, pp. 297–300, two figures, and vol. lxxvii., April 16, 1908, pp. 561–2.

J. W. G.

FIG. 2.—The Pressure Ridges at Cape Crozier. From a photograph taken by Lieut. R. W. Skelton, October 18, 1902; looking S.E. from the land-ice of the eastern extremity of Cape Crozier, Ross Island. From "National Antarctic Expedition, 1901-4. Album of Photographs."

AMERICAN AND CANADIAN WATERWAYS.

WHILE in this country the interest that at one time was evinced in the improvement of our canals, since the evidence that was brought before the Royal Commission, appears to have evaporated, in the United States and Canada this subject has come very much to the front. It is generally recognised that the question of transport by water is one of the most pressing needs of the country. During the last few years the home commerce has grown at such a rapid rate that the railways appear to be utterly unable to cope with it efficiently. During the past seven years, while trade has doubled in quantity, the railway facilities for transporting this have only increased one-fourth. It is generally acknowledged that it will be a wise policy on the part of the Government to spend as much money as will be available in improving the internal waterways and in constructing links with existing canals and rivers and the sea-ports, so as to render an efficient system of national transport.

During the last Presidential campaign, both political parties pledged themselves to make the transport by water a question of first prominence. Those engaged in mercantile traffic, and the large industrial companies are strongly in favour of an improvement

in the waterways of the country as being beneficial to trade by the greater facilities of transport afforded, and in the reduction of freight charges. The railway companies are credited with offering no opposition to such an expenditure of the public funds, as they have already more traffic than they can cope with satisfactorily.

The project that is now occupying most attention is the linking up of the eastern and western sides of the country by a continuous circular waterway extending over 5000 miles, serving a district covering a million and a half square miles, or an area as great as that of this country and Europe, exclusive of Russia.

Taking New York as a centre, the proposal is to connect the waterways southward to Florida and the Gulf of Mexico, running nearly parallel with the Atlantic coast, and connecting up with the existing rivers and canals, thus providing an inland route for barges and small coasting vessels. By the Gulf of Mexico there would be communication at New Orleans with the Mississippi, and thence by the Illinois River along the Drainage Canal to Chicago and Lake Michigan. Along this part of the system dredging would be required in the upper part of the Mississippi and in the Illinois River, over a distance of 850 miles, so as to give 15 ft. depth at low water. By the Great Lakes communication already exists to Buffalo, along the Erie Canal to Albany, and thence by the River Hudson to New York. By Long Island Sound, in which some dredging would be required, Cape Cod and Boston could be reached. As collateral branches the Columbia River would be made passable for barges, and afford a way for transit to the Pacific for the States of Washington, Idaho, and Oregon.

The estimated cost of carrying out this scheme is 100,000,000 pounds.

New York at the present time is spending 20,000,000*l.* in widening and deepening the Erie Canal over a length of 445 miles, so as to enable vessels of 1000 tons to pass along it.

In the State of Illinois the Government has voted 4,000,000*l.* for deepening the Illinois River and connecting Lake Michigan by means of the Drainage Canal with the Mississippi, a distance of 100 miles.

The United States Government is also spending a large amount in improving and deepening the shoal places between the Great Lakes. At Sault St. Marie an additional channel has been cut, having a depth of 26 ft. of water. Below Detroit a curved channel has been replaced by a straight cut 13 miles long, having 20 ft. depth of water, which is to be increased to 26 ft. On the Ohio River, extending from Pittsburg to the Mississippi, a length of 1000 miles, for some time past works have been in course of construction for the improvement of the navigation, involving the making of fifty dams and locks at a cost of 12,000,000*l.* These locks have a length of 350 ft. by 45 ft. in width, with 17 ft. of water over the sills. A new and straighter channel, called the Ambrose Channel, has been dredged from the sea up to New York, giving a depth of 40 ft. at low water. This work has been in progress since 1901. For the over-sea shipping extensive works have also been carried out in the harbour, and a large pier constructed for ocean-going vessels. A canal has been made from the Hudson river, 2000 ft. long with 30 ft. depth of water, along which berths for vessels have been provided. At the city of Newark work has been commenced on a new port opening out of New York harbour; and a canal is being made 3 miles long by 700 ft. wide, in which berths for vessels are to be constructed, and a large area of marsh land reclaimed and adapted for storage purposes.

On the Delaware River and approach to Philadelphia a 30-ft. waterway has been dredged at a cost of 200,000*l.*; and a scheme is now under consideration for a further expenditure of 150,000*l.* by the city for the purchase of the river frontage and construction of wharves. Also, for the improvement of the navigation up to Baltimore, a 35-ft. channel is being dredged 25 miles long.

At the entrance to the Mississippi from the Gulf of Mexico, the jetties constructed by Captain Eade thirty years ago have been replaced and the channel deepened at a cost of 1,200,000*l.* A large sum is also being expended in improving the ports on the Great Lakes.

For the completion of the Panama Canal, which is now being carried out by the United States Government, 30,000,000*l.* has so far been appropriated by Congress.

In Canada the project of providing a cheap and convenient mode of transit for Canadian produce through Canadian territory to Canadian ports for shipment abroad, by connecting the Great Lakes with the St. Lawrence and so with the Atlantic by what is known as the Georgian Bay scheme, has now assumed a definite shape.

During the last few years a most extraordinary development of trade has taken place at the ports situated on the Great Lakes. The freight passing through the locks at Sault St. Marie rose from 13,000,000 tons in 1894 to 51,000,000 tons in 1906. The transit of wheat rose from 35,000,000 to 84,000,000 bushels; and of iron ore from 6,500,000 to 35,500,000 tons. In the meantime the capacity of the vessels trading on the lakes has increased to 10,000 tons. The greater part of this traffic, however, passes by American waterways to the sea coast, and only about 8 per cent. reaches the St. Lawrence. It is estimated that grain can be carried from Chicago to Montreal at two-thirds the cost of transit to New York, and Montreal is 300 miles nearer to Liverpool than New York.

The Canadian Government has been giving recently its serious attention to this matter, and it is generally admitted that the carrying out of this scheme is the next great work to be undertaken after the completion of the Transcontinental Railway.

This scheme was first mooted fifty years ago, and various routes for carrying the waterway have been proposed. A report has, however, been recently presented by the Public Works Department as the result of a survey made by its officers at a cost of 110,000*l.*, and a definite scheme settled. The route proposed is from Georgian Bay along the French river and Lake Nipissing into the Mattawa and Ottawa rivers, and so into the St. Lawrence, the distance between Montreal and Georgian Bay being 440 miles. The waterway where artificial works are required is to be sufficient to carry the largest vessels trading on the lakes, which require 20 ft. of water. The cost is estimated at 20,000,000*l.*, and the time for construction ten years. There will be required eighteen dams and twenty-seven locks, which are to be 650 ft. long. There will be 28 miles of canal excavation, and more than 400 miles of dredging in the lakes and rivers. It is also proposed as part of the scheme to use the water stored for generating electric power, and it is calculated that there will be sufficient supply and fall to develop 1,000,000 horse-power.

For improving the transit up the St. Lawrence to Montreal the Canadian Government is dredging the river over a length of 62 miles, so as to give a depth of 30 ft. at low water.

THE PROBLEM OF AN ULTRA-NEPTUNIAN PLANET.

IN this memoir[1] Prof. W. H. Pickering first gives a graphical method by which Neptune might have been discovered from the data used by Le Verrier and Adams. Having thus demonstrated the practical value of his method, he proceeds to apply it to a search for a planet beyond Neptune. He calls his hypothetical planet by the letter "O," obviously as the next letter of the alphabet to the initial of Neptune, and he finds, *inter alia*,

Mean distance	51·9
Period	373·5 years
Mass	= twice that of the earth
R.A. in 1909·0	7h. 47m.

Now the problem presented by Uranus, Neptune, and "O" may be very readily reduced to the known problem, already fully worked out, of Mercury, Venus, and the earth, for it is easy to show that the theory of a pair of planets is the same if we retain the masses but alter the distances of both in the same proportion.

First of all, as, roughly speaking, we are only able to observe heliocentric longitudes of Uranus and Neptune, we must suppose that our fictitious observer, to whom the existence of the earth is unknown, is only able to observe heliocentric longitudes of Mercury and Venus. We may speak of him, therefore, as an observer in the sun.

Secondly, as the mass of "O" is twice that of the earth, we must credit the observer in the sun with instruments of twice the precision of those used by ourselves.

Lastly, we may divide all distances by 51, and all time intervals by 365. This latter factor enables us to substitute days for years.

We are, therefore, to suppose that an observer in the sun, with instruments of twice the accuracy of our own, has observed Mercury for four months and Venus for two months, and that in addition he has one or two stray observations of Mercury and Venus made before he recognised its planetary character.

Now let us turn to the tables of Mercury and Venus, and estimate for ourselves what chance such an observer has of demonstrating the existence of the earth.

Before doing this, however, we must pause for a moment in order to show that we may dismiss from notice all long-period terms. These terms play a very conspicuous part in planetary theory. Their existence depends upon the same principle as that of the swing, where a very small force applied at regular and suitable intervals will produce very large oscillations. Their existence necessitates the expansion of the disturbing function to ten or a hundred times the accuracy otherwise necessary, and the consequence is that from the computer's point of view the short-period terms are dismissed with scanty notice in the account that he gives of his work.

For example, in the heliocentric longitude of Venus there is a term

$$3'' \sin (13E - 8V)$$

with a period of 239 years. Our hypothetical observer in the sun would have no chance of detecting such a term as this. If he detected in two months' observations any term at all it would be one of the following:—

$$5'' \sin (V - E)$$
$$11'' \sin 2(V - E)$$
$$7'' \sin 3(V - E)$$

the periods being 585, 292, and 195 days respectively.

[1] "Annals of the Astronomical Observatory of Harvard College." Vol. lxi., part ii. A Search for a Planet beyond Neptune. By W. H. Pickering. (Cambridge, Mass.: The Observatory, 1909.)

It may further be observed that it is the long-period terms which are largely affected by small changes in the elements of the disturbing planet; the short-period terms are not appreciably affected. During the hypothetical two months of observation the question is, "Where is the disturbing planet at that time?" not "Are the elements such as produce a long-period term?"

Further, it is not sufficient that a term of moderate amplitude and period should exist. In the hypothetical two months, only a very small portion of a complete period is observed, and the conditions must be such that the term is not mistaken for uniform motion or for a term periodic in the period of the planet under observation, for in either case the term could be represented by a change of the elliptic elements of the orbit.

At this point we wish to say that we do not think Prof. Pickering's case is a good one, and, having thus proclaimed ourselves adverse critics, we wish immediately to concede the following point. In our opinion the hypothetical observer could detect from two months' observations the term $7'' \sin 3(V - E)$ in the heliocentric longitude of Venus, and could distinguish it from a mere error of assumed elliptic elements, provided only the phase of the argument happened to be suitable during the period of observation. Reverting now to the actual case, the existence of planet "O" could be demonstrated from the observations of Neptune at the present date if the epoch of planet "O" were suitable. If the observations of Neptune show nothing, the hypothesis of the existence of "O" would not be negatived, but the hypothetical "O" would at least be confined to certain limits of longitude.

Prof. Pickering, however, has based his discovery of "O," not on Neptune, but on Uranus. In the hypothetical case we have to consider the perturbations of Mercury by the earth. In this case we have terms such as

$$0{\cdot}2'' \sin (M - E)$$
$$0{\cdot}3'' \sin 2(M - E),$$

which we believe to be quite incapable of detection from four months' observations, or at any rate of detection and distinction from elliptic terms. In saying this we do not forget that the terms must be doubled to take account of the double mass attributed to "O."

It will be seen that our criticisms are directed against Prof. Pickering's figures as we find them. We have argued against the extremely small mass assigned to the hypothetical planet, seeing that Prof. Pickering's data are the observations of Uranus. While constructing our argument we have, however, convinced ourselves that the time is ripe for a discussion of the observations of Neptune, for if the planet "O" exists, or any approximation to it, it should have produced, or at any rate should soon produce, a visible effect on Neptune.

NOTES.

MEETINGS of two special commissions appointed by the International Meteorological Committee at Paris in 1907 will be held in London during the week commencing Monday next, June 21. The appointment of the first commission arose out of a proposal made at Innsbruck by the Rev. Lowis Froc, S.J., director of the Zi-ka-wei Observatory, for the general adoption of a code of maritime weather signals now in use in far eastern waters, and a further proposal made at Paris by Prof. Willis Moore, chief of the United States Weather Bureau, in favour of an international system of maritime weather signals. To

this commission the question of an understanding as to the projection and scale of charts for representing marine meteorological data was also referred. It is expected that M. Angot, director of the Bureau Central Météorologique of Paris; Father Froc, of Zi-ka-wei; Prof. Grossmann, representing Rear-Admiral Herz, director of the Deutsche Seewarte, who is prevented by illness from attending; Prof. Mohn, director of the Meteorological Institute, Christiania; and Prof. Willis Moore, will be present to take part in the meetings. The second commission is appointed to consider international questions concerning weather telegraphy, including wireless telegraphy from ships. The members to be present are Messrs. Angot, Grossmann, and Willis Moore. Both commissions are under the presidency of the director of the Meteorological Office, and the meetings will take place at the office. The commissions will report to the meeting of the International Meteorological Committee which is expected to be held in 1910. Some of the visitors will remain to take part in the meetings of the Solar Commission during the week beginning June 28.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Wednesday, June 30.

THE death is announced, in his sixty-sixth year, of Prof. Carl N. I. Börgen, for thirty-four years director of the Imperial Observatory at Wilhelmshaven.

THE Prince of Wales will attend the meeting of the Royal Geographical Society at the Albert Hall on June 28 for the reception of Lieut. E. H. Shackleton, and will present to Lieut. Shackleton the special gold medal awarded to him by the society.

THE Pharmaceutical Society has awarded the Hanbury gold medal to Prof. W. O. A. Tschirch, professor of pharmacognosy and practical chemistry at Berne University. The medal is awarded biennially for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs.

WE have been favoured with a copy of the *Sydney Daily Telegraph* of April 29, containing an interesting account of the inaugural meeting of the Aërial League of Australia, at which Mr. L. Hargreave, the inventor of the box kite, presided. The objects of the league are, among others, to watch the latest achievements in aërial engineering; to secure the best recognition for Australian efforts in that direction; and to awaken public attention to the danger in allowing foreign nations to excel in aërial navigation.

THE Constantinople correspondent of the *Times* reports that a proposal, brought before the Chamber of Deputies on June 12, for the adoption of the system of time-reckoning used in Europe, instead of the Turkish system of reckoning time from the hour of sunset, was carried, in spite of the opposition of the *hodjas* and many Anatolian deputies, by a considerable majority, including the Arabs. But the clerical minority in the Chamber has made such an uproar that the motion has since been withdrawn.

THE council of the Royal Institute of Public Health has awarded the Harben gold medal for eminent services to the public health to Prof. E. von Behring, Marburg. Lieut.-Colonel W. B. Leishman, professor of pathology, Royal Army Medical College, has been appointed the Harben lecturer for the year 1910, and Prof. Angelo Celli, Rome, the Harben lecturer for the year 1911. The Harben lectures for 1909 will be delivered by Prof. R. Pfeiffer, Breslau, in the lecture-room of the institute on June 21, 23, and 25. The subjects of the lectures will be:—the importance of bacteriolysins in immunity; endotoxins and anti-endotoxins; and the problem of virulence. The lectures will be given in English.

WE learn from *Science* that Mr. C. G. Abbot, director of the Smithsonian Astrophysical Observatory, has left Washington for Mount Wilson, California, to continue observations, in progress for a number of years, as to the intensity of the sun's rays and the effect of any variation in them upon the earth. There was recently erected on Mount Wilson a small permanent observatory especially designed for this purpose. Here Mr. Abbot, with the assistance of Dr. L. R. Ingersoll, of the University of Wisconsin, will study during the next few months. The expedition will also spend some time on the summit of Mount Whitney, 14,500 feet high, where the institution proposes to erect in July a shelter of stone and steel for the use of scientific investigators engaged in researches of any kind for which high altitudes, dry air, and clear skies are desirable.

THE famous Hope diamond was on view last week at Messrs. R. and S. Garrard's galleries, Haymarket, London, S.W. Its history has been romantic. It probably formed the larger half of the pear-shaped, Indian stone, which was stolen with the remainder of the French regalia at the time of the Revolution in 1792, and never recovered. In its present form it re-appeared in the collection of Henry Philip Hope, a wealthy banker. At his death it found its way to America, and last year, during the financial crisis, the owner disposed of it to M. Habib, a dealer, who was acting on behalf of the late Sultan of Turkey. Owing to the deposition of that monarch, the stone has come into the market once more. In the catalogue of the Hope collection it is described as of a sapphire-blue, but a slaty- or steely-blue would be more the correct description. It weighs 44½ carats, and is by far the largest blue diamond known.

A SEVERE earthquake was experienced at many places in southern France at about 9.15 p.m. on June 11. From a full report by the Paris correspondent of the *Times* it appears that the shock was felt all along the French Mediterranean shores. On the coast it was most violent at Marseilles and Toulon. At Nice and at Cannes a shock was experienced, but it was not severe. More or less slight shocks were felt through the south-east of France from Montpellier to Grenoble and from Perpignan to Avignon. Telegrams from the Italian Riviera, on the one hand, and from Portugal, on the other, show that the shock was felt in regions so widely apart as these. The region most seriously affected by the earthquake is between Aix-en-Provence, a town about twenty miles north of Marseilles, and the River Durance, the northern boundary of the department. The line of greatest destruction seems to run in a north-westerly direction from Aix through the villages of Saint-Cannat, Lambesc, and Rognes.

A SHORT account of the inauguration, on June 13, of the memorial to Lamarck, which has been erected in the Jardin des Plantes, is given by the Paris correspondent of the *Times* in the issue of June 14. The memorial was formally inaugurated in the presence of M. Fallières, and was committed to the charge of the French Government. It takes the form of a bronze figure of Lamarck seated in an attitude of meditation. Inscribed on the pedestal are the words, "To the founder of the doctrine of evolution." The *Times* says that in his speech M. Perrier

traced the various stages of the development of Lamarck's theory, its relation to the studies of Buffon, Linnæus, and Cuvier, and its influence upon Darwin. The present year is at once the hundredth anniversary of the publication of Lamarck's "Philosophie Zoologique" and of Darwin's birth, and in a striking passage M. Perrier drew a parallel between the Darwinian theory and Lamarck's doctrine of methodical progress on a basis of rigorous determinism. The Minister of Public Instruction contributed to the proceedings a sketch of Lamarck's career, referring to Buffon's sympathy and friendship and to Cuvier's sceptical hostility. In the name of the French Government, M. Doumergue thanked all who had helped France to make this tardy reparation to the memory of her great son.

THE launching of the magnetic survey yacht *Carnegie*, to the design and future work of which reference has been made more than once in these columns, took place on June 12 at the shipyard of the Tebo Yacht Basin Company, Brooklyn, N.Y. We have been favoured with an advance copy of an illustrated pamphlet dealing with the construction of the new boat, her object, and her work. The entire structure of the yacht is practically non-magnetic; with the exception of cast-iron pistons in the cylinders of the bronze internal-combustion engine, and the steel cams necessary for operating the valves, there are no magnetic materials in the vessel. It will be remembered that the function of the department of research in terrestrial magnetism of the Carnegie Institution of Washington is the accomplishment of a magnetic survey of the earth within a period of about fifteen years, and in connection with this scheme the magnetic survey of the oceans is assigned to the new yacht. This work will be done under the direction of Dr. L. A. Bauer, director of the department of terrestrial magnetism, and he will be represented on board the *Carnegie*, as chief of party, by Mr. W. J. Peters, who has great experience in such ocean surveying, gained when in command of the magnetic survey yacht *Galilee* from 1906–8. The *Galilee* has made a general magnetic survey of the Pacific Ocean, the total length of her cruises amounting to about 60,000 nautical miles. It is hoped that the *Carnegie* will effect a magnetic survey of the Atlantic Ocean and the Indian Ocean, and complete that of the Pacific.

WE have received a copy of a paper by Drs. Raymond Pearl and F. M. Surface, reprinted from the first volume of *Zeitschrift für biologische Technik*, Strassburg, 1909, and entitled "Apparate und Methoden, die bei experimentellen Untersuchungen über Vererbung beim Geflügel gebraucht werden."

THE Insectivora of the subfamily Gymnurinæ form the subject of a paper by Mr. M. W. Lyon, published as No. 1680 (vol. xxxvi., pp. 449–56) of the Proceedings of the U.S. National Museum. The author admits the distinction of the Bornean *Gymnura alba* from the typical *G. rafflesi* (or *G. gymnura*), and also describes a new and small race of the latter from Siam. The distinctive skull-characters of the allied genera Hylomys and Podogymnura, the latter at present known only by a single specimen from the Philippines, are likewise pointed out.

THE May number of the *Museums Journal* contains an account, by Mr. R. T. Baker, the curator, of the Technological Museum at Sydney. The building, which was opened in 1893, contains considerably more than 150,000 specimens, and the establishment serves the purpose of a bureau of information in regard to the raw products and manufactures of New South Wales. When inquiries cannot be answered by the museum staff, visitors are referred to other sources of information.

IN vol. xliv., No. 23, of the Proceedings of the American Academy of Arts and Sciences, Mr. S. Morgulis describes the capacity for regeneration possessed by one of the brittle-stars (*Ophiocoma pumila*), with special reference to the influence of the central nervous system. Although the author's experiments do not altogether support the theory that the rate of regeneration of a removed arm increases as the number of uninjured arms still remaining is diminished, it is, nevertheless, evident that there is some correlation between the degree of injury and the rate of regeneration, but this relation does not take the shape of the close parallelism suggested in the above-mentioned theory.

AN account of the myxomycetes of Pictou County, Nova Scotia, by Mr. C. L. Moore, published in the Transactions of the Nova Scotia Institute of Science (vol. xii., part ii.), furnishes a noteworthy addition to the information on this little-studied group of fungi, as well as an interesting contribution to the flora of the country. In the latter respect, the diagnoses of the groups, genera and species will be found useful. One specimen, collected on *Tsuga canadensis*, is made the type of a new species, *Margarita pictoviana*. *Dictydium cancellatum* is stated to be the most general species, and others commonly found are *Fuligo ovata*, *Didymium melanospermum*, *Arcyria nutans*, *Arcyria incarnata*, and *Lycogala epidendrum*.

THE Nyctaginaceæ provides an eminently fitting subject for the Contributions of the United States National Herbarium (vol. xii., part viii.), as the family is very largely American, and the group Mirabilieæ is essentially characteristic of Mexico and the adjacent southern States. This group is monographed by Mr. P. C. Standley, who adopts Allioniaceæ as the family name. The changes and additions submitted are very extensive. About twenty new species are proposed for the genus Abronia, from which the section Tripterocalyx is separated as a genus. Allionia, based on the species *Allionia violacea*, is converted into a large genus, partly by the inclusion of species of Oxybaphus and partly by additional new species. Mirabilis is reduced to four species, while Quamoclidion becomes a genus; similarly, Boerhaavia is split into four genera.

THE beautiful autumnal tints characteristic of the foliage of certain trees and shrubs, so pronounced in temperate countries, are, of course, due to seasonal variations, the factors concerned being diminution of water, stronger insolation, and the advent of cold nights; also, the more marked the changes the more striking, as a rule, are the colour tones. In a short article in the Journal of the College of Science (vol. xxvii., art. 2), Tokio University, Dr. M. Miyoshi refers to a similar colour effect observed during the dry period in the leaves of the tropical tree *Terminalia catappa*. Here it is confined to the old leaves, while the younger leaves show their normal green colour, and is due to drying up of the leaves owing to the formation of an abscis layer. In both cases the colour is produced by the formation of anthocyanin.

DR. GRASSET publishes in the May number of *La Revue des Idées* an elaborate article entitled "La Physiopathologie clinique de l'Homme, Plan d'une Pathologie générale basée sur la Physiologie." The "circle of life" starts with general embryology and heredity, and passes on in succession to "fonctions de réception" (digestion and respiration); "fonctions de circulation de la matière"

(blood and lymph); "fonctions de l'élaboration" (nutrition); "fonctions d'élimination de la matière" (external secretions); "fonctions de calorification" (production, transformation, and elimination of heat); "fonctions de réception, élaboration, et élimination de l'énergie"; "fonctions antixéniques" (protection of the organism against what is noxious in the environment); and, finally, "fonctions de reproduction." The scheme is certainly ingenious, and gives a good illustration of the methods of logical analysis for which science in many of its departments is so largely indebted to the savants of France.

IN *Naturwissenschaftliche Wochenschrift* for May 23 Dr. Ludwig Reinhardt gives an illustrated account of a human skeleton discovered on April 10, 1908, in the well-known cavern of Le Moustier, in the Dordogne, in a stratum lying some 30 feet below the one worked years ago by Lartet and Christy. The latter stratum is assigned to the Neanderthal period, but the new "find," from the evidence of the associated implements, is identified with the earlier Acheuleën (St. Acheul) epoch. An age of some 400,000 years is assigned to the deposit in question, which belongs to the penultimate inter-Glacial epoch; the Le Moustier hunter, for whom the name *Homo mousteriensis hauseri* has been proposed by Prof. Klaatsch, representing the oldest human skeleton at present known. The skull was greatly damaged when discovered, but has been carefully pieced together, while the bones of the skeleton have been freed from matrix and placed in their proper positions. The remains indicate a young man of between sixteen and eighteen years of age. The limb-bones are relatively short and thick, the cranial portion of the skull is markedly receding, while the jaws are very protruding, after a fashion occasionally met with among modern Australians. Associated with the ape-like muzzle is an extremely powerful dentition, the individual teeth having much stouter roots and more enamel-folds than in any living race. Among other characters of the skull, it must suffice to mention the large size and wide separation of the orbits, and the broad and deeply sunk root of the nasals, the latter feature indicating a wide and flattened nose, with the nostrils directed mainly forwards. Whether the shape of the skull has been altered by the restoration has to be taken into consideration.

IN the third Bulletin of the Archæological Survey of Nubia Dr. G. A. Reisner describes the excavations conducted up to the close of 1908, and Drs. G. Elliot Smith and Douglas E. Derry review the anatomical results. The excavations supply further evidence in support of the views advocated in the previous reports. In pre-dynastic times, and up to the third Egyptian dynasty, this part of Egypt and Nubia formed a territory occupied by a homogeneous race which was Egyptian, and not Nubian, in physical type and culture. This disposes of the theory that the archaic Egyptians contained a strong negro element. Since the rise of the third dynasty there has been a continuous intermixture of Egyptian and negro strains. Negroes seem to have moved north when the seat of Egyptian government was moved from Upper to Lower Egypt, and the hold of the Empire upon Nubia was probably relaxed. After that time both races were reinforced by fresh emigrants, but the fusion was gradual and continucus. In the time of the New Empire, doubtless owing to Hyksos domination, refugees flocked southwards and formed connections with Nubian women, individuals of both races of different sexes being found in the same grave. The question of the existence of tuberculosis in ancient times is again raised by Dr. Derry. The case reported in the first bulletin was discredited, but since then the body of a priest of Amen belonging to the twenty-first dynasty, found at Thebes, shows angular curvature of the spine and a psoas abscess, which are diagnosed as evidence of Pott's disease. If the disease prevailed at Thebes in the New Empire, it is not improbable that the Nubian cases of the Middle Empire may be of a similar character.

THE *Bolletino della Società Sismologica*, vol. xiii., No. 4, contains an important paper, by Prof. Grablovitz, on the secondary oscillations recorded by the tide-gauge at Ischia. The period of these is found to have varied considerably during the last nineteen years, from a maximum of 14m. 19s. in 1892 to a minimum of 11m. 55s. in 1908; as a rule, the variation is slow, and the period remains constant for a considerable time, but at times it changes rapidly. During 1897, for instance, the period fell from 13m. 45s. to 12m. 34s., and in 1902 it dropped from 14·1m. on January 8 to 13·2m. on March 30, rose again to 14·1m. on April 26, fell to 13·0m. on May 14, and rose again to 14·3m. by May 27. Accepting the explanation that the period of these secondary undulations is the natural period of oscillation of the water, and is, consequently, a function of the dimensions of the basin, he shows that, as there has been no known alteration of the coast-line adequate to account for the observed variation in period, this explanation necessitates the assumption of variations in depth. Some facts are quoted which show that such changes may well have occurred, but it is also pointed out that the variations in period may be directly connected with the action of the exciting cause, and not entirely determined by resonance.

THE report of the Southport Meteorological Observatory for the year 1908 has been received. This station occupies an important position in the Irish Sea, and is kept in great instrumental efficiency by the Corporation, the practice being to employ continuously two self-recording instruments for each of the principal elements. The observatory also maintains two subsidiary stations—Marshside, a mile to the N.N.E., for additional anemometrical observations, and an evaporation station at Barton Moss, about 5½ miles to the S.S.W. Regarded as a whole, the year was decidedly warm and the rainfall normal (32½ inches); there was a predominance of south-easterly winds quite unequalled in any other of the thirty-seven years over which the record extends. The report includes a useful comparison of sunshine and other climatological statistics at sixty-three health resorts and large towns, all of which have been checked by either the Meteorological Office or the Royal Meteorological Society.

THE *Revue générale des Sciences* of May 15 contains an important article, by Prof. B. Brunhes, on "The Evolution of Barometric Depressions and M. Guilbert's Rules for Weather Prediction," illustrated by weather charts. The article is, in fact, the preface to a work which is about to be published by M. Guilbert entitled "New Method of Weather Forecasting." Eighteen years ago M. Guilbert, who is now secretary of the meteorological commission of the department of Calvados, communicated certain rules to the Meteorological Society of France; these have since been developed, and have attracted more general attention in consequence of his success at the international competition in weather forecasting in connection with the exhibition at Liége in 1905. The rules have since appeared in several meteorological periodicals, including the *U.S. Monthly*

Weather Review, and the method was referred to by Dr. Shaw at the British Association meeting of 1907, who explained that it "depends upon the comparison of the actual winds, as recorded on the map, with ideal or normal winds as computed from the distance apart of the consecutive isobars." Prof. Brunhes discusses at great length both the rules and the objections that have been raised against them. He thinks the principal questions now are:—(1) whether the method of forecasting, which in the hands of M. Guilbert gives such surprising results, can be formulated in a way which may obviate objections to his exposition; and (2) whether the principles can be so enunciated that other meteorologists may attain the same success. To the first question he gives a decided affirmative, but to the second the reply is more reserved; the publication of the work, which has been urged by M. Teisserenc de Bort and himself, is an effort to hasten the solution of these questions.

WE have received a new catalogue of physical and electrical instruments, balances, &c., from Messrs. W. G. Pye and Co., of Granta Works, Cambridge. We note that a considerable number of pieces of apparatus have been designed by Mr. G. F. C. Searle, F.R.S., of Cambridge. This kind of cooperation between the maker and user of scientific apparatus is much needed, and will, we believe, result in a great improvement in the utility and accuracy of the instruments made in this country.

THE question whether intermolecular radiation would account for any appreciable fraction of the heat transmitted through a metal owing to temperature differences existent in it has often been discussed. Several years ago Riecke showed that the part contributed by radiation must be excessively small. His calculations were, however, based on an equation given first by Sampson and afterwards by Schuster, which Königsberger showed was not accurate. In the *Physikalische Zeitschrift* for May 15 Dr. M. Reinganum takes up the question again, and, basing his investigation on the radiation work of Planck and on the law that the intensity of radiation in a medium of index of refraction n is n^2 times that in the ether in equilibrium with it, he arrives at the conclusion that in silver and in zinc radiation will not account for more than one-millionth part of the heat transmitted. In alloys it is still far below the order of magnitude of the conduction. In all electron theories of conduction it may therefore be entirely neglected.

EASEMENT curves form the subject of an interesting article, by Prof. R. H. Smith, in the *Engineer* for June 4. The term "easement" indicates a curve which can be turned without damaging collision, without the fury of whirlpool motion in fluids or of hard knocks between solid members. Within elastic limits, a heavy stress steadily maintained does no harm. The damaging intensity of a blow is proportional to the time rate at which the stress increases. When the stress is produced by curvature in the motion path, the author shows that the intensity of the radial shock is proportional to the product of the cube of the velocity and the rate of change of the curvature with respect to length measured along the path. In proportion as the cube of the velocity is high, the rate of change of curvature should be low. Hence the importance of examining different forms of easement curves in respect of this purely geometric characteristic. The author discusses mathematically curves shaped to the equation $y=Kx^m$, where m is any index. The time rate of increase of radial stress should be little or nothing at first, and should gradually increase up to the unavoidable amount. It starts with zero if m be anything greater than 3, but the most satisfactory result is not obtained with m less than 4. Of all this class of easement curves, the biquadratic parabola is the best.

IN several notices and reviews it has been pointed out that the experimental study of flow of air past resisting bodies not only was of importance in connection with aviation, but might also have valuable applications to the problem of dust formation in the wake of motor-cars. At that time it was not known to the writer of the notices that the matter was receiving attention. A paper by Mr. W. R. Cooper, read before the Royal Automobile Club on May 18, shows that automobilists have not been so behindhand in appreciating scientific methods as was supposed. Indeed, experiments involving photography of dust clouds were described in the Automobile Club Journal so far back as December, 1905, and an account of them appeared in NATURE. Mr. Cooper now describes a recording apparatus with which he has studied the direction of the stream lines in the neighbourhood of the car. It consists essentially of a small vane at the end of a bamboo rod, which can be moved about behind or in front of the car, the vane being connected by pulleys with a pointer inside the car. An apparatus for measuring air pressures is also described. Mr. Cooper is to be congratulated on the progress he has made, and though there are still many difficulties to be overcome, there is no doubt about the practical value of these researches.

AN American edition of Mr. R. C. Punnett's little book on Mendelism has been published by the Wilshire Book Co., of New York. The new edition is provided with a preface by Mr. Gaylord Wilshire, in which he deals with the sociological significance of the Mendelian theory.

MESSRS. MACMILLAN AND CO., LTD., now publish the well-known book by the late Prof. A. Milnes Marshall, F.R.S., on "The Frog." The volume, which, it will be remembered, is an introduction to anatomy, histology, and embryology, has been edited by Dr. F. W. Gamble, F.R.S., and has now reached its tenth edition.

A CATALOGUE of books on astronomy, mathematics, and physics, consisting mainly of important works purchased recently from several private libraries, has just been issued by Mr. Bernard Quaritch, 11 Grafton Street, New Bond Street. The price of the catalogue is one shilling.

DURING the seventh International Congress of Applied Chemistry, held recently in London, photographs of fourteen groups of the various sections were taken by the Dover Street Studios. Prints of these groups have been sent to us, and one of them, reproduced in a reduced form, accompanies the general article upon the scientific proceedings of the congress which appears elsewhere in this issue. We are informed that the photographs are to be published in complete album form at the price of four guineas, or they may be had separately.

A SECOND edition of "Sanitary Law and Practice: a Handbook for Students of Public Health and Others," by Drs. W. Robertson and Charles Porter, has been published by the Sanitary Publishing Co., Ltd. The original issue of the work was reviewed in NATURE of June 1, 1905 (vol. lxxii., p. 97), and it is sufficient to state here that much new matter has been added to the volume, and the former text completely revised and in many instances re-written. Among the new sections, those on school medical inspection and vital statistics may be mentioned. The size of the print has been reduced slightly, and the price remains at 10*s.* 6*d.* net.

OUR ASTRONOMICAL COLUMN.

THE ENSUING RETURN OF THE PERSEID METEORS.—The season especially favourable for the observation of meteors may be said to commence in July, and after the full moon of July 3 of the present year the sky will begin to exhibit a marked increase of meteoric activity. The Perseids, Aquarids, and many other showers give evidence of their presence at about the middle of July, and afford an abundance of material to the vigilant student until about the third week in August.

It is true that the great, annually visible stream of Perseids has been already fairly well watched, but it seems likely that we shall have to accumulate data for several future centuries before our knowledge of the system may be regarded as pretty complete and satisfactory. We do not know the period of revolution of the parent comet and of that particular region of the meteoric group where the particles are collected most abundantly, nor have we learnt the precise nature of the variations affecting the annual returns of the shower. The different conditions occurring every year in regard to the weather, moonlight, &c., render it extremely difficult to form correct conclusions as to the strength of the region encountered at successive returns.

During the forthcoming display it is to be hoped that observers will record the apparent paths of all the brighter meteors they may observe, for the computation of the real paths of these objects is very important.

THE SOLAR PARALLAX, FROM OBSERVATIONS OF EROS.—A preliminary account of the results obtained from the observation of Eros, at Mount Hamilton, for the determination of the solar parallax, is given by Prof. Perrine in No. 150 of the Lick Observatory Bulletins. The observations were made during the latter part of 1900, and the full discussion is reserved for publication by the Carnegie Institution of Washington.

The solutions of 126 equations, giving the correction to the assumed value of the parallax, 8·80″, are given, and the various methods of weighting the means discussed. Finally, the value 8·8067″ ±0·0025″ is adopted as the result.

Comparing the results of a long series of daily meridian observations with the ephemeris, an apparent periodicity of the residuals is exhibited, the double amplitude of the variation being 0·05s., and the period about nine days; this periodicity is not accounted for by the effect of any known bodies, but there appears to be some relation to the period of light variation of Eros during the opposition of 1900–1. For a further discussion it will be necessary to have brightness observations of Eros made at the same times as the position observations, but it is thought that, even should this periodic inequality be found to be real, the final value will be but little affected.

A DOUBLE-IMAGE CŒLOSTAT FOR DETERMINING THE MOON'S POSITION.—In No. 2016 of NATURE (June 18, 1908, vol. lxxviii., p. 152) Prof. Boys described an apparatus, designed by Mr. Wade, of the Egyptian Survey Department, for the field determination of longitude, the moon's position being known.

Mr. Wade has now adapted his apparatus so that it may be used for the inverse problem, viz. the determination of the moon's position when the longitude is known, and a lecture in which he described the modified instrument appears in No. 30, vol. iii., of the *Cairo Scientific Journal* (March, p. 64).

The two mirrors of the former instrument are combined in a cœlostat mirror, on which two distinct faces are figured, the one to reflect the moon's image, the other to reflect the images of the reference stars. The instrument having been adapted for photographic observations, the difficulties of the moon's relative brilliance and differential motion among the stars had to be obviated, and this has been done by the interposition of an especially designed prism before that half of the camera objective which forms the lunar image. This prism reduces the brightness of the image, and, when rotated by a handle at a uniform rate, corrects the moon's motion to stellar rate. Thus photographs are obtained showing a properly exposed lunar image among a number of star images, and it only remains to measure the positions of the moon's centre, or a well-marked crater, and the stars. A number of difficulties and devices are explained in Mr. Wade's paper, but cannot be given in a brief note.

THE DETERMINATION OF THE SOLAR CONSTANT.—In No. 4, vol. xxix., of the *Astrophysical Journal*, Messrs. Abbot and Fowle, jun., discuss a number of improvements and new results in solar-constant determinations.

Among other results is a new value for the effective solar temperature, which Mr. L. B. Aldrich computed from the previously published results, by Goldhammer's process, and found to be 6200° absolute. In the previous results, published by the Smithsonian observers, allowance was made for the extreme regions of the spectrum not observable by them, and recent research indicates that the corrections then applied were all too small. By employing a quartz prism and magnalium mirrors, it is hoped to settle this point definitely in future researches.

Another new point, arising from a comparison of the 1908 and 1906 results, is the suggestion that in 1908 the intensity of the ultra-violet rays in sunlight, as compared with that of the red rays, was less than in August, 1906; the proposed new outfit should enable the question of the reality of this apparent variation to be settled definitely. The "solar constants" for the two epochs indicate no such variation in the total emission.

Pyrheliometric experiments during 1908 gave a correction to the unit of energy previously employed which entails a lowering of the 1902–6 "solar constant" values by 7·6 per cent., whilst the correction for the unobserved infra-red and ultra-violet radiations would raise them about 10 per cent.

THE WELSH GORSEDD.

THE ritual of the present-day Welsh Gorsedd, while it attracts the curious crowd, arouses the indignation of many sober-minded nationalists, who deplore the tendency to "popery" so manifest in their fellows. But while these good people remain outside the mystic circle to rail and storm, every effort to persuade the bards to give up the Gorsedd and its ceremonies has been unavailing. The Gorsedd of the bards has grown year by year in its influence upon the life of the nation until it has become the centre of authority for holding the only truly national assembly of the Welsh people—the National Eisteddfod.

The bards, however, have done very little to satisfy the curious or to appease the indignant by a rational explanation of their doings, with the result that in certain quarters judgment has gone against them by default.

Perhaps the most serious effort to show them the evil of their ways was that of Prof. J. Morris Jones, of Bangor, during 1896. In a series of articles published in *Cymru* of that year he deplores the spirit of formalism that is on the increase in the "world and Church," and avows that it is "full time for the country to understand more plainly the true history of the Gorsedd" and the "fiction and deceit upon which its claims are based." The articles are five in number, and it must be admitted that they are a masterly contribution to the history of Gorseddic literature of modern times; since they appeared they have been considered as containing the last word on the antiquity of the Gorsedd, and as the author holds a position among the highest authorities on the poetry and language of Wales, it is in the nature of things that the results of his investigation of this subject should carry great weight. That this is actually so we will quote a paragraph from a very important book on Welsh history in general, "The Welsh People," by Sir John Rhys and D. Brynmor Jones. In chapter xii. of that book, dealing with the "language and literature" of Wales, an allusion is made to the Eisteddfod, and a quotation is given from the "Laws of Howel Dda" concerning the ceremony of chairing the bard. In a footnote relating to this quotation the following comment is made:—"We abstain from saying anything about the 'Gorsedd' as its antiquity is contested. See *Cymru* for 1896, where the reader will find several articles on the subject by Prof. J. Morris Jones, whom we have to thank for calling our attention to the passage

concerning the Chair Contest" (third edition, 517). This statement is repeated in the fourth edition, 1906. This is the only reference to the Gorsedd in the whole of that work. To cause the learned authors of that book to become suddenly cautious on a matter of so great an interest to Welsh people as the Bardic Gorsedd, and that in the course of an allusion to the Eisteddfod, is a fine tribute to the authority of Prof. J. Morris Jones, but to "abstain from saying anything concerning the Gorsedd" throughout a book dealing with purely Welsh history and institutions, more than is contained in a footnote, is, it seems to us, to force deference to the critic almost to breaking point.

Our object is not to minimise the value of these articles; their value as a contribution to the history of post-Reformation MSS. no one can deny or destroy. Our desire is simply to direct attention to the fact that they deal with the Gorsedd history from the sixteenth century onwards, and that it is only in a qualified sense it can be said that they are an examination of the antiquity of the Gorsedd itself. They are being constantly referred to as contesting the antiquity of the Gorsedd; what they actually deal with is the modernity of the bards' connection with the Gorsedd. The antiquity of the Gorsedd itself they do not touch but in so far as they teach us to look beyond modern bardism for that antiquity.

The only reason why the Gorseddites have not given an effective answer to these articles hitherto is that they had no argument—they lacked an effective weapon. There are gaps in the history of the Gorsedd which the historian has failed to bridge. The astro-archæologist, however, has come to the rescue. An effective weapon has at last been forged, or, to change the metaphor, an antidote has been discovered to neutralise the baneful effect of the dose administered by Prof. J. Morris Jones to Gorsedd enthusiasts. The Gorsedd has been invested with new interest since Sir Norman Lockyer gave to the world the theory upon which ancient stone circles were constructed. It is only now, bearing that theory in mind, that the proper value can be assigned to these articles, and also to much other Welsh literature bearing upon the Gorsedd.

The object of these articles was to show that the Gorsedd of to-day was the creation of the bards of Glamorgan of the sixteenth century. In the first article the reader is asked to bear in mind the following statements. We give full quotations, because they indicate what the author has set out to prove; they also show that the author does not particularise between the terms "Gorsedd" and "*Gorsedd Beirdd Ynys Prydain*" (the Gorsedd of the bards of the Isle of Britain).

"(1) It was in Glamorganshire, *after* the middle of the sixteenth century, that every one of the manuscripts which mention the Gorsedd was written.

"(2) In all manuscripts written before that time throughout Wales, not a word is mentioned of such a thing as the Gorsedd of the bards of the Isle of Britain. Mr. Gwenogfryn Evans has examined hundreds of these older manuscripts, and has failed to observe so much as the name of the Gorsedd in one of them."

The author finds evidence in the Gorseddic literature of this period that the bards "poached" the laws of Howel Dda for rules and regulations to be applied to the institution they were setting up; and in his remarks on these laws we see again the want of distinction between "Gorsedd" and "Gorsedd of the Bards." He says:—"Not one of the three books of law, neither does one of the thirty-one editors, mention anything of the Gorsedd of the Bards. These books treat minutely of every aspect of Welsh life in those ages, from the ceremonies of the Princes' Courts to the marketable value of a wooden spade; they relate much of bards, of the office and place of every grade of bard and the gift that was due to him for his song; and of the different Gorsedds: Gorsedd of assembly (*dygynnull*); Lord's Gorsedd; Bishop's Gorsedd; Abbot's Gorsedd; but though mention is made of bards and of Gorsedds, Gorsedd of the Bards is not suggested."

When the writer says that no mention is made of "Gorsedd" in the whole range of Welsh literature, including the *Mabinogion* and the "Laws," we infer that he means to say that these ancient MSS. do not contain reference to "Gorsedd of the Bards" as such. Seeing that the word "Gorsedd" does occur in the *Mabinogion* and in the "Laws," we deplore the fact that the author does not give a philological analysis of the word and let us know what it meant before the bards appropriated it as a name for their stone circle. It is quite evident, even from the author's own words, that the modern bards did not coin the name, but borrowed the name and the idea from antiquity.

Space will not allow us to give an account of the author's examination of the Gorseddic literature from the fifteenth century onwards. It is not to our purpose, and in the main his judgment concerning the value of these MSS. will stand the test of time, and we accept them at his valuation. They "increased," we are told, as a result of a quarrel between bards at the Carmarthen Eisteddfod of 1451. The bards of Glamorgan from that year sought to set up an institution in opposition to the former assembly of the Welsh bards, and soon after began to call it a Gorsedd. The first document cited by the author containing reference to the new heresy is a collection of Triads by Rhisiart Iorwerth, who flourished *circa* 1510. Then is passed under review a series of MSS., beginning with the collection of Iolo Morganwg (who died in 1826) onward to the middle of the last century. Of the claims made by the bards to the antiquity of the traditions contained in these documents the author makes ridicule as a story worthy only of repetition to the "marines."

When we admit, without reserve as we do, that the author has in these articles given a masterly account of the connection of modern bards with the modern Gorsedd, we strike the sum total of the value of these articles as a contribution to the history of the Gorsedd. He has led us back to the beginning of the sixteenth century by documentary evidence, and if his statement of the bardic quarrel is correct, we arrive at the middle of the fifteenth; but he has done more. By playing the gamekeeper on the bards of the fifteenth and sixteenth centuries we must follow him to their "poaching" ground, and find that we have travelled backwards at least 600 years.

As we have to thank the bards of modern times for reviving and restoring the Gorsedd even when they appropriate it for their own use, we have also to thank Prof. J. Morris Jones for leading us to the source of their inspiration as to its rules and regulations. This source, or quarry, is the Laws of Howel Dda. The Gorsedd rules, the author tells us, were taken mostly from the sections of the Laws regulating the court of "landed property."

Most authorities agree that these Laws were compiled in the tenth century (E. Llwyd gives 940, Taylor 942, Wotton 943, Rhys and Jones 942–3). The authors of "The Welsh People" say of the authenticity of the copies we now possess:—"There is no reason for not carrying back the first setting down in writing of the Welsh customs to the time of Howel Dda. Nor is there any real doubt that these bodies of law consist of custumals which were once in actual operation" (third edition, 185).

The following quotations are taken from the "Venedotian Code," the oldest of the "Three Books of the Law" (from "Ancient Laws and Institutions of Wales," Commission Records, 1841, A. Owen).

"XI. Here begin the laws concerning landed property and the form of pleading in respect thereto.

"(1) Twice the law shall be open for landed property, and twice it shall be closed.

"(2) From the ninth of the calends of winter (Kalangayaf) it shall be open until the ninth day of February.

"(3) From the ninth day of February the law shall be closed until the ninth day of May.

"(4) From the ninth day of May the law shall be open until the ninth day of August.

"(5) From the ninth day of August the law shall be closed until the ninth day of the calends of winter.

"(6) The reason why the law shall be closed in autumn and spring is because the land is cultivated during these two periods: lest ploughing in the spring and reaping in autumn be impeded.

"(7) The cause why it is right for the law to be closed for nine days after the calends of winter, and nine days after the feast of St. Bridget to be open: is to avoid closing the law on one day: and the same manner, nine days after the calends of May to be closed, and nine days after August (footnote, the 'Calends of August') to be open: to avoid opening the law on one day likewise.

"(8) Whoever willeth to institute a suit for landed property let him do it when he will, from the ninth of the calends of winter forwards, or from the ninth of May, because those are the times the law is open for landed property."

Anyone conversant with the evidence given in Sir Norman Lockyer's "Stonehenge" as to the May-August-November-February arrangement of the year that once prevailed in this country, and the articles in NATURE by the Rev. John Griffith, of Llangynnwyd, showing that the Gorsedd of the Welsh bards is a May-November stone circle, will not fail to appreciate the confirmatory evidence contained in the above quotations from the Laws of the tenth century. It is conclusive proof, we take it, that the May-November year was the only division of time recognised for legal purposes at the time of Howel Dda. It must be remembered, also, that there is no evidence to show that these Laws were creations of the tenth century, but simply records of customs from time immemorial.

While the Venedotian Code of the Laws gives the May-November division complete, the Demetian and Gwentian Codes, which are of slightly later date, in one or two instances mention solstitial dates as the proper time to "plead." For instance, the Demetian Code has:—"There are two days, that is, the ninth of December and the ninth day of May, whereon it is right to commence proceedings as to the inheritance of land by kin," &c. The bardic literature of the sixteenth century onward, discussed by Prof. J. Morris Jones, mentions only the solstices and equinoxes as the proper times to hold Gorsedd meetings.

Did the bards have access only to the later codes, and therefrom take their Gorseddic instructions? The Rev. John Griffith in NATURE, May 2, 1907, directed attention to the interesting fact that the plan of the May-November Welsh Gorsedd preserved by Iolo Morganwg was accompanied by instructions applicable only to a solstitial Gorsedd. The full history of this plan has not yet been found out, but we would suggest that the solstitial instructions became attached to the May-November plan by quarrying in the wrong sections of the Laws. The Venedotian Code contains the instructions proper for holding a May-November Gorsedd; they correspond with the stone-circle plan preserved by the bards, while the bards have failed to preserve a stone circle to correspond with the solstitial instructions.

Sir Norman Lockyer found evidence at Stonehenge that the solstitial replaced the earlier May-November cult, and in Welsh bardic traditions we have to this day evidence of this struggle. We have references to the solstitial and the May-November years. They seem to have got mixed up by the blunderings of the bards. The Gorsedd plan as preserved, and followed this week in London by the Welsh bards, and the corresponding enactments of Howel Dda's Laws, especially the Venedotian Code, represent the older arrangement, while the several references in the Welsh Triads to Stonehenge as one of the mighty deeds of the Cymry, the solstitial instructions about holding a Gorsedd, and the great desire of present-day leading Gorseddites to hold a meeting at Stonehenge, represent the newer arrangement that prevailed until the coming of the Julian year.

While we have no excuse to offer for the present-day ritual of the Gorsedd, we would plead for a re-consideration of the whole question in the light of recent discoveries. The Welsh bards have been "guilty" of saving an obsolete institution from oblivion. The control of bards was, perhaps, only one function belonging to the Gorsedd of ancient times. Long before the fifteenth century all its functions, except the control of the bards, had been taken over by the secular and ecclesiastical administrative courts of England and Wales. In the records of the tenth century there were at least four Gorsedds, suggestive of peculiar administrative power, and on the analogy of the development of institutions in every country it does not require a very great effort of the imagination to see that in the long ago in this country there was but one Gorsedd, from which emanated the directing influence of a whole people.

W. GRIFFITH.

SCIENTIFIC WORK OF THE INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

IN reviewing the general nature of the papers communicated to the seventh International Congress of Applied Chemistry it may be observed that the tendency has been to discuss matters relating to the general improvement in the various chemical industries during recent years rather than to contribute the results of original researches. By far the greatest number of original papers before the congress were read in the section for organic chemistry, but the official order of the sections is here maintained.

In the section for analytical chemistry much stress was laid by various speakers on the general classification of the purity of marketable chemical reagents. Thus Dr. J. T. Baker proposed that all chemicals should be sold with a label stating the percentage of impurity present. The term "chemically pure" was described as liable to lead to confusion, since absolute purity is in all cases impracticable. The General Chemical Company of New York communicated improved methods for the estimation of small amounts of arsenic existing as impurity in sulphur and sulphuric acid. Messrs. Gardner and Hodgson described a method for the rapid estimation of phenols, based upon the action of iodine upon this class of substances. Prof. Chesneau gave an account of his work on the estimation of phosphorus in iron and steel, which indicated that the phosphorus is completely precipitated as ammonium phosphomolybdate only under definite conditions of concentration of the reacting substances, and that this precipitate, which is not a chemical compound, but a definite mixture of ammonium phosphomolybdate and molybdate, should in all cases be washed only with pure water. Papers on the estimation of creatinine were communicated by Mr. F. C. Cook and by Mr. A. C. Chapman. The effect of the creatinine in alkaline solution is to cause reduction of the picric acid to picramic acid, and errors of analysis are liable to be produced by the excessive reduction of the picric acid to colourless tri-amido phenol. A new form of electrode for electrolytic determination of metals was advocated by Mr. J. W. Turrentine. This was composed of graphite which had been impregnated with paraffin wax, and gave results as accurate as those obtained by the use of platinum electrodes.

In the section for inorganic chemistry Dr. Forster Morley read a paper recommending authors to index all communications to scientific journals according to the system employed for the International Catalogue of Scientific Literature. This procedure would considerably lighten the labour of the regional bureaux. Papers on the decomposition of Portland cement by sea-water were read by Prof. Le Chatelier and by M. J. Bied. It was shown that the stability of cements towards sea-water is increased by the addition of puzzuolana. A review of the chemical nature of puzzuolana was contributed by M. R. Feret. Dr. George Harker gave an account of the methods of fire extinction in ships and enclosed spaces by means of flue-gas.

In the section for mining and metallurgy the greater portion of the communications dealt with purely technical points. Mr. C. W. Bannister reviewed the processes for extraction of zinc from its ores, and discussed the losses of this metal during distillation, recommending the employment of carbonaceous filters to prevent the admission of oxygen and to prevent the condensation of lead vapour with the zinc. Prof. R. Schelle described the production of pure tellurium from its ores. The finely powdered ore was fused with soda and sulphur, with formation of the sodium sulphide compound of tellurium. On treatment of the aqueous solution of this compound with sodium sulphite, a grey precipitate of the pure metal was produced. M. C. F. Jarl gave an account of the quarrying

of cryolite, which occurs in quantity only in south-west Greenland. After a rough hand-picking, the mineral is shipped to Copenhagen, where it is purified. It is at present employed as a constituent of a leadless glaze and for the electrolytic production of aluminium. Dr. C. H. Desch read a paper on eutectic alloys, and discussed the suggested method for predicting the position of the eutectic point. Flavitzky's rule was shown to rest upon an insufficient theoretical basis.

In the section for organic chemistry the great majority of the papers read were of importance in their technical bearing, but a certain number dealt with subjects of theoretical interest. On Friday, May 28, all the papers read related to hydrocarbons and their simple derivatives. Dr. M. Z. Jovitchitch communicated the results of his experiments on the action of the silent electric discharge on ethylene and acetylene. The remarkable statement was made that in all cases the analyses of the total resultant products showed a deficiency in carbon, always above 10 per cent. and often so great as 20 per cent. Moreover, when these products were allowed to stand in open vessels the carbon content was observed to rise, sometimes to the extent of 5 per cent. These substances were found to fog photographic plates through the dark-slide, and were therefore considered to be radio-active.

Dr. Gustav Koller gave an account of the chlorohydrocarbons produced by the action of chlorine on acetylene under the influence of ultra-violet light. The utility of these substances as non-inflammable and non-explosive solvents for fat extraction and other purposes was emphasised.

On Saturday, May 29, the communications in the section for organic chemistry dealt with the chemistry of naturally occurring hydrocarbons, such as the terpenes, with cellulose, and with the synthesis of alcohols. With regard to the chemistry of cellulose, Prof. Wichelhaus described the formation of pure phenol during the destructive distillation of cellulose, no other phenols being detected. In reference to the mercerisation of cotton, Dr. Vieweg dealt with the action of cuprammonium solutions on cotton cloth. The mercerising effect was found to decrease with rise of temperature. Dr. Hübner stated that caustic soda lye of specific gravity 45° Twaddell caused the maximum degree of mercerisation. Prof. Knecht gave an account of the action of certain dicarboxylic acids on cellulose. When cellulose is treated with oxalic acid, formyl cellulose is produced by loss of carbonic acid. Similarly, malonic acid and its derivatives yield acetyl cellulose and the corresponding acyl derivatives of cellulose. With succinic and glutaric acids this effect is not produced.

On Monday morning, May 31, the subjects under discussion in the section of organic chemistry were colloids, fatty acids, &c., paints and varnishes. Mr. H. R. Procter discussed the structure of organic jellies, advocating the view that jellies consist of a solid solution of the solvent in a network of colloid molecules. Doubt is cast upon the justice of a distinction between colloidal and "true" solutions, the difference depending merely upon the size of the molecules or molecular aggregates. Prof. Haller, of the Sorbonne, read a paper on the alcoholysis of certain esters. The esters, on being heated with a 1 per cent. solution of hydrochloric acid in methyl alcohol, were quantitatively converted into the corresponding methy esters. This method was found to be especially applicable to the case of fats, glycerine and the methyl ester of the fatty acid being produced. In another paper the same author gave an account of the action of ozone upon the methyl ester of ricinoleic acid. Results somewhat different from those obtained by Harries and Thieme were observed. M. Jean B. Senderens described a new method of pre-

Photo.] [*Dover Street Studios.*

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paring ethyl ether. The vapours of the alcohol were passed through a tube containing gently ignited precipitated alumina at a temperature not exceeding 260° C. Quantitative yields of ethyl ether in a high state of purity were obtained. Above 260° the ether itself was dehydrated, with formation of ethylene. In the case of methyl alcohol, methyl ether was formed even at higher temperatures.

On Monday afternoon a joint meeting of the section of organic chemistry with the section for colouring matters was held for the discussion of fluorescence and colour in relation to chemical constitution. Dr. Kauffmann advocated an extension of the "auxochrome" theory to account for fluorescence. Analogous terms, such as "fluorogen," "fluorophore," "luminophore," "luminogen," were suggested. Contributions to this theory were adduced by Dr. Ley. A theory of selective absorption as conditioned by conjugate linkage was advanced by Dr. Hewitt. This theory is founded on considerations of the atomic attractions produced by changes in dynamic conditions. With increase in the number of conjugated double linkages in a chain the oscillation frequency is diminished, although the atomic forces involved in the dynamic change are not increased in proportion to the number of double linkages. Other contributions to the theory of colour were introduced by Prof. Green, Dr. Morgan, and Dr. Mascarelli.

On Tuesday morning, June 1, papers on miscellaneous subjects were communicated to the section of organic chemistry. Dr. E. Biilmann stated that only two stereoisomers of cinnamic acid were known, namely, the ordinary variety and an iso-acid, which, however, is trimorphous. The ordinary variety was shown to be fumaroid, while the iso-acid was the maleinoid form. Description of the refractometric determination of the solubility of ethyl ether in water was given by Mr. Y. Osaka, and the existence of gaseous compounds of carbon and nitrogen other than cyanogen was discussed by M. A. P. Lidoff, who asserted the probability of the existence of a gas "oxan," CNO. In the afternoon of the same day the contributions dealt with compounds of therapeutic interest. Dr. Power gave a striking account of his exhaustive researches on the composition of jalap, and showed that the products obtained from jalap resin are all mixtures of indefinite constitution. M. A. Guyot described several new syntheses of vanillin, depending on the condensation of aromatic compounds with esters of ketonic acids, such as mesoxalic acid, with formation of the corresponding carbinols. The relations between physiological action and constitution of certain series of compounds were discussed by Dr. Jowett, who pointed out the uncertainty of predictions as to the effect on the human organism. M. F. Garelli gave an account of the production of soaps by the interaction of fats, sodium chloride, and ammonia, which, if practicable on a commercial scale, may prove to be of great industrial importance.

A large number of papers were contributed to the section for colouring matters, and many were discussed at length by the meetings. The dyeing effect of dyes in aqueous solution upon inorganic matters, such as sand, was described by Mr. Dreaper. It was shown that basic dyes were absorbed to a greater extent than acid dyes, while the addition of salt caused a considerable increase in the dyeing action. The decolorising action of various forms of charcoal was discussed by Prof. Knecht, who pointed out that the absorptive power depended entirely upon the amount of organic impurity present in the charcoal, and that the purer the sample the less absorbent action is observed. The same author, in a joint paper with Mr. Batey, adduced evidence, based upon conductivity and ebullioscopic determinations, to prove that certain dyestuffs do not behave as colloids in aqueous solution. M. L. Vignon gave an account of his experiments in relation to the theory of dyeing. The conclusions drawn were that the fabric behaves as a porous body endowed with chemical properties; that the ionised dyes are fixed in the fabric by chemical action; while the insoluble dyestuffs in water behave as colloids, and are fixed by molecular attraction. A description of the various and important uses of formaldehyde sodium bisulphite in the dyeing industry was furnished by MM. Baumann and Thesmar. M. T. Valette discussed the influence of the various bleaching and fat-removing agents upon the dyeing properties of wool, and stated that of all such agents lime gave the most satisfactory results, while chlorine gave good results, but weakened the fabric. An account of the chemistry of aniline black was given by Prof. Green, in which he described his process of oxidation of aniline by atmospheric oxygen by the catalytic influence of a paradiamine associated with a copper salt. An explanation of the formation of hydrocyanic acid during the oxidation of aromatic nitro-compounds by ammonium persulphate was communicated by MM. Seyewitz and Poizat. Dr. Cain described a method of acetylation of diamines of the benzidine type in cold alcoholic solution, by which monoacetyl derivatives could be prepared in good yield. The same author described new dyestuffs of the methylene-blue type derived from paranitrosomethylethylaniline. Mr. G. A. Prochazka stated that the recent legislation in the United States permitting the use of duty-free alcohol for the manufacture of coal-tar dyes has been rendered valueless owing to the unreasonable regulations of the Inland Revenue.

In the section for physiological chemistry the sectional meetings were held on Saturday, May 29, at University College, for the purpose of demonstrations. Two papers on colloids were included in this section, both of which were of considerable importance, namely, that of Dr. W. B. Hardy, who discussed the source of the electric charge on colloidal particles, and that of Dr. W. M. Bayliss, who dealt with the general properties of colloids as exhibited by certain dyestuffs. Dr. H. Bechold also considered the nature of colloids from a physiological point of view. The part played by adsorption in the mechanisms of the animal organism was described by Prof. H. Freundlich. Prof. Hans Meyer discussed the pharmacological action of the lipoids.

The use of a 15 per cent. to 25 per cent. solution of hydrofluoric acid at 100° C. was recommended by Dr. L. Hugounenq for the hydrolysis of proteins. Less oxidation and humic decomposition was observed in the employment of this reagent than in the hydrolysis by means of 25 per cent. sulphuric or hydrochloric acid. Moreover, by this method certain natural polypeptides of considerable importance were detected among the products of hydrolysis. A monograph on nucleic acid was contributed by Dr. H. Steudel.

In the section for agricultural chemistry the chief subject of discussion was the employment of artificial nitrogenous manures. A paper on the employment of cultures of leguminous bacteria was communicated by Dr. H. von Feilitzen, of the Swedish Society for the Cultivation of Peat Land. It was stated that cultures such as "nitragin" and "nitro-bacterine" produced absolutely no effect, and that the only certain method is inoculation with naturally favourable soils. M. M. A. Vivien showed that the loss of nitrogen from dung-hills is accelerated by the presence of inorganic substances such as sodium nitrate and calcium carbonate. The reactions of dicyandiamide were stated by Prof. Prianichnikow to indicate that it may be regarded as cyanoguanidine.

In the section for hygiene several papers upon the sterilisation of drinking-water were communicated. The majority of these dealt with the action of ozone, which appears to have a considerable germicidal action, and can be utilised at no great expense. Papers on the purification of sewage were contributed by Dr. W. E. Adeney, Mr. J. H. Johnston, and M. J. Begault. In reference to lead poisoning, a communication from Mr. K. Goadby and Dr. F. W. Goodbody proved that by far the greater portion of the lead present in the system of operatives suffering from lead poisoning enters by the lungs. The condition of the patient is considerably aggravated by the inclusion of alcohol in the diet. The experiments described in the paper were carried out on cats.

In the section for physical and electrochemistry the most striking event was a lecture and demonstration by Prof. Bernthsen on the oxidation of atmospheric nitrogen by the flaming electric arc, with formation of nitrogen peroxide, followed by an account of the process for the manufacture of calcium cyanamide by Prof. Caro. Since the formation of calcium cyanamide is an exothermic reaction, much less power is required than for the oxidation of nitrogen. From this substance ammonia can be produced, which can

then be converted into nitric acid by Ostwald's electrolytic process. A *résumé* of the recent work on the electrometallurgy of iron and steel was given by Mr. F. A. Fitzgerald. Prof. Taussig read important papers on large electric furnaces, and on the electrolysis of sodium chloride, in which the recent developments in the Castner-Kellner process were reviewed. A recommendation for national and international conservation of water-power was introduced by Mr. E. R. Taylor, in which the author deprecated the failure to employ the waste power of rivers and streams. The combination of nitric oxide and oxygen was shown by Dr. M. Bodenstein to consist of a trimolecular reaction. M. A. Coppadoro described a process for the simultaneous production of hydrochloric and sulphuric acids, in which electrolytic chlorine was caused to interact with sulphurous acid. The question of the amount of chemical work produced by light was discussed by Dr. F. Weigert, who by examination of the photochemical change of anthracene into dianthracene concluded that nearly 5 per cent. of the total amount of absorbed light was converted into work. M. Malfitano, in a paper on the constitution of colloids, described the use of celluloid membranes, which permit the passage of electrolytes, but remain impermeable to colloids. The mechanism of the absorption of hydrogen by carbon at low temperatures was shown by Dr. J. W. McBain to depend entirely upon condensation of the hydrogen upon the surface of the carbon.

THE SUPPLY OF SECONDARY EDUCATION IN ENGLAND AND ELSEWHERE.

IN their report, published in 1895, the Secondary Education Commissioners, when discussing the amount of secondary education required for the whole country, stated :—

"After the most careful consideration we have been forced to the conclusion that the problem contains so many indeterminate elements that any attempt at a solution applicable to the whole country would necessarily be misleading."

The Schools Inquiry Commissioners of 1868, however, had no such hesitation, and light-heartedly estimated requirements at 16 per 1000 of the population for boys in towns, of whom one-half would be third-grade pupils.

Circumstances have changed since 1895. A new Education Act has been in operation for six years; a list of recognised schools has been prepared and issued; surveys of their districts have been instituted by many educational authorities. These facts give warrant for making an approximation to the result. Any such approximation must be subject to errors; in some cases it is well-nigh impossible to obtain information, and the difficulty of standardisation is ever present.

Presuming that the reader is acquainted with, and can make allowance for, disturbing influences, we will place before him material which will enable him to answer three questions, and will throw light incidentally on others. These three questions are :—

(1) How many of our population receive a secondary education?

(2) What proportion continue their education after the age of sixteen as all-day scholars?

(3) How do we compare in these respects with the foreigner?

The latest returns concerning higher elementary education in England give the number of pupils as :—

Boys	8035	... Girls ...	6178
Average attendance	94·3 per cent.	...	92·4 per cent.

These pupils correspond to Bürgerschüler, and represent those who, under more favourable conditions, would receive secondary education. In Germany the Bürgerschule exists in many places on sufferance; the local authority wishes to have the whole elementary education under its control, and maintains a Bürgerschule as a means of checking the establishment of private schools. In Great Britain we have encouraged the private school, and have thus only this small pittance of higher elementary pupils to put forward. We shall discover our missing Bürgerschüler later.

The number of pupil-teachers and pupils in classes preparing for pupil-teachership, or its equivalent, was given in 1906–7 as :—

	Boys	Girls
Preparatory classes	1,077	5,473
Pupil-teachers (*a*)	2,771	10,735
Pupil-teachers (*b*)	2,468	8,550
Total	5,239	19,285
Training college students ...	2,663	5,645

In this same year the secondary schools under the Board account for 62,712 boys and 50,877 girls, *i.e.* five boys to four girls nearly, classed as follows :—

	Boys	Girls
Preparatory classes ...	18,214	... 13.993
Age 12–13	12,521 (4,011)	... 10,505 (1,433)
Age 13–14	9,812 (3,179)	... 9,180 (1,445)
Age 14–15	5,248 (3,377)	... 6,673 (1,276)
Age 15–16	2,551 (1,806)	... 3,052 (637)
Over 16	1,993	... 2,683

where the numbers in brackets refer to those taking special courses.

If, for the moment, we class pupil-teachers as secondary scholars, these figures show that secondary education for a girl too frequently means preparation for the teaching profession. If we analyse our table we find that for every

100 boys	100 girls	age 12–13
there were		
78·5	89·0	age 13–14
52·2	66·6	age 14–15
26·3	30·9	age 15–16
12·0	22·5	over 16

who were taking an approved course. That is, only about one boy in four who begins a course of secondary education ever remains to finish it. Our national view of secondary education is that it is simply a veneer of respectability which has no bearing on the capacity of the individual or the future of the nation. This statement of the national conception of education is unjust to some local areas. Let us consider London, the State-aided schools of Scotland, and Wales. The corresponding figures read :—

	London		Scotland		Wales	
Age	Boys	Girls	Boys	Girls	Boys	Girls
12–13 ...	100 ...	100 ...	100 ...	100 ...	100 ...	100
13–14 ...	123 ...	125 ...	149·6 ...	148·5 ...	71·5 ...	77·3
14–15 ...	114 ...	117 ...	184·3 ...	186·7 ...	47·9 ...	54·6
15–16 ...	69·5 ...	75·6 ...	163·4 ..	174·2 ...	29·2 ...	26·1
16–17 ...	35·2 ...	45 ...	106·6 ...	135·4 ...	14·7 ...	13·6
17–18 ...	16 ...	26 ...	48 ...	90 ...	— ...	—
18–19 ...	6·4 ...	7·5 ...	17·7 ...	46·8 ...	— ...	—

After her sacrifices for education, no one will accuse Wales of indifference. Yet her standard is still far from satisfactory. London is showing that she appreciates the value of a course of secondary education. What about Scotland? Explain that the Scotch parent is satisfied with the primary school, and keeps his children there until thirteen or fourteen years of age, and you give deserved praise to the elementary school. Explain that the lower age of entrance to the Scotch universities induces a parent to give his son a full secondary education so that he may see, if he does not gather, the prizes that lie beyond, and you compliment the foresight of the nation. Allege that the Scot does not succeed in life and you will be laughed to scorn. Protest that his success is not due to superior insight or fertile imagination or sporting enterprise, and you only accentuate the value of steady, disciplined intelligence. The German has this virtue, and so has the Scot. If you wish to know where the Scot gained it, remember the traditions of the country and study closely the middle column.

The list of secondary schools recognised as efficient for 1907 (Cd. 4374) accounts for 132,849 children, classed thus :—

	Under 12	12 to 16	Over 16
Boys	16,084	49,829	5,478
Girls	12,724	40,165	8,669

The total number of pupil-teachers enrolled at these schools is 9869, and the total number of pupil-teachers noted as at secondary schools or pupil-teacher centres is 4745 boys and 15,803 girls.

Thus in 1907, 89,994 pupils out of 132,849 (67·74 per cent.)
in 1906, 76,728 pupils out of 115,594 (66·38 per cent.)
in 1905, 53,309 pupils out of 85,358 (62·45 per cent.)

were taking an approved course. The rise in numbers and percentages is satisfactory, as it indicates the approach of a time when the secondary school will have a complete secondary character, and, when this is attained, we shall have a rise in standard of performance.

If we compare the schools discussed in Prof. Sadler's county reports (of date 1904 and 1905) with the particulars given in the Blue-book for 1908 about these same schools, we find the following results :—

Boys	Under 12	Between 12 and 16	Over 16
Reports ...	997	4174	374
Blue-book	1127	4478	417
Increase ...	13 per cent.	7·3 per cent.	11·5 per cent.
Girls			
Reports ...	698	2049	406
Blue-book	752	2494	521
Increase ...	8 per cent.	21·7 per cent.	28·3 per cent.

Here again a welcome improvement is recorded, and the more welcome because it shows a large increase among girls. It is interesting to note that whilst we are debating what to do with children under five, the question is being debated in Germany whether school attendance might not be postponed until seven, because, among other things, the German mother has received such a good school training that she is able to give efficient elementary education in the home up to the age of seven.

Secondary schools for boys may be divided into four classes, according as they are, or are not, recognised by the Board of Education or represented at the Headmasters' Conference.

The classes are :—

(A) Recognised schools which are represented.
(B) Recognised schools which are not represented.
(C) Non-recognised schools which are represented.
(D) Non-recognised schools which are not represented.

The last two, which trouble the calculator, may be classed as "proud but probably efficient" and "mean and probably inefficient." With a satisfactory system of inspection, as is being evolved, these harsh epithets will come more and more to be deserved.

In class A, of the schools which take pupils between eight and nineteen there is one pupil under twelve for every four between twelve and sixteen and for every one over sixteen. This proportion is nearly exact, the error being slightly in favour of the oldest and against the youngest pupils.

To class C the "Schoolmasters' Yearbook" assigns 24,638 pupils, of whom 16,928 are at schools which take pupils under the age of twelve, and 7710 at schools which have no pupils under twelve. The larger number we will divide up in the ratio 1 : 4 : 1. The smaller we will divide on the supposition that there are two pupils under sixteen for every one over that age.

To calculate class D we will compare with the totals of classes A and B. Here Mr. Sadler's reports on Liverpool, Newcastle-on-Tyne, Exeter, Essex, Hampshire, and Derbyshire, a representative list, will give us a standard. This standard is :—

	Under 12	Between 12 and 16	Over 16
Classes A and B ...	100	100	100
Class D	336	52	41

We promised to show where the Bürgerschüler were. Here they are, in non-recognised schools, which are probably primary in character, and perhaps not efficient at that, yet aping the respectability of a secondary school.

Our total for boys is thus :—

	Under 12	Between 12 and 16	Over 16
Classes A and B ...	16,084	49,829	5,478
Class C_1	2,821	11,286	2,821
Class C_2	—	5,140	2,570
Class D	54,042	25,911	2,246
Pupil-teachers at schools	—	60	4,685
Total	72,947	92,226	17,800

Or, if we take the population of England as 32,000,000, there are in secondary schools

2·28 boys, per 1000 inhabitants, under 12
2·88 ,, ,, ,, ,, between 12 and 16
0·56 ,, ,, ,, ,, over 16.

And, it should be noted, 26 per cent. of those over sixteen are preparing for work as teachers in primary schools.

A similar calculation could be made for girls; but it would be much harder to work out. If the proportion of five boys to four girls be taken, an error will be made for older girls, as many girls remain at school from want of a fixed occupation, and in many cases the secondary school has still to perform for women the functions of a university.

If we take the number of boys in primary schools in England as 2,800,000, these figures give, for every 100 boys in primary schools, 6·53 in secondary schools, of whom 3·93 are more than twelve years of age.

Against this we may set the following :—

		Higher Grade Age	Secondary Age
Basel Town...	Boys ...	54·7 (10–14)	... 45·3 (10–18)
	Girls ...	57·4 (10–14)	... 28·2 (10–18)
Mannheim ...	Boys ...	20·5 (8–14)	... 24·2 (10–19)
	Girls ...	21·6 (8–14)	... 9·1 (10–19)
Zürich Canton	Boys ...	17·0 (12–15)	... 2·04 (12–15); 5·24 (15–18)
	Girls ...	13·6 (12–15)	... 1·91 (15–18)
Boston, U.S.A.	Boys and Girls	19·43 (14–19)	
Württemberg	Boys	12·85 (8–14), 2·69 (14–18)	

The figures for girls in Zürich apply only to pupils in public secondary schools. Whatever exceptionally favourable circumstances may be put forward in these cases, compulsory military service or social precedence, taken as a whole they show that England is far in arrear.

It is possible, though in some cases difficult, to construct a table giving the number of secondary pupils in various areas. If we take the figures for Prussia in the "Statesman's Year-book," 1908, we get, for boys and girls in public and private schools :—

8·28 pupils per 1000 inhabitants in secondary schools.
4·51 pupils per 1000 inhabitants in Mittelschulen.

The Mittelschulen may, for social distinction, rank as intermediate, but many of them would be recognised by us as secondary schools.

Other figures for recent years which may be quoted are, per 1000 inhabitants :—

	Boys	Girls	Boys and Girls
U.S.A.	—	—	10·61
Boston, (14–19)	12·37	12·67	25·04
Connecticut (13–19)	—	—	12·67
Maine (13–19)	—	—	18·94
Massachusetts (13–19) ...	—	—	17·26
Germany—			
Cologne	8·7	4·7	13·4
Hamburg	11·4	11·7	23·1
Mannheim (10–18)	14·56	5·52	20·08
Munich (10–15)	11·0	7·20	20·45
Munich (16–18)	2·26		
Switzerland—			
Confederation :			
Age 12–15 (Higher Grade)	7·31	6·01	13·32
Age 12–19 (Secondary)	—	—	7·4
Basel Town :			
Age 10–14	8·71	8·01	16·72
Age 14–18	5·00	3·43	8·43

Zürich Canton :			
Age 12–15	11·61	9·63	21·24
Age 12–19	4·03	2·22	6·25

The foregoing statistics may be compared with those subjoined :—

Birkenhead	6·59	8·72	15·31
Derbyshire	3·53	1·54	5·07
Essex	6·11	5·76	11·87
Exeter	11·14	13·73	24·87
Hampshire...	6·85	3·88	10·73
Huddersfield	3·99	3·46	7·45
Liverpool	4·14	3·70	7·84
Newcastle-on-Tyne	6·79	5·88	12·67
Shropshire...	5·9	5·6	11·5

It will thus be seen that in education we are not yet up to a one-Power standard.

If, however, we take Edinburgh, where a representative committee has been studying the subject, we find from the committee's figures :—

	Under 12	Age 12 to 15	Over 15
Higher Grade	0·3	5·40	1·12
Secondary	6·36	6·28	3·84

being 6·82 per 1000 inhabitants for higher-grade schools and 16·48 for secondary schools. These figures are for boys and girls, and only three private schools are included.

England has no reason to despair. There is sufficient evidence to show that progress is being made. The West Riding County Council has the following record per 1000 inhabitants :—

	1903–4	1904–5	1905–6	1906–7	1907–8	1908–9
Boys...	1·5	1·7	1·9	2·1	2·3	2·4
Girls	0·7	1·3	1·6	1·9	2·2	2·3
Total	2·2	3·0	3·5	4·0	4·5	4·7

where, again, the number of girls has greatly increased, a notable augury for the home of the future.

In the West Riding a large number of pupils go to schools in county boroughs; this may account for the slower increase in the figures for boys. If allowance be made for them and for other variations, the average becomes at least 6·2 per 1000, promising, but not yet sufficient.

Statistics relating to university education are liable to uncertainty, on account of the presence of the foreign or colonial student. Thus in Switzerland the chief problem of university education is to exclude the Russian undesirable without offending democratic sentiment. The foreigner who attends a German university does so from belief in its efficiency. At home let us assume that what we gain by the presence of the non-Britisher we lose by emigration to the Continent.

The "Statesman's Year-book" for 1908 gives the following figures for the United Kingdom in 1907 :—

Oxford and Cambridge	7205
Durham	926
London, including School of Economics	7141
University Colleges	3081
Birmingham, Leeds, Liverpool, Manchester, Sheffield	4685
Scotch Universities	7579
Wales	1301
Ireland	2066

a total of 33,984, or about 7·8 per 10,000 inhabitants.

In No. 591 of Diplomatic and Consular Reports, Dr. Rose gives the following figures per 10,000 males in Germany :—

1870	1873	1876	1881	1886	1889	1892	1897	1900
8·89	10·03	11·08	11·73	13·85	14·39	13·87	15·70	16·78

The returns for Switzerland give per 10,000 inhabitants :—

Summer Term 1906—

Natives 9·58 ... Foreigners 12·34 (Men 8·10, Women 4·24)

Winter Term 1906–7—

Natives 10·29 ... Foreigners 12·88 (Men 7·67, Women 5·21)

The figures for German universities given in "Minerva" for 1907 are classified for winter and summer sessions and for matriculated students and Zuhörer. Interpolating for omissions we get :—

	Matriculated students	Total attendance	Ratio
Winter	44,590	51,045	100 : 114·5
Summer ...	45,052	54,137	100 : 120·2

Or, on the standard of students per 10,000 inhabitants :—

Winter, 8·1 and 9·28. Summer, 8·2 and 9·84.

Further figures bearing on university statistics in Germany will be found on pp. 51 and 57 of No. 591 of Diplomatic and Consular Reports. Estimating for university education on the German basis, we should expect to find 44,370 students in Great Britain and Ireland. We have already enumerated 33,984 at degree-granting universities. The Board of Education accounts for 2,655 at "day technical institutions" in England. Let us add half that number for the rest of the United Kingdom, though 1029 of them are known to be under eighteen years of age. At agricultural and veterinary colleges we know there are 630 students. We thus get a total of 38,597, without any allowance for duplicates.

This is much better than we might expect. The newer universities in the north and the Midlands show the presence of large numbers of people who believe in education of a high standard. There is nothing to compare with the 16,000 or more students at German technical high schools, and little to record in commercial education of a high standard, London always excepted; but there is much promise for the future.

That we have plenty of people willing to be taught is shown by the official returns. Under the heading "Schools of Art" we find :—

	Men	Women
Day classes	1,474	7,631
Evening classes	15,887	11,938

Under "Day Technical Classes" there are 8538 students, and under "Other Classes for Further Instruction" 307,908 men and 207,989 women who qualified for grants, of whom 90,656 were under fifteen and 163,448 between fifteen and eighteen.

In dealing with numbers, the author has endeavoured to put a good complexion on the British position. He has touched but briefly on standards and curricula. He has not overstated the case for the foreigner. The result of all this labour is to leave the impression that the future is promising though the present is deficient. The existence of a crisis in education is being recognised. Local authorities are making schools efficient; parents are availing themselves of the opportunities so created; inspection is telling those most interested whether the work of a school is satisfactory or whether its reputation is only sustained by skilful advertisement. It would be well if the great public schools were to pocket their pride and accept recognition, for that would give a hall-mark of respectability which private schools could not ignore.

Amid all this promise there is much to deplore. The English parent does not whole-heartedly believe in secondary education. Of four boys entering a secondary school, only one completes the curriculum. If the parent can be got to see the value of trained thinking power and to resist the enticement of an immediate wage; if he can appreciate the self-discipline that a steady, self-contained course of education demands; if he will realise the remorselessness of research and ignore the sporting chance of a prize limerick; if he will value the moral forces which have moulded nations and despise the patriotism of the music-hall: then there is still hope for the nation. We can add one-eighth to the number of our university students without creating an academic proletariate. We can almost double the numbers of our secondary schools without being overstocked. We can open a technical university where now a technical institute exists. And if all this is done, we shall neither be financially ruined nor oppressively over-educated. Whilst much remains for the statesman to do, much also remains for the teacher. If parents will insist on knowing what careers are open for their children on leaving a secondary school, the narrow-mindedness of the teacher must give way. If the public

will encourage attendance at continuation classes during the day, the employer will attach more value to the work of his employees, and the parent will take care that the primary school does not become a wilderness of book-learning.

The difficulties of making this comparison and the devices which have been employed will be apparent to everyone. Of the conclusions that can be drawn, one at least is incontestable: it is not yet possible to give a definite statistical statement because the materials do not exist. It seems bad economy to suggest further advances until the completion of a national stock-taking.

A. J. PRESSLAND.

THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES.

UNDER the presidency of Dr. D. H. Scott, F.R.S., the South-Eastern Union of Scientific Societies held an extremely successful congress at Winchester from Wednesday to Saturday of last week. As Sir Archibald Geikie in his presidential address to the congress at Hastings last year had dealt with the geological history of the Weald, Dr. Scott this year appropriately discoursed on the flora of the Wealden strata. This was a subject of peculiar interest to the Union, inasmuch as many of the most interesting fossil plants of Wealden age have been obtained within the sphere of its activity. The flora was of similar type to that which had prevailed from the beginning of the Mesozoic period, and in so far as seed-bearing plants are concerned consisted chiefly of conifers and cycads. It is believed that the angiosperms did not appear until later Cretaceous times, and their comparatively sudden rise was probably related to the contemporary development of insect life.

With a living specimen of *Cycas revoluta* in front of him, and aided by a fine series of lantern-slides, Dr. Scott described the structure of recent cycads and their relation to the fossil types. Before dealing with cycads, however, he referred to the fact that in the Secondary flora there were many plants more or less related to the Ginkgo, or maiden-hair tree, which at the present day survives as an isolated species, possibly wild on the mountains of western China. It was discovered by Japanese botanists that cycads and Ginkgo alone among living seed-plants were fertilised, like ferns, by motile cells, or spermatozoids. Misled by the resemblance of the leaves of the African cycad Stangeria to the fronds of a fern, the systematic position of Stangeria was at one time misunderstood. It is interesting to learn from Palæozoic botany that a real affinity exists between the cycads and the ferns.

During the Jurassic and Wealden stages of the earth's history cycadaceous plants were so abundant and varied that probably among vascular plants one in every three was a cycad, whereas at the present day the proportion scarcely reaches one in a thousand. Although cycads have now a very limited geographical distribution, they formerly spread over the whole world, and, as their relics testify, must have abounded in what is now the British area. Many of the Mesozoic cycads, notwithstanding the general resemblance of their leaves, differed essentially from the modern types, and where the reproductive organs have been preserved, as in specimens of Bennettites, the fossil fructification is found to be much more complicated than are the simple cones of the living cycads. In America, where abundant material has been discovered, Dr. Wieland, of Yale, has shown that the fructification of many cycad-like plants consisted of true bisexual flowers, comparable in general terms with those of such highly organised modern plants as the magnolias. Recent researches have, indeed, led to the conclusion that the origin of the angiosperms, which are to-day the dominant plants in the world, may perhaps be sought in those cycad-like plants that are so abundantly represented in the Wealden beds. If, as is probable, the flowers were brightly coloured, the fertilisation by insects may have begun among these cycads.

Not without some relation to the subject of the presidential address was a lecture by Mr. R. W. Hooley, of Southampton, on the Age of Reptiles in Hants and the Isle of Wight. The lecturer gave the results of much original investigation in the Wealden beds of the island, resulting in the discovery of many interesting remains. He held strongly to the view that the strata were of deltaic origin.

Another evening lecture was on the prehistoric memorials of Hampshire, by Mr. W. Dale, of Southampton. The lecturer, who is an active archæologist in the field, illustrated his discourse by some fine local antiquities in stone and bronze from his own collection, as well as by a large series of lantern-slides, including many original photographs.

Each morning during the congress two scientific papers were read; these related to botany, entomology, and geology, and most of them were appropriately of a local character. The afternoons were devoted to excursions, which were admirably organised by Mr. N. C. H. Nisbett; and in the evenings, before the lectures, there were receptions by the Mayor and by the headmaster of Winchester College. An excellent temporary museum was arranged at the Guildhall, under Mr. E. W. Swanton, of Sir Jonathan Hutchinson's Museum at Haslemere, the collections including a large series of interesting objects from the Hartley University College, Southampton. The success of the congress was largely due to the energy of the hon. local secretary, Mr. W. Norris, and the hon. general secretary, the Rev. R. Ashington Bullen.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. H. F. Newall, F.R.S., fellow of Trinity College, has been elected to the recently founded professorship of astrophysics. Mr. Newall was formerly assistant to the Cavendish professor of physics and demonstrator in experimental physics in the same laboratory, and now holds the position of assistant director of the observatory at Cambridge.

H. E. Durham, King's College, has been approved by the general board of studies for the degree of Doctor in Science.

The general board of studies has appointed Dr. Haddon as reader in ethnology, and Dr. Bromwich as university lecturer in mathematics.

The same board has re-appointed S. Ruhemann as university lecturer in organic chemistry; Dr. Sell and Dr. Fenton as university lecturers in chemistry; Dr. Duckworth as university lecturer in physical anthropology; H. Woods as university lecturer in palæozoology; A. Harker as university lecturer in petrology; and T. S. P. Strangeways as Huddersfield lecturer in special pathology. All these re-appointments are for five years, and date from October 1, 1909. They have also all been confirmed by the special boards connected with the subjects mentioned.

The Vice-Chancellor, Dr. Ridgeway, W. Durnford, C. E. Grant, A. Gray, P. Giles, L. Whibley, and S. C. Cockerell have been nominated a syndicate to consider the administration of the Museum of Classical Archæology, the relation between that museum and the Fitzwilliam Museum, and, in particular, the appointment, duties, and powers of the curator of the Museum of Classical Archæology; the syndicate is empowered to confer with such bodies and persons as it may think fit, and is to report to the Senate before the end of the Lent term, 1910.

It is proposed, the Chancellor, as president of the University Association, having given his approval, that a sum of 1000*l.* from the unassigned portion of the benefaction fund be appropriated towards the cost of the erection of the first block of the new museum of archæology and ethnology, and that the Vice-Chancellor be authorised to accept a tender for the erection of block i. of the new museum of archæology and ethnology provided that the tender does not exceed the sum of 11,000*l.*, and that the sums subscribed or guaranteed amount to 12,500*l.* before any contract is signed.

Mr. Francis G. Smart, having made to the University an offer to give the sum of 600*l.* in order to found two prizes to be awarded in each year, one for botany and one for zoology, a Grace will be brought before the Senate

to-day, June 17, recommending that Mr. Smart's offer be gratefully accepted.

The special board for divinity has nominated Dr. Humphry as assessor to the regius professor of physic for the ensuing year, and the special board for mathematics has nominated Sir Robert Ball as an elector to the Isaac Newton studentships until September 30, 1913.

The Cavendish professor of experimental physics announces that a course of demonstrations in practical physics will be given during the long vacation, beginning July 5.

The first three names in the Mathematical Tripos list, part i. (old regulations), are P. J. Daniell, Trinity; E. H. Neville, Trinity; and L. J. Mordell, St. John's.

DR. H. A. WILSON, F.R.S., professor of physics in King's College, London, has accepted the appointment of professor of physics in McGill University, Montreal.

THREE lectures on "Aëronautics" are being delivered at the East London College by Mr. A. P. Thurston. The first lecture, on Monday, June 14, was on flying machines (heavier-than-air type). The second, on Wednesday, June 23, will deal with balloons, airships, and kites, and the subject of the third, on Wednesday, June 30, will be the mechanical principles of flight. Applications for tickets of admission to the lectures should be sent to the registrar at the college.

THE Department of Agriculture and Technical Instruction for Ireland will in August next award not more than six industrial scholarships to persons engaged in industries, such as the woollen, linen, leather, and tanning industries. The object of these scholarships is to enable selected persons, who must already have been engaged in one of the higher branches of the industry, to take a full course of instruction in an institution providing special courses of an approved character with the view of training them for the management of such an industry. The scholarships will be tenable at some higher institution, to be approved by the Department, in which the industry, and the principles underlying it, are taught. They will be of the value of 80*l*. each, and may be renewed for a second or a third year at the discretion of the Department. Candidates must fill in and return, addressed to the secretary of the Department, not later than June 30, Form S. 192, copies of which may be had on application.

THE philanthropic aspects of the work of the administrators of the Children's Country Holidays Fund are appreciated and understood widely, but it is not generally known that, without some preliminary training, the ordinary town child is unable to benefit educationally from a short stay in the country. We are glad to learn, therefore, that a subcommittee, called the countryside committee, of the workers who organise the holidays was formed some time ago to develop means of interesting the children sent into the country in the natural wonders of countryside life. The subcommittee has arranged for the children, who will in August be sent by the fund into the country, a series of lantern lectures and nature talks about common animal and plant life, and also a succession of short rambles into metropolitan environs on Saturday afternoons to secure for them some preliminary practice in observation and general open-eyed intelligence. An appeal is made to competent men and women who love children to give, during the present month and the first weeks of July, nature talks to the children in the schools they attend, or to arrange for Saturday afternoon rambles in the immediate neighbourhood of London. Similar persons who live in the country and are willing to assist in making the fortnight's holiday a profitable time physically and mentally for the children are asked to communicate with the honorary secretary of the countryside committee, Mrs. Douglas Wilson, 17 Buckley Road, Brondesbury, London, N.W.

BEDFORD COLLEGE (University of London), the oldest university college for women, celebrates this year the sixtieth anniversary of its foundation. Since 1849, when it was first opened, its progress has been continuous, and the number of students entered this year exceeds three hundred. It is the only college exclusively for women which receives a Parliamentary grant. Recent developments in the work and the increase in numbers of students have caused serious pressure on the space available in the present buildings. In 1903 a building and endowment fund was started, which has received generous support; and the end of the lease of a Crown property in Regent's Park, known as South Villa, has been purchased, with a promise from the Crown for its renewal on a further lease of ninety-nine years. It is estimated that to erect on this site buildings well equipped for college purposes, including a library, laboratories, lecture-rooms, and a residence for students, will cost about 80,000*l*. The council of Bedford College, encouraged by the support it has already received (which includes a special bequest for a botanical laboratory), hopes that sufficient support may be forthcoming to enable it to obtain this sum, and to build a college in which the educational work so worthily begun may be carried on in worthy surroundings. In order to celebrate the sixtieth anniversary, and to make this desirable site known to their friends, the council and principal will hold a garden-party at South Villa on Tuesday, June 29, from 4 p.m. to 7 p.m., for which cards of invitation may be obtained from the secretary, Bedford College, York Place.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 10.—Sir Archibald Geikie, K.C.B., president, in the chair.—The functions of the pituitary body (Croonian lecture): Prof. E. A. **Schäfer**.—A wave-length comparator for standards of length: Dr. A. E. H. **Tutton**. Two and a half years ago the author was requested by the Standards Department of the Board of Trade to devise and superintend the construction of a new comparator, for comparing standards of length—the imperial standard yard, for instance, with official copies, and the latter with the copies constructed for local authorities—in terms of wave-lengths of light. The instrument now described is the result. Besides performing its functions as a wave-length comparator, and being the first instrument specifically constructed as such, it is also the most perfect instrument yet devised for measurement in wave-lengths in general. It is described to the Royal Society by permission of the President of the Board of Trade. The principle of the instrument is that of the author's interferometer, described to the society in 1898 in connection with an interference dilatometer, and again as improved in 1904 in connection with the author's elasmometer or interference elasticity apparatus. The interferometer, which is totally different from that of Michelson or that of Fabry and Perot, is adapted, as regards details, in a special manner for the specific object in view, but with the exception that a Hilger constant-deviation prism is employed instead of a train of two spectroscope prisms, its principle is preserved intact. The essential point of the instrument is that one of the two microscopes, employed to focus the two defining lines on a standard yard bar, actually carries just above the objective one of the two glass plates of the interference apparatus, which reflect the monochromatic light (hydrogen or cadmium red radiation) which is caused to interfere and produce rectilinear dark bands. When the microscope is moved the plate consequently moves with it, and the amount of movement is absolutely afforded by the movement of the interference bands, being equal to half the wave-length of the light employed for every band which passes the reference spot in the centre of the field of the interferometer telescope. So perfectly has this fine movement been achieved that the microscope and the bands can be caused to move simultaneously, by rotation of a large, fine-adjustment wheel, so steadily that each band can be made to pass the reference spot as slowly as one wishes, and be arrested instantly, without the slightest tremor, at any fraction of its width, so that the control of the bands and the counting is a perfectly simple matter. In order to compare two standard bars, it is only necessary (1) to place the bar of known length, supported on an elaborate mechanism for the adjustment of the bars, also novel, under the two microscopes, carried on massive yet deli-

cately moving sliders on a 6-feet V-and-plane bed, so that the two defining lines are adjusted between the spider-lines of the micrometer eye-piece in each case; (2) to replace the standard by the copy to be tested, so that the defining line near one end is similarly adjusted under the corresponding microscope; then, if the other defining mark is not also automatically adjusted under the second microscope which carries the glass interference plate, as it should be if it is an exact copy, (3) to traverse that microscope until it is so adjusted, and (4) to observe and count the number of interference bands which move past the interference spot during the process. The difference between the bars is this number multiplied by the half-wave-length of the light in which the bands are produced. The paper also gives an account of the electrical and thermal arrangements, as well as of the foundation masonry of the new comparator room. The temperature of the whole room is controlled entirely electrically, being maintained constant at the official temperature, 62° F. The thermostatic arrangements are of an original character, and of two different independent types—a thermometric and a resistance type.—The use of wave-length rulings as defining lines on standards of length: Dr. A. E. H. **Tutton.** The delicacy of the method of measurement in wave-lengths described in the preceding communication calls for a corresponding refinement in the engraved lines which form the defining lines of the length of a standard yard or metre or other line-measure bar. The defining lines on the imperial standard yard are sharp-edged, but contain the equivalent of forty interference bands of red light in their thickness, and the Benoit defining lines of the platinum-iridium copy made in 1902 are not only very ragged-edged, but contain fifteen interference bands in their thickness. The author has been in communication with Mr. J. H. Grayson, of Melbourne, whose fine rulings have recently evoked such interest among microscopists, and after a long investigation has found that wonderfully satisfactory rulings on the scale of 40,000 to the inch can be made on polished speculum metal, covered with a thin cover-glass cemented only at the corners away from the rulings. Now the forty-thousandth of an inch is a single wave-length of red light (for Hα = 1/38710 inch and Cd red = 1/39450 inch), so that the interval between any adjacent pair of these lines is equivalent to only two interference bands. The thickness of each line, which is absolutely sharp-edged, is less than a single interference band. The author has therefore devised a defining mark in these rulings, which he terms a "Tutton location signal," to distinguish it from the "Benoit defining line." It consists of five such parallel lines spaced one forty-thousandth of an inch apart, with a pair of strong "finder" lines outside them and parallel to them, and another pair of similar finder lines perpendicularly transverse to them, to indicate a central part of the lines for use. The central line of the five fine Grayson rulings is *the* defining line. These location signals can also be ruled on platinum-irid'um, and with less success on gold and invar; but the result on speculum metal is so very superior that a large number of location signals have been made on this metal by Mr. Grayson for the Standards Department. The paper indicates their possible mode of use, not only as the end-mark defining lines of standard bars, but for a new mode of determining, by a stepping-off process of repeated doublings, the total number of wave-lengths of red cadmium light contained in the British yard.

Linnean Society, June 3.—Dr. D. H. Scott, F.R.S., president, in the chair.—*Calamites (Calamitina) Schutzei*, Stur, and on the correspondence between the length of internodes and the position and function of the short internode in the genus Calamites and in the recent Equisetaceæ: A. R. **Horwood.** The author stated that a specimen of *Calamites Schutzei*, Stur, shortly to be figured, exhibits graphically the fistular character of the stem in Calamites, a specimen 3 feet long having been split into two portions longitudinally and so preserved. In the same specimen (from the Main Coal, Stanton-under-Bardon, Leics.) and in another from Brighouse, Yorks, provisionally referred to this species, the regularly uniform length and position of a short internode at the commencement of each period of uniformly longer internodes are specially marked. As a result of a study of this specimen and of a comparison made between it and specimens of the recent species of Equisetum, it is found that there is a strong resemblance between the two groups, Calamarieæ and Equisetaceæ, in the position of the short internode, and a marked similarity in the uniform rate of increase or decrease in the length of the internodes in both groups also, most apparent in Calamitina, but probably in a modified form in Eucalamites and Stylocalamites, and in subterranean stems of *S. Suckowii* there is a strict homology.—The Cephalochorda—"amphioxides"—of the *Sealark* expedition: H. O. S. **Gibson.**—The Alcyonaria of the *Sealark* expedition: Prof. J. A. **Thomson.**

Mathematical Society, June 10.—Sir W. D. Niven, president, in the chair.—The behaviour at the poles of a series of Legendre's functions representing a function with infinite discontinuities: F. J. W. **Whipple.**—An analogue of Pascal's theorem in three dimensions: W. H. **Salmon.**—Some symbolical expressions for the eliminant of two binary quantics: A. L. **Dixon.**

EDINBURGH.

Royal Society, May 17.—Dr. John Horne, F.R.S., vice-president, in the chair.—A simple radioscope and a radiometer for showing and measuring radio-activity: Dr. J. **Aitken.** The instruments were a natural development of his own and C. T. R. Wilson's investigations on cloudy condensations. A U-tube about 2 cm. internal diameter was filled partly with air and partly with water. The open end of the tube was in connection with a rubber ball, by which pressure on the enclosed air could be increased and diminished at will. The rubber ball was compressed by a simple, suitable mechanism of hinged levers. When the pressure was suddenly diminished by relief of the ball after compression had been applied, fog cloud might be observed in the air space. After a few alternate compressions and reliefs of pressure the cloud ceased to form, the air being purified of natural nuclei. When, however, a radio-active body was brought near, the relief of pressure was accompanied by formation of cloud. Various forms of the radioscope were described. To convert the instrument into a radiometer, Dr. Aitken made use of his method of counting the drops as they fell on a surface ruled into small squares. The instrument was not capable of the same accuracy as Wilson's form of apparatus, but it was simple and easily worked, and could give results of quantitative value in comparing the radio-activity of different substances.—Mendelian action on differentiated sex: Dr. D. Berry **Hart.** After referring to the well-known facts that the male and female genital tracts contain, not only the potent elements proper to the sex, but also non-potent elements of the opposite sex, Dr. Hart proceeded to apply the principles of Mendelism, regarding the non-potent elements as recessive and the potent elements as dominant in Mendel's sense. If the genital tract contained dominant and recessive determinates, then, in Weismann's terminology, the zygote from which they arose contained dominant and recessive determinants, and this made it an impure determinant. To get such a heterozygote two varieties of gamete seemed to be necessary, viz. a non-sex and sex male gamete and a non-sex and sex female gamete. By the crossing of a sex male gamete and a non-sex female gamete, and of a sex female gamete and a non-sex male gamete, respectively, male and female zygotes were produced—variation zygotes. Evidence was given that the dominant and recessive genital determinants were not segregated in the gametes, but combined in the sex gamete. The origin of the gametes was discussed in relation to the Owen-Weismann law of the continuity of the germ-cells. Ovarian and testicular teratomata were regarded as derived from a non-sex gamete, which, owing to imperfect reduction from a primitive germ-cell, retained some power of zygotic development. The general view was that dominance and recession acted on differentiated sex, but that the dominant and recessive genital determinants were in the sex gamete, and were not segregated in the gametes as the theory of gametic segregation demands. The dominant and recessive elements are not segregated in the human race, but are segregated in the free-martin, and probably in

bees. In the free-martin—a sterile bull usually with a potent twin—the potent bull has the dominant determinates as the result of the division of the zygote, while the free-martin has the recessive determinates.

DUBLIN.

Royal Dublin Society, May 25.—Prof. Sydney Young, F.R.S., in the chair.—Injurious insects and other animals observed in Ireland during the year 1908: Prof. G. H. **Carpenter.** Observations were given showing the uselessness of sprays recommended for destroying the eggs of the apple sucker (*Psylla mali*), the early stages of which are described and figured. The larva of the beetle *Dascillus cervinus*, which feeds on the roots of oats and cereals, is described, and some details of its external structure are given; in many respects it appears a remarkably primitive larval form. Attention was directed to the unusual abundance in Ireland during the autumn of 1908 of the laburnum moth (*Cemiostoma laburnella*).—The analysis of beeswax: Prof. Hugh **Ryan.** By a method in principle similar to, in detail different from, that of Hehner, the author determines the percentage of beeswax in mixtures of that substance with other waxes. The acid number of the wax is first found, sand is added, and the mixture is evaporated to dryness; the esters and hydrocarbons are then extracted with low-boiling petroleum-ether in a Soxhlet apparatus. From the percentage by weight of the free acids and the acidity of the wax, the percentage of cerotic acid can be calculated, and from the latter the amount of beeswax in the mixture. If Montana (Montan) wax and stearic acid be present, the method will yield incorrect results. In the latter case it will be necessary to find the percentage of hydrocarbons, and the mean molecular weight of the combined acids in the wax, before the true percentage of beeswax can be calculated. Analyses of waxes from Ireland, Chili, Sierra Leone, and Madagascar, and of an artificial wax composition containing, amongst other substances, Montana (Montan) wax, are given to illustrate the methods described.—Montanin and Montana (Montan) waxes: Prof. Hugh **Ryan** and T. **Dillon.** A sample of wax called Montana wax, identical with that known in Germany as Montan wax, examined by the authors, melted at 76° C., had an acid number 73·3, an ester number 0·6, and contained 47 per cent. of unsaponifiable matter. The iodine number of the wax was 16, and that of the unsaponifiable matter was 31·13. The saponifiable portion consisted of an acid (montanic), the molecular weight and analysis of which agreed with the formula $C_{28}H_{56}O_2$. Montanin wax is a white, hard, brittle wax of melting point 96° C., much higher than that of Montana wax, with specific gravity (15° C.) 0·980, acid number 56·9, ester number 1·0, and containing 34·8 per cent. of unsaponifiable matter. The acid liberated from the saponifiable matter proved to be montanic acid, and the unsaponifiable matter was identical in composition with that obtained from Montana wax. The great difference in the physical properties of the two waxes is due to the presence of 23·87 per cent. of sodium montanate in montanin wax, and the absence of the sodium salt from the Montana wax.

NEW SOUTH WALES.

Linnean Society, March 31.—Mr. C. Hedley, president, in the chair.—Notes on the geology of the Mount Flinders and Fassifern districts, Queensland: Dr. H. I. **Jensen.** Mount Flinders is a rugged peak attaining an altitude of 2240 feet, and situated about eleven or twelve miles S.S.E. of the town of Ipswich, Queensland. Surrounding the main peak there are a number of smaller cones and rugged rocks, most of which represent former parasitic vents or smaller foci of eruption which encircled the large volcano. It is noteworthy that the conical mountains are usually composed of breccia, with more or less of basic trachyte, dacite, and andesite, and, further, they are characterised by better soil (usually of a red or brown colour), and a thicker vegetation; patches of vine scrubs occur on them. The volcanic rocks of the Fassifern scrub are all post-Triassic, and probably post-Cretaceous. There seems to have been an old series of dolerites anterior to the trachytes, but the author has not satisfied himself on this point. The remaining links of the sequence are (1) trachyte, later (2) andesite, and still later (3) basalt.—Can opsonins be obtained directly from bacteria and yeasts? Dr. R. **Greig-Smith.** Since the inoculation of dead cultures of bacteria and the ingestion of yeast give rise to an increased production of opsonin in the blood, there is the possibility that this might be derived directly from the digestion of bacteria and yeast. Staphylococcus and yeast were attacked with pepsin and with pancreatic extract, but while anti-opsonin was clearly present, no evidence of the formation of opsonin could be obtained.—The coagulation of condensed milk: Dr. R. **Greig-Smith.** Condensed milk which became coagulated or "jellified" in the course of a few months was found to contain a micrococcus closely allied to *Staphylococcus albus*. Pure cultures of the micro-organism produced a coagulation in sterile condensed milk. The coagulation was hastened by the presence of traces of calcium carbonate, and the trouble appeared to have been aggravated by the small quantity of residual air in the tins.

PARIS.

Academy of Sciences, June 7.—M. Bouchard in the chair.—Presentation of the *Comptes rendus*, reports and communications of the first International Low Temperature Congress, Paris, October 5–12, 1909: M. **d'Arsonval.**—Presentation of a meridian catalogue of the Observatory of Bordeaux: B. **Baillaud.** The catalogue contains 6999 stars, the declinations of which are comprised between −15° and −20°.—Hertzian waves and Fredholm's equation: H. **Poincaré.**—Preparation of the three oxy- and the *p*-dimethylamido- and diethylamidobenzylidenecamphors and the *p*- and *m*-tolylidenecamphors: A. **Haller** and Ed. **Bauer.** A general method is given for the preparation of these substances by condensation of camphor with aldehydes in presence of sodium amide. The chemical and physical constants of several of these compounds are detailed, special attention being given to the influence of the introduction of various groups into the benzene ring upon the colour and optical properties.—Congruences the two focal surfaces of which are quadrics: C. **Guichard.**—The total eclipse of the moon of June 3, 1909, observed at Marseilles by MM. Borrelly and Coggia: H. **Bourget.**—Surfaces such that the geodesic lines of curvature are respectively functions of the principal corresponding curvatures: A. **Demoulin.**—A generalisation of the geometry of the cyclid: B. **Hostinsky.**—The altimetry of the Pelvous-Écrins *massif*: P. **Helbronner.** A preliminary paper giving the heights of thirty peaks. Comparison is made with data furnished by the *Carte de l'Etat-Major*, and the causes of the divergences discussed.—A physical representation of the θ-functions: H. **Larose.**—The standardisation of condensers: M. **Devaux-Charbonnel.** The results of the application of the tuning-fork method are described. The convenience and exactitude of this method (0·1 per cent.) is pointed out. The capacity of an air condenser was found to be constant and independent of the vibration frequency of the fork, but the capacity of a mica condenser was found to be slightly less with a higher frequency.—The absolute measurement of an electrical resistance in electrostatic units: M. **Hurmuzescu.**—Catalytic action produced by moisture: J. **Meynier.** Mixtures of dried nitric oxide and oxygen were treated with minute quantities of water vapour, freed from large ions by filtration through cotton wool. No proportionality could be traced between the velocity of the reaction and the amount of water vapour present.—Chemical reactions in gaseous mixtures submitted to very high pressures: E. **Briner** and A. **Wroczynski.** The gaseous mixture is liquefied by cold in a thick-walled tube, the latter sealed, and allowed to assume the ordinary temperature. Results are given for the mixtures (NO,HCl), (NO,SO_2), (HCl,SO_2), (NO,CH_3Cl), and (SO_2,O_2).—The hydrated combinations of thorium chloride with alkaline chlorides: Ed. **Chauvenet.**—Normal butine and some of its derivatives: Georges **Dupont.** The most satisfactory yields were obtained by starting from normal butyl alcohol; this was converted into butylene by the Senderens reaction, absorbed by bromine, and the resulting bromide heated with dry potash. The pure butine, $C_2H_5.C{\equiv}CH$, boils at 18·5° and melts at −130°. Numerous derivatives are described.—The synthesis of derivatives of racemic fenone: MM. **Bouveault** and **Levallois.**—The maltase from buck-

wheat: J. **Huerre.** This maltase acts between 3° C. and 70° C., the maximum effect being produced at 55° C. The activity is increased either by a partial neutralisation of the alkalinity or by the addition of amino-acids or acetamide.—Some Tertiary French basalts of the Alpine Vorland: Albert Michel **Lévy.**—The reddening of the branches of Salicornia: H. **Colin.** The accumulation in the plant cells of a considerable proportion of mineral compounds, such as sodium and magnesium chlorides, does not prevent the production of anthocyanine.—The influence of various nutritive media on the development of the embryos of *Pinus pinea*: J. **Lefèvre.** Sugar is the essential food of the embryo; small quantities of nitrogenous materials, such as peptones, are only accessory foods.—The phytogeographical subdivisions of the Kabylie of Djurdjura: G. **Lapie.**—Some observations relating to anaphylactic phenomena: P. **Delanoë.**—The effects of chocolate and coffee on uric acid and the purins: Pierre **Fauvel.** In a healthy man, on a vegetarian diet, chocolate and coffee increase the excretion of purins, diminish the excretion of uric acid, and prevent the precipitation of the latter, and this diminution of uric acid is not due to retention in the body.—The problem of kinematographic vision without vibrations: C. **de Proszynski.** The frequency of interposition of the shutter which cuts off the light during the motion of the film is increased from fourteen to fifty-six per second. In this way the painful vibratory sensation is completely suppressed.—The treatment of nœvus by electrolysis and radium combined: Fouveau **de Courmelles.** Positive electrolysis with multiple needles followed by the application of radium reduces the necessary time of treatment to three or four days.—The signification of the Rhabdospora, supposed parasitic Sporozoa in fishes: L. **Léger** and O. **Duboscq.** The conclusion is drawn that this is not a parasite, but a normal histological element in fishes, a glandular secretion cell, and hence that *Rhabdospora thelohani* should be deleted as a species.—The madrepores of the islands of San-Thomé and Prince (Gulf of Guinea): Ch. **Gravier.**—Contribution to the experimental analysis of the process of fecundation in the Amphibia: E. **Bataillon.**—The skeleton of the trunk and limbs of the fossil man of La Chapelle-aux-Saints: Marcellin **Boule.** The characters of the skeleton show that the fossil distinctly belongs to the human group. It presents, however, a mixture of characters; some correspond to those found in the lowest type of the existing races, others belong more to the anthropoid apes.—Earth induction currents in the Polar regions: Kr. **Birkeland.**—The compensation between the types of seasons in certain regions of the earth: H. Hildebrand **Hildebrandsson.**

DIARY OF SOCIETIES.

THURSDAY, JUNE 17.

ROYAL SOCIETY, at 4.30.—On the Origin of Certain Lines in the Spectrum of ε Orionis (Alnitam): Sir Norman Lockyer, K.C.B., F.R.S., F. E. Baxandall, and C. P. Butler.—On Electrostatic Induction through Solid Insulators: Prof. H. A. Wilson, F.R.S.—The Effect of Pressure on the Band Spectra of the Fluorides of the Metals of the Alkaline Earths: R. Rossi.—The Ionisation produced by an α Particle. Part I.: Dr. H. Geiger.—On the Diffuse Reflection of the α Particles: Dr. H. Geiger and E. Marsden.—The Decay of Surface Waves produced by a Superposed Layer of Viscous Fluid: W. J. Harrison.—The Passage of Electricity through Gaseous Mixtures: E. M. Wellisch.—A Study of the Use of Photographic Plates for the Recording of Position: Dr. C. E. K. Mees.—The Coefficients of Capacity and the Mutual Attractions or Repulsions of Two Electrified Spherical Conductors when close together: Dr. Alexander Russell.—On the Effect of Previous Magnetic History on Magnetisation.—Prof. E. Wilson, G. F. O'Dell and H. W. K. Jennings.

LINNEAN SOCIETY, at 8.—On the Growth of a Species of Battarea: J. G. A. Tepper.—The Deposits in the Indian Ocean: Sir John Murray, K.C.B., F.R.S.—The *Sealark* Perseidea, Stenopidea, and Reptantia: L. A. Borradaile.—The *Sealark* Polychæta. Part II.: F. A. Potts.—The *Sealark* Lepidoptera: T. Bainbrigge Fletcher.—New Species of Malesian and Philippine Ferns: Dr. H. Christ.—The African Species of Triumfetta, Linn: T. A. Sprague and J. Hutchinson.—The Acaulescent Species of Malvastrum: A. Gray and A. W. Hill.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Department. Annual Meeting.

FRIDAY, JUNE 18.

ROYAL INSTITUTION, at 9.—A Recent Visit to the Panama Canal: A. H. Savage Landor.

MONDAY, JUNE 21.

VICTORIA INSTITUTE, at 4.—Annual Meeting: Presidential Address by the Earl of Halsbury, F.R.S.

THURSDAY, JUNE 24.

ROYAL SOCIETY, at 4.30. (Meeting at the Royal Astronomical Society).—*Probable Papers*: The Possible Ancestors of the Horses living under Domestication. Part I., Introductory: Prof. J. C. Ewart, F.R.S.—The Electrical Reaction of Certain Bacteria, and an Application in the Detection of Tubercle Bacilli in Urine by Means of an Electric Current: Charles Russ.—(1) On Pressure Perpendicular to the Shear Planes in Finite Pure Shears; and on the Lengthening of Loaded Wires when Twisted; (2) The Wave Motion of a Revolving Shaft, and a Suggestion as to the Angular Momentum in a Beam of Circularly Polarised Light: Prof. J. H. Poynting, F.R.S.—Thermal Conductivity of Air and other Gases: George W. Todd.—The Effect of the Injection of Intra-cellular Constituents of Bacteria (Bacterial Endotoxins) on the Opsonising Action of the Serum of Healthy Rabbits: R. T. Hewlett.—On the Occurrence of Protandric Hermaphroditism in *Crepidula fornicata*: J. H. Orton.—The Alcoholic Ferment of Yeast-juice. Part IV., The Fermentation of Glucose, Mannose, and Fructose by Yeast-juice: Dr. A. Harden, F.R.S., and W. J. Young.—Studies of the Processes Operative in Solution. XI., The Displacement of Salts from Solution by Various Precipitants: Prof. H. E. Armstrong, F.R.S., and Dr. J. V. Eyre.—And other Papers.

FRIDAY, JUNE 25.

PHYSICAL SOCIETY, at 5.—A Transition Point in Zinc Amalgam: Prof. Carhart.—A Method of Producing an Intense Cadmium Spectrum, with a Proposal for the Use of Mercury and Cadmium as Standards in Refractometry: Dr. T. M. Lowry.—On the Measurement of Wave-length for High Frequency Electrical Oscillations: A. Campbell.—An Electro-magnetic Method of Studying the Theory of and Solving Algebraical Equations of any Degree: Dr. A. Russell and J. N. Alty.—The Sine Condition in Relation to the Coma of Optical Systems: S. D. Chalmers.—Exhibition of a new Fery Thermo-electric Calorimeter: C. V. Drysdale.—An Instrument for Measuring the Strength of an Intense Horizonal Magnetic Field: F. W. Jordan.—On a Method of Determining the Sensibility of a Balance: Prof. Poynting, F.R.S., and G. W. Todd.—The Balance as a Sensitive Barometer: G. W. Todd.

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