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ALL ABOUT WATER.

Water: Its Origin and Use. By William Coles-Finch. Pp. xxi+483; with illustrations. (London: Alston Rivers, Ltd., 1908.) Price 21*s.* net.

THERE is little about water on which Mr. Coles-Finch does not touch in this volume, for he even takes his readers back to the day when the world was but a glowing mist and oxygen would not have combined with hydrogen. The method has its disadvantages, though useful to anyone in want of an encyclopædic treatise, because the author has often to fall back on second-hand information, not even excluding the "science notes" of a daily journal. His manner of reference also is slipshod, for he is generally content with simply naming the author. But readers are not always trustful, and like to be enabled to consult the original passage—especially after coming across one or two rather puzzling misprints, such as Gretroz for Giétroz, Maindetta for Maladetta, Demavena for Demavend, Dun, perhaps for Dust, and Brunz (the name of a Swiss Lake), we presume for Brienz. Small inaccuracies—such motes as might so easily have been removed by inducing a friend more familiar with the scientific side of the subject to read the proof sheets—are rather too numerous. Here are a few samples. The difference between hard and soft water is said on p. 127 to consist in the relative quantities of carbonate of lime in it, yet just below come the words, "there are two kinds of hardness, permanent and temporary," the one due to the presence of calcium sulphate, the other to its carbonate. The amount of chalk in the world is probably over-estimated by forgetting that it means one, not every kind of limestone. Ice-fields are said, on p. 195, to form every winter on polar seas, but the author directly afterwards speaks of them as occurring on Iceland, and makes an extraordinary statement about those of Greenland. "The ice-fields of Greenland are beyond our comprehension; how high the plateau rises we cannot say. . . . No man has yet penetrated more than 130 miles from the west coast, where the ice is nearer the sea. It is related that explorers, after travelling 130 miles, saw a solid wall of ice 6000 feet high, and rising towards the east" (p. 195). Has he forgotten Nansen and the "First Crossing of Greenland," not to mention later explorations?

The statement about the "parallel roads" in Glenroy is confused. Also, the author is hardly justified in taking it for granted that the erratics near Wolverhampton mark the terminal moraine of a glacier, or that the Scandinavian ice-sheet successfully crossed the deep channel bordering the Norway coast, to deposit boulders at Cromer, and, as he might have added, at least as far inland as Bedford. The Lofoden Islands are hardly "a typical instance of the manner in which the sea has swallowed up the solid land" (p. 330), unless this is by submergence, which he clearly does not mean. They afford no parallel with Reculver Church. "The Lake of Campania in Italy" near Baiæ is usually called *Avernus* or Averno, and "Lake Chala on Mount Kilimanjaro" does not lie 400 to 800 feet below the summit, for, according to Meyer, Lake Jala, discovered by New, is "at the foot of Kilimanjaro on its south-eastern side." The Lago d'Alleghe in the Italian Tyrol was not formed by the terminal moraine of a vanished glacier, but by a berg fall in 1772. The height of the Lake of Geneva above sea-level is understated by about 70 feet. The maximum depths of the Lake of Constance and of the Lago Maggiore are incorrectly given. The Dead Sea can hardly be said to be "deeply embedded in lofty cliffs of limestone," and we have no reason to suppose that volcanic activity had much to do with forming the Lake of Tiberias. There is no eruption of Vesuvius on record until A.D. 79; it was an earthquake which damaged Pompeii in A.D. 63. The hippopotamus neither has a horn nor had one in the days of Palæolithic man (p. 240).

But, apart from these slips, and notwithstanding some defects of arrangement and a little too much sermonising, Mr. Coles-Finch's book contains a large amount of interesting information. We are told among the *obiter dicta* that Manchester soot comprises 50 per cent. of substances which are not carbon. Among these are "snow-white samples of ammonium chloride, ammonium sulphate, calcium sulphate, and a beautifully crystallised paraffin hydrocarbon." In fact, the heavy hydrocarbon oils in household soot amounted to 13 per cent., and Prof. E. Knecht, who analysed the material, manufactured from these components "a dye stuff which was capable of producing absolutely fast shades of brown on cotton"! We heartily sympathise with the author in his denunciation of the domestic fireplace, so much beloved in this country, for it often contributes about one-half the soot which fouls the atmosphere of London, and produces the minimum of effect at the maximum of cost. We would also gladly commit to his mercies the hooligans who wreck trees planted to adorn towns, and wilful wasters of water such as those who leave a tap running while they are away for a holiday in order to secure that their drains are scoured.

Perhaps the most valuable part of the volume is that dealing with practical matters, where Mr. Coles-Finch speaks from experience, such, for instance, as his description of a water-bearing fissure in the chalk, discovered at a depth of 120 feet while making a well at Strood for the supply of Rochester. Such fissures are, of course, well known as important sources of water supply in the Thames basin, but we do not remember to have seen in any book generally accessible plans, sections and illustrations of them.

The volume is abundantly illustrated by reproduced photographs, the majority of which have been taken in the High Alps and other mountain districts by Mrs. Aubrey Le Blond. Some of these, perhaps, are not very closely connected with the text, and Mr. Coles-Finch has too often failed to indicate by a reference the subject which a picture is meant to illustrate; but they are often so pretty as to add materially to the attractiveness of the volume; though in some, as will

happen in Alpine scenery, the rocks have come out too dark. Among the full-page illustrations, hoar-frost on a tree, a frozen lake in the Engadine, and a view at Ragaz strike us as particularly good. In fact, though the book is certainly not free from defects, it has not a few countervailing merits.

COLOUR AND PIGMENTS.

Colour-sense Training and Colour Using. By E. J. Taylor. Pp. 88. (London: Blackie and Son, Ltd., 1908.)

THIS should prove a very useful little book to teachers who wish to explain the fundamental laws of colour to their pupils. The old division of the spectrum into the three primaries—blue, yellow and red—still persists among artists and leads to much confusion of thought, and doubtless a book of this character will assist in bringing in a truer perception of the nature of colour-vision, while it is not so difficult as Prof. Church's book or Sir William Abney's "Colour Measurement and Mixture."

The author in dealing with this subject takes the ordinary Young-Helmholtz theory of the primary colour sensations, and is quite right in so doing. It is simpler, and at any rate covers most of the facts, and there is no need in a book of this character to discuss any rival theories which may exist. The weakest chapter in the book is that dealing with the mixing of pigments, and in a future edition this chapter might well be re-written and developed. One of the most important lessons the artist can learn from the study of the theory of colour is the extent to which he can limit his palette and get all the effects he requires. For instance, by means of a rich madder, cobalt yellow, viridian, and cobalt blue, every tint can be obtained, including a deep, rich, velvety black, while a complete spectrum can be constructed on a lower key by the use of black, Indian and Venetian red and yellow ochre, and it is therefore of great importance that the art student, having once mastered the theory, should test it by experiments with a few selected pigments, and should realise for himself that lampblack and yellow ochre really give a green, and that he can get practically a complete absorption of the spectrum from not more than three or four pigments.

It is also of importance that he should be trained to use a palette consisting of permanent pigments, and should avoid as far as possible those that are fugitive. It is therefore a pity to see in a modern text-book an artist advised to use such pigments as crimson lake, carmine, indigo and gamboge. These should all be excluded. The writer has also apparently not realised the extent to which his theory will assist the artist who wishes to paint in the method of the French impressionist school by the juxtaposition of small dots of colour instead of by an actual mixing of the pigments. If, for instance, blue and yellow are painted in small dots side by side, from a little distance the effect is to give a grey and not a green; in fact, green is the one colour which cannot be produced by such juxtaposition of pigment, but must be obtained either by the use of a green pigment or the mixing of a blue and yellow so as to leave the net result of their mutual absorptions. A short discussion, therefore, of the French method of painting as opposed to the method of mixing pigments, and a statement of the actual results obtained by the blending in the eye of the lights reflected from two separate pure pigments painted side by side, would be of great value to the modern artist. Most of our painters to-day make use of both methods to get their effects, and would probably be much helped by being taught a few fundamental principles. The only reference which the author has to this method of painting is to be found on p. 60, where he says the designers avoid dirty tones by placing the pigments very close, with the alternate colours in dots and dashes, but he does not seem to realise that the resulting colour may be quite different from that obtained by blending the pigments.

There is another difficulty which faces the artist in dealing with actual pigments, and which has not been discussed by the author. Many when mixed with white completely alter in tint, and the matter is not so simple as it would appear from the description in the text of the graded tones to be obtained in this way. To take a simple instance, the great value of yellow ochre to an artist is that it can be mixed with white without an alteration in the tint, so that the yellow ochre let down with white has the same colour value to the eye. This is not true of most other yellows, and consequently yellow ochre is invaluable for producing the effect of bright sunlight falling on a white surface. With reference to the training of children in the meaning of colour, it is open to question if the modern kindergarten methods are wise. The colours which are used in practice for training young children, and from which they are supposed to build up various patterns, are remarkable for their peculiar ugliness and the hideous colour schemes which result from them. Children grow up with a beautiful perception of true colour schemes in many lands where the kindergarten methods have never been heard of, and one of our greatest difficulties at present is that those engaged in trade processes which involve the use of colour have no fine sense of what is beautiful. It is surely an open question whether the hideous colours presented to very young children in the kindergarten classes are not positively injurious, and tend to destroy any instinctive taste for colour with which they have been endowed by nature.

THE ATLAS OF CANADA.

Atlas of Canada. Prepared under the direction of J. White. Pp. 21; 83 plates. (Canada: Department of the Interior, 1906.)

THIS atlas, which has been compiled with great care, shows, in a form which can usually if not always be easily comprehended, much of the information which is at present obtainable concerning the Great Dominion. It contains about forty maps, and rather more than that number of plates of diagrams.

Regarding the arrangement of the maps it is unfortunate that some method more in agreement with the principles of geographical development has not been followed; why the distribution of telegraphs and telephones should precede that of temperature and rainfall is not easy to understand. In a few cases also the maps might have been improved; it is to be regretted, for example, that some other method than that chosen was not adopted to show the physical features of the land, at least in the better-known parts of the country. To mark everything above 2000 feet in height in one of three shades of brown results in a map which is decidedly wanting in plasticity. The map showing drainage areas would also have been rendered more effective had it been printed in different colours.

The greatest defect, however, in this part of the atlas is the absence of a few maps illustrating and explaining the development of agriculture in Manitoba, Saskatchewan, and Alberta. The value of the book would have been enhanced by the introduction of some maps similar to those which accompanied Prof. Mavor's report to the Board of Trade on wheat-growing areas in Canada, showing the regions in which the cultivation of wheat is considered possible, the districts in which it is at present grown, the lands which have so far been occupied, &c.

Considerable attention has been paid to meteorology, and some valuable information is given. Besides the isothermal charts, which show temperature reduced to sea-level, and are therefore not particularly illuminating at first sight, in the case of Canada there are several interesting maps showing the number of days during the year in which the temperature is above 32°, 40°, 50°, 60°, and 70° respectively. It is to be hoped that in the course of time it will be possible to verify and extend this information, which is likely to be of great value in Canada, where it is directly connected with important agricultural problems. Unfortunately, we are not told over what period the observations have extended. Space will only permit us to remark that among the remaining maps there are several interesting ones showing the international boundary at various places, and several which show the railways of Canada, completed or projected, along with the sphere of influence of each system. To many of the maps also are appended useful tables of statistics.

That part of the atlas which is occupied by diagrams contains a great deal of valuable information, information of a kind, however, which in the case of a country like Canada begins to be out of date even before the publication of the work in which it is contained. Nevertheless, it suffices to show that within recent years the progress of Canada has been, on the whole, steady and continuous, even although the complete story of its development is not told here. A few examples will illustrate this. The occupied land has increased from 36,000,000 acres (of which 17,000,000 acres were "improved") in 1871 to 63,000,000 acres (of which 30,000,000 acres were "improved") in 1901. The wheat area has been largely extended, though we miss a few diagrams which would have made the extent of this increase visible at a glance.

The exploitation of the mineral wealth of Canada has increased very rapidly within the last twenty years, and is still increasing, notwithstanding the greatly decreased amount of gold which has been produced within the last few years. Regarding the forest products of the country, further information would have been welcome, and the same is true with regard to manufactures. The figures and diagrams which are given under this last head show that the capital invested had increased from 80,000,000 dollars in 1871 to 450,000,000 dollars in 1901, while the number of employees had risen from 180,000 to 313,000 during the same period. (The diagrams, however, do not make it clear how far these figures are comparable.) The chief manufacturing province is Ontario, while Quebec takes second place, and the remaining provinces are of less importance.

The most striking fact brought out by the series of diagrams on the foreign trade of the country is the extent to which the United States is taking the place of Great Britain as the chief importer into Canada. While Canada still sends more of her goods to this country than she does to the States, the latter country supplies her with more than twice the amount that Britain does. The latest figures given are for 1904, but since then the advance of the United States has been continued.

A number of diagrams deal with population in various aspects. One of these shows the distribution of males and females in the different provinces, and incidentally throws light on the conditions of life in different parts of the country. In British Columbia and the Territories, men outnumber women considerably; in Manitoba, Saskatchewan and Alberta to a less extent, and elsewhere only very slightly. The death-rate in all the provinces is less than the average for the British Isles, except in the case of Quebec, where it is higher. In 1891 Quebec was the most illiterate of all the provinces, but the large immigration from the continent of Europe during the following ten years has led to that position being taken by Alberta and Saskatchewan.

There is much in the atlas which it is impossible to touch upon in this review. We can only express our gratification that the Canadian Government has seen its way to publish so important and valuable a work, and hope that the Governments of other countries may follow in its steps.

ANIMAL HISTOLOGY.

A Text-book of the Principles of Animal Histology. By Ulric Dahlgren and Wm. A. Kepner. Pp. xiii + 515. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 16*s.* net.

IN many respects Messrs. Dahlgren and Kepner's "Principles of Animal Histology" may be regarded as a decided advance on the current text-book. It is no mere compilation; its method of treatment is novel, the subject-matter embraces a considerable amount of new and original work, and it presents a wider view of histological study than any previous treatise on the subject.

The scheme of the book is the study of structure

based on functional value, the functions of the various tissues and organs being discussed as an introduction to their intimate structure. The scope is necessarily a very wide one, and as a consequence the description of detail is in many cases limited, and in some cases tends to obscurity.

The authors confine their aim to general principles which shall serve as a broad foundation for further studies (*vide* preface). The treatise, however, is better adapted as a reference book for the more advanced student who has already some acquaintance with histological detail than as a guide to one commencing its study.

Although the function of the structure is the key-plan of the work, insufficient force is given to the mutual interdependence of the two, the significance of a structure as a functional adaptation being frequently lost sight of. The statement in the preface that "all structures exist only for the purpose of performing certain functions in some particular way" is dangerous and open to misinterpretation, while the statement in the text (p. 185) that nerve cells of a size beyond a definite limit "are obliged to develop in their cytoplasm a set of channels that will serve to increase the power of nutritive exchange" is open to more than criticism, and is misleading to a degree.

The various theories as to the intimate structure of protoplasm are fairly well given, but it is not made sufficiently clear that the hypothetical structure of protoplasm is largely founded on the examination of dead tissue, and that the appearances presented by tissues which have been treated by hardening and staining reagents may give a very inadequate picture of living matter.

Electrical and light-producing organs are dealt with in chapters replete with instruction and teeming with interest, but the treatment of gas and heat production is not so satisfactory. It is not sufficiently insisted upon that the production of heat is a necessary concomitant of most metabolic processes, while it is pushing the processes of *secretion* too far to suggest that heat is to be regarded as the outcome of certain specialised granules for which the term "thermochondria" is proposed (p. 141), or that the gas which fills the swim-bladder of a teleost fish first appears in special gas-secreting cells in the form of granules (p. 334).

Chondrostosis involves a bewildering succession of complicated changes, a convincing account of which has yet to be written. A perusal of its description in the work under notice (p. 70) will not bring confused ideas into order. The changes taking place are described as a *transformation* of hyaline cartilage into bone, that the process is fundamentally neoplastic not being recognised. The statement that "when ossification begins a vascular loop enters the bone bringing with it the various bone-making cells" endows the blood-vessel with a potency of active migration which it certainly does not possess; the so-called vascularisation of the cartilage certainly involves an active migration of cellular tissue, but the vessels which appear therein undoubtedly develop *in situ*. A description of the intermediate stage, the formation of a temporary metaplastic bone represented by the calcification of the cartilage, is omitted, the deposition of the lime salts being entirely ascribed to the osteoblasts. That the bone formation begins in the middle of the "joint" of an embryonic finger is a novel use of the term joint; it is perhaps popularly correct, but not to be expected in a scientific text-book as a term defining a digital segment. Bone, it is stated, can be formed in the connective tissue, but no account is given of parostosis, and this omission is a serious one.

Vertebrate histology, on the whole, receives scant treatment, and this will be felt in studying the abbreviated descriptions of the retina (p. 255 *et seq.*), the organ of Corti (p. 221), and the organs of digestion (chapter xv), but the authors hint that such matters are adequately dealt with in medical text-books, and this relative deficiency is more than compensated for by such able and comprehensive contributions as the sections dealing with nephridial tissues, mechanical protection, poisonous fluids, &c.

The book is richly illustrated; the figures, for the most part in black line, are exceedingly clear and instructive, and add vastly to the value of the work as a whole. Many of the illustrations are original; others are selected from well-known sources with a wise discrimination.

The chapter on "technic" (!), although very abbreviated, gives a good practical outline of general methods of hardening and staining, but the suggestions, scattered throughout the text, as to the methods for elucidating the details of special tissues are scanty in the extreme, and of no practical value.

The whole bibliography is slender; the authors seem to have relied largely on the results of their own original research; this, however, adds greatly to the intrinsic value of the work. Typographical errors are numerous; "Haidenhain" in the text, and the titles of French and German papers quoted on pp. 166, 173, 501, &c., stand in need of correction.

With some amendments in the text, a few more details concerning the preparation of tissues for examination, and a more complete bibliography, Messrs. Dahlgren and Kepner's treatise will prove an invaluable addition to the library of the biologist.

INDIAN WILD-FOWL.

The Indian Ducks and their Allies. By E. C. Stuart Baker. Pp. xi+292; illustrated. (Bombay: Natural History Society; London: R. H. Porter, 1908.) Price 21. 2s. net.

THE enormous flocks in which many members of the duck tribe visit the plains of India during the cold season, coupled with the relatively large number of species by which the group is there represented, affords ample justification for the issue of this handsome and superbly illustrated volume. For these swarms of ducks, geese, swans, and mergansers naturally attract the attention of a host of sportsmen, many of whom are anxious to identify the species of the birds which go to form their bag, and ascertain something about their natural history. Neither is the

book of less importance to the ornithologist—either professional or amateur—for Mr. Stuart Baker has much new matter to record concerning many of the species passed under review, while the thirty coloured plates—reproduced from sketches by Messrs. Grönvold, Lodge, and Keulemans—have a distinct scientific value of their own, altogether apart from their beauty as works of art.

The origin of the book dates from 1896, when the author was asked to communicate a series of illustrated articles on Indian ducks to the Journal of the Bombay Natural History Society which should incorporate the numerous notes on the group published in the Indian scientific journals and sporting papers since the issue of Hume and Marshall's well-known "Game-birds of India." These articles were commenced in the eleventh volume of the aforesaid serial, and the work now before us is a reprint of the series, with such additions and emendations as were necessary to bring them up to date.

Apart from the flamingoes, which are brigaded with the ducks under the general title of "Chenomorphæ," the author recognises no fewer than forty-three representatives of the group as visiting or permanently residing in India. He is, however, somewhat of a "splitter," and certain of his species, as in the goose-section, would very probably be relegated to a lower grade by many naturalists. We are also inclined to disagree with his views as to the multiplication of generic groups. The division of the flamingoes into two genera, and likewise the splitting of the brent-geese into Rufibrenta and Branta, are examples of what appears to us totally unnecessary complication in this matter. The author has, however, taken Count Salvadore's British Museum catalogue of the group as his guide, and he has adhered religiously to the classification therein adopted. We confess to a feeling that it would have been better to follow the late Dr. Blanford's volume in the "Fauna of British India," whereby greater simplicity would have been secured, and at the same time some advance made towards uniformity in the names of Indian animals. In this connection we may note the urgent need of a proper table of contents at the commencement of the volume, the one which does duty therefor being too absurd for words, two out of its half-dozen items being "title-page" and "contents," while a third is "Indian Ducks."

For a book which must be largely patronised by sportsmen (if it is to make a profit), we also venture to think that too many technical terms, or definitions, are introduced without any sort of explanation. What, for instance, will the sportsman (or, for that matter, the amateur naturalist) make of the bald statement that the Chenomorphæ are characterised by having the "palate desmognathous," or what will he understand by the "neotropical region"? If such expressions are used at all, they ought to be adequately explained; but in our opinion they are altogether out of place in a work of this nature; the professional naturalist does not want them, and the amateur and the sportsman do not understand them. In the place of the former a statement to the effect that the palate in the dry skull is of the closed or bridged type, and that the difference between the bridged and the open or slit type may be realised by comparing the skull of a duck with that of a fowl, would have been much more to the point; while as regards the latter it would have been infinitely better to use the ordinary names, South and Central America, in place of neotropical region.

With these exceptions—if it be added that the author has an extremely old-fashioned and obsolete way of spelling Indian place-names—we have nothing but commendation for the volume before us, the species being clearly and carefully described, with full and well-written notices of their distribution and habits. As Mr. Baker observes, the collection and collation of a vast amount of scattered information concerning the Indian Anatidæ renders it from the first possible to know the extent of our information on the subject, and to realise what gaps require filling up. The book should be in the library of every Indian sportsman, by whom it should be taken into camp in each winter's sporting trip. R. L.

BIOCHEMICAL MONOGRAPHS.

The Nature of Enzyme Action. By Dr. W. M. Bayliss, F.R.S. Pp. ix+90. (London: Longmans, Green and Co., 1908.) Price 3*s.* net.

The Chemical Constitution of the Proteins. By Dr. R. H. Aders Plimmer. In two parts. Part i., pp. xii+100; part ii., pp. xi+66. (London: Longmans, Green and Co., 1908.) Part i., 3*s.* net; part ii., 2*s.* 6*d.* net.

Neuere Ergebnisse auf dem Gebiete der speziellen Eiweisschemie. By Emil Abderhalden. Pp. 128. (Jena: G. Fischer, 1909.) Price 3.50 marks.

Intracellular Enzymes. A Course of Lectures given in the Physiological Laboratory, University of London. By Dr. H. M. Vernon. Pp. xi+240. (London: John Murray, 1908.) Price 7*s.* 6*d.* net.

THE number of books issued in any particular subject is not always a sure criterion of the importance of that subject. In this particular instance, however, where a shower of five monographs has suddenly fallen, not only is the interest which biochemistry is at present attracting indicated, but a perusal of the books themselves shows that they deal with a subject of supreme importance both to the chemist and to the biologist.

The first three on the list, that by Dr. Bayliss, and the two parts from the pen of Dr. Plimmer, are monographs which are being issued under the joint editorship of Dr. F. G. Hopkins, of Cambridge, and Dr. R. H. Aders Plimmer, of University College, London. To some extent the idea is similar to that underlying the issue of the "Ergebnisse der Physiologie" in Germany, only with this important difference, namely, that the individual monographs or chapters (each written by someone who is master in that particular subject) are issued independently of the others, so that if necessity arises a new edition of any

one of them can be printed without re-issuing the whole series. The rate of progress now being made in biochemical science is so rapid that this method of publication is the best that can be adopted for keeping abreast of increasing knowledge; and, in addition to this, those interested in any particular subject will be able to obtain the latest information at minimal expense.

Dr. Bayliss's essay on enzyme action is a fitting introduction to the series, not only because of its excellence, but also because it is becoming recognised that the action of ferments lies at the root of biochemical actions. Outside the living organism the same chemical changes can be made to occur, but only, as a rule, at a high temperature or by the aid of powerful reagents. In the body, the changes are produced at body temperature with far greater rapidity, and in the presence of moderate concentrations of acid or alkali. The enzymes responsible for this action are catalysts; that is to say, their presence induces a rapidity in the chemical transformation of the substances they come in contact with, in a manner analogous to that seen in the action of inorganic catalysts. Any deviation from the laws of catalytic phenomena which they exhibit depends upon the colloidal nature of the enzymes. This statement gives in brief the gist of the book. Such questions as the reversibility of ferment action, the nature of the compound between enzyme and substrate, and autocatalysis both positive and negative are also discussed, the whole forming an up-to-date, clear and readable exposition of our knowledge on this most important subject, a subject which Dr. Bayliss's own original work has done so much to elucidate.

Dr. Plimmer's work is a brief and masterly exposition of the present state of protein chemistry, and is most appropriately dedicated to Prof. Emil Fischer, whose epoch-making discoveries have done so much to render clear what before was so obscure. In the first of the two parts, the protein molecule as a whole is first examined, and then the individual amino-acids which form its constituent units are treated, and finally, in the second part, the attempts made by Fischer and his colleagues to build albumin from its constituent bricks are described. It is in this last aspect that the subject is least complete, because, although Fischer has been successful in forming short linkages of amino-acids which he terms polypeptides, and although some of the longer chains he has constructed bear a close resemblance to the peptones, it is well known that his ultimate aim, the synthesis of albumin itself, has not yet been realised. One cannot, however, doubt that this culmination of his work is only a matter of time.

Prof. Abderhalden, in his monograph, traverses much the same ground. He has been Prof. Fischer's right-hand man throughout his arduous work, and so is well fitted to expound it. His pamphlet is a reprint of the chapter he has written on the subject in Karl Oppenheimer's "Handbuch der Biochemie," which is now issuing from the press.

It must not be supposed that either Dr. Plimmer's or Prof. Abderhalden's contributions to the subject cover the whole ground. In Oppenheimer's handbook there are several other chapters on the proteins which deal with them from other points of view. There is, for instance, their importance from the biological side, and the *rôle* they play in life and in the metabolism of living cells. But before it is possible to understand that to the full, the chemistry of the protein molecule must be understood first. That is the foundation upon which the biologist must build, and that is the reason why so many researchers are spending their lives on the purely chemical aspect of this most important question. Proteins are the most abundant of the constituents of protoplasm; they are always present and never absent, and so far no other laboratory has succeeded in constructing them but the laboratory of the living cell. Chemists and biologists alike, however, are beginning to doubt whether proteins are exclusively endowed with the properties we term vital, and are beginning to direct their attention to some other substances which are universally present in protoplasm, and which manifest the character of lability to an even greater degree than do some of the proteins. These substances are termed lipoids, and cholesterin and lecithin may be taken as examples of the class. As a rule they are present in much smaller quantity than are the proteins, but they appear to be an indispensable part of the living molecule.

In Dr. Vernon's little book we return once more to the question of enzymes. It is the seventh of a series of books which Mr. Murray is issuing under the auspices of the University of London; like the others, it is the outcome of a course of lecures delivered in the physiological laboratory of that institution, and it will compare very favourably with its predecessors.

As already stated, it is becoming more and more clearly recognised that the activities of living protoplasm are bound up with the activities of ferments, the complex organic keys which are able to lock and unlock the unions between the elaborate molecular groups of which living material consists. The action of extra-cellular enzymes, such as pepsin and trypsin, which do their work outside the body-cells, has been familiar for many years. So also is the enzymatic activity of such micro-organisms as yeast and bacteria. But the conception that metabolism in the higher organisms is mainly the result of ferment action in their cells is a comparatively new aspect of the subject, and consequently the one in which the gaps in our knowledge are the most numerous. Dr. Vernon himself, by his original work on autolysis, on tissue erepsin, and other ferments of similar nature, has done a good deal to bridge over these intervals, and is therefore well fitted to lecture upon and write about the subject in a systematic manner. The book that he has produced is eminently readable and highly instructive, and its perusal should be thoughtfully undertaken by all those interested in the mechanism of the many problems presented to the student of animal and vegetable life. W. D. H.

ELEMENTARY MATHEMATICS.

(1) *Elementary Solid Geometry, including the Mensuration of the Simpler Solids.* By W. H. Jackson. Pp. xii+159. (London: Edward Arnold, 1907.) Price 2*s.* 6*d.*

(2) *Euclid Simplified in Accordance with the New University Regulations, with Additional Propositions and Numerous Examples.* Fourth edition. By Saradaranjan Ray. Pp. xvi+271. (Calcutta: The City Book Society.) Price 1.8 rupees.

(3) *A Preliminary Geometry.* By Noel S. Lydon. Pp. iv+108. (London: Methuen and Co., n.d.) Price 1*s.*

(4) *Examples in Elementary Mechanics, Practical, Graphical, and Theoretical.* By W. J. Dobbs. Pp. xii+344. (London: Methuen and Co., n.d.) Price 5*s.*

(1) THE study of three-dimensional geometry is generally more or less neglected in our schools; this excellent text-book should materially help to correct this fault; its effect on the reader is to enhance his sense of the importance and attractive nature of the subject. In part i. the properties of the line and plane and of the simpler curved surfaces are demonstrated with Euclidean rigour, but with a delightful freshness which recent reforms have done so much to encourage. Moreover, the numerous and well-chosen exercises, and the admirable figures and diagrams, are quite a feature of the book. Part ii. deals with the mensuration of solids. It is as effective as before; in style and treatment and in the diagrams and exercises the same high standard is maintained. Prof. Horace Lamb has written an appreciative preface, and there is no book on this branch of mathematics more worthy of adoption in our schools and colleges.

(2) In this geometry, in order to preserve continuity and for convenience of reference, the sequence and indeed the numbering of Euclid's propositions are maintained, while the arrangement is designed to meet the requirements of the new syllabus of geometry for the matriculation examination of the Calcutta University, which will be found very similar to the schedules now prevailing in this country. In remodelling Euclid according to this scheme, propositions of minor importance are relegated to the exercises, and new propositions are added. The enunciations and proofs are revised and often rewritten. Many exercises are provided. The book will appeal to those who wish to follow the new methods with as little departure from the old as possible, and who are not prepared to accept the reform in its entirety.

(3) This useful little book gives a simple and orderly course of practical geometry for beginners, intended as a preliminary to a formal and deductive study of the subject. The pupil becomes acquainted with the terminology and with the properties of the simpler plane figures, and to some extent is trained to use his reasoning faculties. The author is very successful in carrying out his scheme.

(4) The distinction between theoretical and applied mechanics is gradually losing its significance, and it is now generally recognised that the subject of mechanics cannot be satisfactorily taught without some amount of experimental and practical work done by the student himself. The present book is written from this point of view; the graduated series of examples, arranged in chapters, are experimental, numerical and graphical, and are accompanied by just sufficient explanation and discussion of principles as, with the guidance of a teacher, will enable the student to dispense with an ordinary text-book. The apparatus used, while effective for its purpose, is of the simplest character, and is for the most part made by the student himself. Statics is fully discussed before dynamics is taken up, a sequence which, we think, is the right one. The conception is good and well worked out, and the book will commend itself to many teachers.

TWO SPECULATIVE CONTRIBUTIONS TO GEOLOGY.

Die Entstehung der Kontinente, der Vulkane und Gebirge. By P. O. Köhler. Pp. vi+58; 2 figures. (Leipzig: W. Engelmann, 1908.) Price 1.60 marks.

Die geologischen Grundlagen der Abstammungslehre. By G. Steinmann. Pp. ix+284; 172 figures. (Leipzig: W. Engelmann, 1908.) Price 7 marks.

THESE two books have little in common except that they are both German speculative discussions of geological principles. Herr P. O. Köhler's pamphlet on the origin of continents, volcanoes, and mountains is a contribution to dynamical geology, in which he rejects some of the most generally accepted facts in geological morphology, and opposes especially some of the main conclusions of Prof. Suess. The author denies the existence of "Senkungsfelder," or foundered blocks of the earth's crust, and he declares that raised earth blocks—the Schollen of Suess—are statically impossible. Herr Köhler regards plutonic and volcanic intrusions as closely allied, and attaches great weight to the extent of plutonic activity; he describes the views of those whom he calls the "passive plutonists" as erroneous in all important respects, and he traces their errors to two chief fallacies—the secular cooling of the earth and its higher internal temperature.

Prof. Steinmann's book is a bold attempt to reclassify the animal and vegetable kingdoms. He advocates principles which, if not altogether new, have long been out of fashion and lead to startling and incredible results. Twenty years ago Prof. Steinmann was driven to study the bases of the current theory of phylogeny, as it would not fit the facts; and in this volume he gives a most interesting sketch of the history of the subject, followed by a statement of the principles and results obtained by his own long studies. Most palæontologists share Prof. Steinmann's faith in the importance of the historic evidence. The positive records of geology as to the succession of life on the world afford the ultimate test by which all theories of evolution must be judged. A sufficient volume of evidence may not be collected

for several generations, but when it comes its conclusions will have to be accepted, for it consists of the actual facts as to the development of life on the globe. The weight assigned by Steinmann to the value of the historic method is not exaggerated, but his methods of using it are open to question.

He advances two main principles, racial immortality and the primary importance of external characters. He emphatically denies the current belief that whole classes of animals and plants have become extinct. He says groups of animals always survive, though we fail to recognise the connection between successive generations. That organic variation should never have followed unsuitable directions and that there are no dead ends in the tree of life is a startling doctrine. This principle of racial immortality leads Prof. Steinmann to conclusions which are not likely to be generally accepted. The trilobites, according to his views, must have lineal descendants, and he finds that various insects are the progeny of different families of trilobites.

Prof. Steinmann's second principle is equally revolutionary. He holds (p. 119) that "for phylogeny the most significant characters are sculpture and form." Engineers have been driven to give torpedoes shapes which resemble those of some sharks, some Mesozoic marine reptiles and whales. This external similarity is usually regarded as an adaptation to the physical necessities of rapid progress through water; but this homoplastic explanation is rejected by Prof. Steinmann. In accordance with his view that form and sculpture are the best guides to relationships, he maintains that the whales are the direct descendants of Mesozoic reptiles. The numerous characters in which the Cetacea agree with mammals and differ from reptiles Prof. Steinmann dismisses as of secondary importance, and as due to a sort of zoological fashion. He maintains that their external resemblances show that the various Cetacea are derived from various groups of reptiles. The Delphinidæ (dolphins and porpoises), according to Steinmann, are the descendants of the Ichthyosaurians, the sperm whales of the Plesiosaurs, and the whalebone whales of such reptiles as Clidastes and Mosasaurus. Similarly, he derives the Casuaries from Ceratosaurus, the Patagonian Miocene bird Phororhacos from Belodon, and the walrus from Dinoceras.

Prof. Steinmann's views as to the relationships of various invertebrates and plants are equally startling. The tunicates he represents ingeniously as shell-less descendants of the Rudistidæ, and the characters believed to connect the ascidians with the ancestors of the invertebrates, he says, are of secondary importance, and have been recently acquired.

Prof. Steinmann has done such valuable work both in palæontology and geology that his views are always entitled to careful consideration; but he must not be surprised if the arguments in his present essay are generally dismissed as unconvincing, for they require the re-classification of both animal and vegetable kingdoms on lines which have been almost unanimously rejected by modern biologists.

J. W. G.

OUR BOOK SHELF.

Das Gebiss des Menschen und der Anthropomorphen. Vergleichend-anatomische Untersuchungen. Zugleich ein Beitrag zur menschlichen Stammgeschichte. By Dr. P. Adloff. Pp. 165; 9 text-figures, 27 plates. (Berlin: Julius Springer, 1908.) Price 15 marks.

THIS excellent book is part of the literature of an arduous if somewhat wordy warfare concerning the genealogy of mankind in general and of that variety in particular known as the "Neanderthal" or "Spy" man which broke out some years ago amongst the anatomists along the Rhine valley, and, as this work shows, is still being carried on with great vigour. The outbreak was really a consequence of the discovery of *Pithecanthropus erectus* by Eugène Dubois in 1894. In the light of that discovery, Prof. Schwalbe, of Strassburg, commenced a critical re-examination of the remains of the Neanderthal-Spy race, and came to the conclusion that they could not be regarded as ancestral to modern Europeans owing to their many physical peculiarities, and that they constituted a species of mankind, to which the name *Homo primigenius* was applied.

Prof. Kollmann, of Basel, slighted the specific marks assigned by Schwalbe to *Homo primigenius*, and set out to find the ancestry of modern man in a race of pygmies, with as yet but little success. Then came the discovery of the Krapina men in Croatia by Gorjanović-Kramberger, with teeth belonging to some ten individuals in excellent preservation, and of a type almost unknown among modern men. While the discoverer regarded the Krapina men as mere variants of modern man, Adloff excludes them from the ancestry of modern Europeans, and gives them the specific name of *Homo antiquus*.

The discussions and the disputes have been widened by the Dutch anatomists, Klaatsch (now in Breslau) and Bolk, of Amsterdam, the first of whom upholds the theory that man and anthropoids have sprung independently from a lemuroid stock, while the second maintains that the old-world apes and monkeys are derived from a stock akin to the South American monkeys. It was to clear up the points in dispute that Dr. Adloff produced the work under review; but it is to be feared their settlement is as far off as ever. Dr. Adloff has made a special study of teeth and has taken much pains to obtain access to all available material. He has described and figured all he has seen with accuracy, and thus produced a work which must prove of the greatest value to all who are investigating the problems connected with the origin of man. The facts will stand, but it is to be feared that most of the author's inferences are not of an abiding value. The discussion has scarcely received the attention it deserves in England; the present position of matters may be gleaned from this work.

A. K.

The Hope Reports. Vol. vi. (1906–8). Edited by Prof. E. B. Poulton, F.R.S. (Oxford: Printed for private circulation by H. Hart, 1908.)

THE memoirs contained in the bulky sixth volume of the Hope Reports were published separately in the course of the two years from June, 1906, to June, 1908. They bear eloquent witness to the quantity and quality of work which is being turned out by the Hope Department of Zoology in the University of Oxford. The first ten memoirs are chiefly or wholly concerned with bionomic subjects—*e.g.* particular cases of mimicry sometimes studied on the spot, the recent developments in the theory of mimicry, experiments on seasonally dimorphic forms, the natural

attitudes of rest in British moths, predaceous insects and their prey. A subject like the last, for instance, worked out by the cooperation of many naturalists, commends itself as zoological work of the soundest sort; it brings together a mass of trustworthy information in regard to insect natural history, it has an obvious bearing on the theory of selection, and it makes towards supplying a trustworthy basis for practical measures. Three of these interesting bionomical memoirs are contributed by Dr. F. A. Dixey, two by the Hope professor, and one each by Messrs. T. R. Bell, A. H. Hamm, S. L. Hinde, W. J. Kaye, and S. A. Neave. Three papers by Dr. Longstaff contain records of observations—chiefly bionomic—on insects met with in various parts of the world. Then follow papers, chiefly of a systematic nature, on Blattidæ by Mr. R. Shelford, on "grasshoppers" by Dr. J. L. Hancock, on beetles by Commander J. J. Walker. After these the volume ends, as it began, with bionomical inquiry, from which modern entomologists are seldom far away. We cannot look over a volume like this (reviving our recollections, in some cases, of papers we had read before) without feeling afresh that the entomologist, more, perhaps, than most naturalists, has his finger on the pulse of evolution. The Hope Reports show that he is not unaware of his great opportunities.

Calcul graphique et nomographie. By M. d'Ocagne. Pp. xxvi+392+xii. (Paris: Octave Dion, 1908.) Price 5 francs.

THE "Encyclopédie scientifique" of which this book forms one volume is intended ultimately to consist of 1000 volumes divided into 40 sections, written by specialists in different sciences, and edited by Dr. Toulouse. While aiming at the completeness of an encyclopædia, it differs from most publications bearing that name in that it consists of small volumes, each treating of one subject, instead of bulky volumes, each containing a number of widely diverse articles.

In this volume M. d'Ocagne deals with graphical methods of computation, a subject in the development of which he has himself played an important part. It is pointed out that such methods are sufficiently accurate for the solution of most problems, financial calculations and certain geodetic operations constituting an exception, though even in these graphic methods may play an important part. The first part of the book deals with graphical algebra and graphic methods of integration, the second with nomography. The latter subject is treated from two points of view, between which a kind of principle of duality exists—the method of concurrent lines, and the method of collinear points. In the former the relation between three variables is determined by the intersection of the lines corresponding to constant values of the respective variables; in the latter three straight or curved lines are scaled, and the simultaneous values of the variables are represented by collinear points on the scales which can be read off by laying a ruler across them. In Prof. d'Ocagne's hands this method has effected quite a revolution in simplifying numerical approximations, and it has the merit of being easily extended to more than three variables.

Mythenbildung und Erkenntnis. By G. F. Lipps. Pp. viii+312. (Leipzig: B. G. Teubner, 1907.) Price 5 marks.

THIS is an interesting contribution to the literature which in recent times has been filling up the gap between mathematics and philosophy. In it the author traces the origin of mythical superstitions in primitive races and their subsequent replacement by the critical methods of exact analysis. He further discusses the application of symbolic methods to the representation of phenomena connected with the universe, with existence, and with thought. The book forms a suitable sequel to Poincaré's "Science and Hypothesis," and is published in the form of the third of a series of books bearing the title of Poincaré's volume. While covering a somewhat different field, Dr. Lipps's method of treatment is more constructive in character. He has attempted to build up a connected theory rather than to ask the invariable question, Why?

The Old Yellow Book. By Charles W. Hadell. Pp. viii+cclxii+345. (Washington: Carnegie Institution, 1908.)

THE first part of this large volume consists of a complete photographic reproduction of the "Yellow Book," now in the library of Balliol College, which formed the theme of Browning's poem, "The Ring and the Book." This is followed by an English translation, as well as translations of two other sources of information relating to the Franceschini murder case, and an essay by the author on "The Making of a Great Poem." The photographic reproductions, as the author points out, are of first importance to secure the scholarly world against the possible destruction of the unique copy in Balliol College. At the same time, seeing that a few blemishes, due to creases in the original book, have been removed, and that the pages have been re-numbered, it seems a pity that the present book was not properly guillotined before being issued to the public.

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.*]

On the Magnetic Action of Sun-spots.

IT was perhaps to be expected that the recent discovery of the Zeeman effect in the spectra of sun-spots should revive the idea of a direct magnetic action originating in the sun and observable at the surface of the earth. A numerical estimate is therefore called for as to the magnitude of the disturbance which might be produced by such a direct action.

A solar vortex involving electric circulation, and consequently magnetic fields, will be most favourably placed to produce magnetic action if its apparent position is at the centre of the solar disc. If we consider the disturbed area, which for convenience I shall call the spot, as a magnetic pole, the first question that arises refers to the whereabouts of the opposite pole. We may place it at the further end of the solar diameter passing through the spot, and thus again assume the most favourable conditions. If, now, the vertical forces on the solar surface are treated as made up of a series of spherical harmonics, we need only consider the first term from which forces varying inversely as the cube of the distance are derived, because the numerical values of the forces derived from the higher terms are, at the distance of the earth, at least a hundred times weaker. Write, therefore, for the vertical force F

$$F = B\mu + \text{higher terms},$$

where μ is the cosine of the solar co-latitude measured from the spot.

The coefficient B is determined in the usual way by

$$\int_{-1}^{+1} F\mu d\mu = \tfrac{2}{3}B.$$

As the spot is confined to a small region, for which $\mu = 1$, and F has only finite values over this region and at the opposite pole, we may for the left-hand side of the

equation substitute $2Fa$, where a is the area of the spot measured in terms of the solar hemisphere. This leads to

$$B=3Fa.$$

The vertical force will not be constant over the whole spot area, but we may now take F to be the average vertical force, and its variations are immaterial when it is only a question of evaluating the order of magnitude of the effect. At the distance of the earth the corresponding force acting in a direction radial from the sun is equal to $3Fa\alpha^3$, where α is the angular semi-diameter of the sun as viewed from the earth ($\alpha^3=10^{-7}$).

If we adopt Zeeman's estimate of 3000 C.G.S. for F, the only remaining quantity to be estimated is a. We may take account of the greatest possible collective effect of all spots by imagining them all of the same polarity and placed at the centre of the solar disc; a then represents the total spotted area which may be obtained by reference to the Greenwich tables. If we include in the spot area the penumbra as well as the umbra, we find the average value to be about 500 in millionths of the sun's hemisphere, but in years of sun-spot maxima this number will be considerably exceeded. Taking the year 1893, which was the most prominent sun-spot year since 1870, I find that on August 7 the value of a was 5128 in the above units. Writing 0·005 for a, the radial solar force is found from the above expression to be $4{\cdot}5\times10^{-6}$ C.G.S. On the Greenwich curves such a force would be represented by a displacement of one-tenth of a millimetre.

The magnetic fields on the sun, on which our calculations are based, cannot, of course, form or disappear suddenly, and in view of the smallness of the effect the only question that can arise is whether, if persistent for a sufficiently long time, periodic variations might just be traceable. Some years ago I worked out in full the periodic effects of a magnetised and rotating sun (*Phil. Mag.*, vol. xlvi., p. 395, 1898). The main periods introduced are two, one of twenty-nine days, if the synodic revolution of the sun is twenty-seven days, and one equal in length to the sidereal day. (The period of twenty-seven days drops out altogether.) As regards the former period, it could only show itself if the magnetic state of the sun persisted for a sufficiently long period, and would probably even then escape detection owing to its smallness.

Similarly, the sidereal period would be hidden behind that of equal period and much larger amplitude which is introduced by the seasonal fluctuation of the ordinary diurnal period; but we need not enter into a detailed discussion of the possibility of tracing minute effects. My main object has been to show that the magnetic disturbance hitherto associated with the state of the sun's surface cannot be accounted for by the direct magnetic action of Prof. Hale's electric vortices.

ARTHUR SCHUSTER.

Kew Records of the Italian Earthquake.

THE accompanying traces show records of the Italian earthquake of December 28, 1908, given by the Milne seismograph and the declination magnetograph respectively at Kew. The former shows a very sudden arrival of seismic waves of some magnitude at 4h. 23·6m. a.m. (G.M.T.). If these represent "preliminary tremors" from an earthquake originating in Italy, about 2000 kilometres away, one would expect the large waves not to commence until some seven minutes later. Ordinarily, the maximum amplitude occurs some little time after the large waves commence. In the present case, however, the maximum is shown at either 4h. 31·1m. or 4h. 32·7m., the lateral traces overlapping at both these times. This means a movement of more than 17 mm. at the end of the boom.

It is unusual for the Kew magnetic curves to show any record whatever of earthquakes. On the few past occasions when the magnetic traces have shown anything, it has taken the shape of a burr of vague outline, indicating that the magnets have been put in oscillation. (Ordinary magnetic changes are not discontinuous, and for these the magnets are practically dead-beat.) The present occasion is, I think, unique in that not one, but several, of these burrs are distinctly visible in the original declination curve, though in a copy they will, I fear, be indistinct. The time scale is only 15mm. to the hour, and an uncertainty of at least 0·5 minute must be allowed in estimates of time. To prevent prejudice, the four burrs distinctly seen were measured prior to an inspection of the Milne trace, and the times allotted were respectively 32, 36, 40, and 47

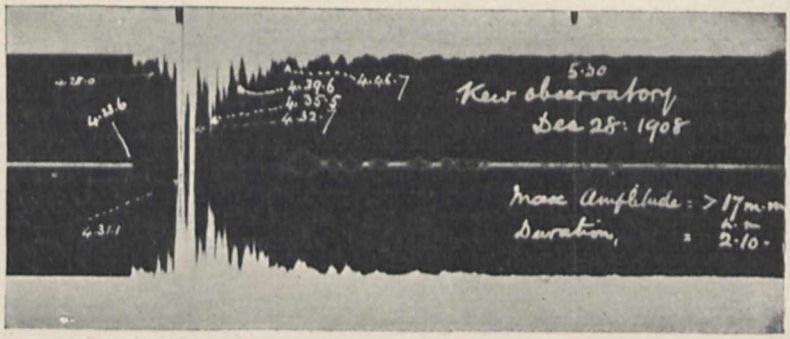


FIG. 1.

minutes after 4 a.m. These answer apparently to the seismic movements of which the measured times are 32·7 (or 31·1?), 35·5, 39·6, and 46·7 minutes after the hour. The original declination trace shows a distinct movement at 4·27, but this is of a different type, and may not be of seismic origin. There is also at 4.23 or 4.24 a very faint suggestion of movement. This may answer to the commencing seismic movement, but, unlike the other movements on the declination trace, it was not noticed until after the Milne record had been examined, and it should be regarded as doubtful.

The horizontal-force curve showed only one conspicuous burr, the measured time for which was 4·33. For some

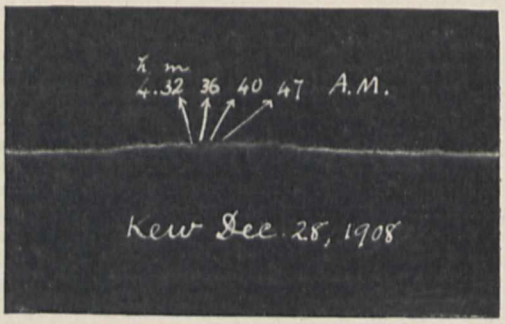


FIG. 2.

time prior to 4.23 the edge of the declination curve was pretty sharp, and apparently no disturbance existed. Any magnetic effect originating at the seat of the earthquake should have affected the Kew magnets several minutes in advance of the earliest seismic record. Thus in this case, at least, the movements shown on the magnetic curves are of purely mechanical origin—the magnetograph acting as a seismograph—or else they represent some magnetic effect arising in the near neighbourhood on the arrival there of the earthquake waves.

The periods of the declination and horizontal-force magnets and of the Milne boom are respectively about $10\frac{1}{2}$, $13\frac{1}{2}$, and $17\frac{1}{2}$ seconds, and as recorders of earthquakes

none of the three is dead-beat. Thus the apparent amplitudes of the records will depend on the proximity of the natural period to that of the seismic wave. This may account for the fact that whilst the seismograph and the horizontal-force magnet indicate a maximum of disturbance at from 4.31 to 4.33, the declination magnet indicated more disturbance at 4.36. A movement of 17 mm. on the seismic trace answers to a tilt of fully 9″, but it may be produced in a variety of ways, and no immediate deduction is possible as to either the character or the amplitude of the disturbing motion. C. CHREE.

January 1.

[Added January 4.—An examination of the glass scale used with the magnetic curves shows that a correction of about −0·5 minute is required to the times deduced by it. This brings the above times from the magnetic and seismic curves into even more perfect agreement.]

The Commercial Products of India.

IT is not customary for an author to reply to his reviewers, but I trust you will permit me to depart from that usage. Captain A. T. Gage, superintendent of the Royal Botanic Gardens, Calcutta, stands, to my recent work "The Commercial Products of India," in an entirely different position from an anonymous reviewer, and his opinion, as expressed in certain passages of the notice published in NATURE of December 17, 1908, therefore seems to me to call for a reply.

Captain Gage accuses me of having "unnecessarily spun out" certain articles by a "failure to discriminate between essential and superfluous information and between proved facts and mere opinions not worth recording." He then proceeds to exemplify that contention by quoting one sentence regarding tea. Removed from its context, that particular passage might fall under the condemnation he has passed upon it, but when read in connection with the sentences immediately preceding and following, its meaning and value are, I venture to think, abundantly brought out. The contention, it will be seen, is advanced that even in China tea appears to have been first used as a vegetable or medicine, and that it was not until the fourth century that its modern usage as a beverage began to attract attention. If I am justified in assuming that many of my readers may find interesting what had proved such to myself, it seems likely that the fact that the habit of tea drinking is not very ancient, even in China, will not be regarded as superfluous information.

Then, again, Captain Gage apparently objects to my method of exemplifying the failure, so far, with rhea cultivation in Kangra. I have given prominence (so he affirms) to the fascinating effect on myself personally of the undying faith of a very old lady. Now anyone at all familiar with the recurrent interest in rhea and China grass—aware, in fact, of the extent of capital even now at stake—would hesitate to pronounce rhea, as Captain Gage has done, "a distinctly doubtful crop." The fibre, at all events, is in itself immensely valuable, hence, in reviewing India's position in the controversy of future production, I felt myself compelled to give actual results in preference to dogmatic pronouncements. My position regarding India's future participation is briefly that, while we have the "undying faith" of some of the pioneers, the results so far attained have not been exactly favourable; but I have urged that there is distinctly a future for the crop when certain misleading statements and misconceptions have been effectively removed. In other words, I by no means concur with Captain Gage that rhea is "distinctly a doubtful crop."

But my reviewer has fallen foul of me because my abridged articles on tea and rhea (as he thinks) are longer than the originals. Perhaps I may be permitted to explain that the chief difficulty I experienced in writing the work in question was the necessity, imposed on me, to restrict and restrain my efforts on every hand by calculations or ratios of space to articles, and by the final accomplishment of the entire task within one volume. Captain Gage's criticisms on the science of circumscription are, in fact, examples of that very difficulty, only that he fails in the all-important detail of accuracy. If he will consult again the original work he will perhaps discover that it often happened that a subject was there dealt with under two or more positions. In the new work each had to be disposed of once and for all. Hence *Boehmeria nivea*—Rhea—does not have fifteen pages in the old and sixteen pages in the new work, as Captain Gage affirms, but sixty and sixteen pages respectively. So also *Camellia thea*—Tea—does not have fourteen pages in the old and thirty-five pages in the new work, as Captain Gage also affirms, but eighty-two and thirty-five respectively. The articles on these two subjects thus occupy, as near as possible, the exact spaces reserved for them in the scheme of the new publication. GEORGE WATT.

Richmond, December 19, 1908.

The Isothermal Layer of the Atmosphere.

I HAVE read with much interest the letters on this subject that appeared in NATURE during last February and March, and also the account of the discussion at the British Association (NATURE, October 1, 1908), and my only excuse for re-opening the question at this late date is that a point seems to have been overlooked which appears capable of explaining the phenomena without any appeal to an isothermal layer. Both in the correspondence and in the discussion several physicists cast doubt on the accuracy of the thermograms, but, so far as I have seen, only Mr. A. L. Rotch, at the British Association, mentioned that his instruments were verified for low temperatures and pressures. The following physical effect on the barographs does not appear to have been mentioned, and I should be glad to know what precautions are taken to eliminate it in practice. Pressures are necessarily registered by aneroids, and it appears to be assumed throughout all these discussions that a lower pressure on an aneroid means a higher altitude, but this is not so. In 1892, when I was a temporary observer in Ben Nevis Observatory, Mr. Edward Whymper visited the district to have some fourteen or fifteen aneroids of various sizes compared with the mercurial barometers at the low-level station, and as soon as possible afterwards at the top of the hill. It was invariably found that the indexes kept on falling after the aneroids had been brought to rest in the observatory. The rate of fall was at first fast, but became slower as time went on, and it depended upon the difference of pressures between the two stations and also upon the time taken in transit from one to the other, being greater for greater differences of pressure and less for longer times of transit. The aneroid would tend to give the true pressure immediately on arrival or after some hours, according as the standardisation had been rapid or slow. The effect is due to a kind of elastic fatigue, and was reversed on returning the aneroids to sea-level.

Mr. A. Mallock, F.R.S. (Proc. Roy. Soc., vol. lxxx., p. 530), has shown that up to the altitudes corresponding to pressures of about 100 millimetres of mercury the velocity of the balloons increases slightly, but at these altitudes it decreases so suddenly that the hypothetical balloons with which he deals must there have ceased rising. It is clear that at such altitudes the conditions are most favourable to the operation of elastic fatigue. The change of pressure to which the aneroid has been subjected is considerable; the time of ascent is fairly rapid, and the velocity is suddenly destroyed; but although the balloon may cease to rise, the apparent pressure does not cease to fall. Consequently, when the barogram is deciphered, if the effect of elastic fatigue is ignored, an increased height will be inferred at the same epoch as a constant temperature. There may even be an increase of temperature if the balloon should leak slightly or if the gas should be sluggish in acquiring the low temperature of the air into which it has risen, and, cooling somewhat, causes the balloon to descend slightly. It should be remembered that at these altitudes a small change of pressure corresponds to a very considerable change of altitude, so that this effect of fatigue would be greatly exaggerated. The great differences of altitude at which the isothermal layer

has been met would, on the above supposition, receive a simple explanation in the varying mean densities of the balloon and its contained gas on different occasions, since the balloon will come to rest when its mean density is equal to that of the air in which it floats.

In this connection it may not be out of place to recall that an increased velocity of the balloon does not indicate an ascensional current, nor does a decreased velocity indicate a downpour of air. In the latter case, what has more probably happened is that the balloon has crossed a surface of discontinuity in density, and is less buoyant.

J. I. CRAIG.

Survey Department, Giza, Egypt, December 5, 1908.

IT does not appear to me that the explanation suggested by Mr. Craig is tenable. I will first state that the instruments used in England are calibrated over the whole range of conditions to which they may be exposed by placing them in a glass vessel so that they are completely covered by liquid which has been cooled to the desired temperature by solid CO_2, and then exhausting the air by a pump. Thus the instrument is exposed at the same time to the conditions of pressure and temperature which it will meet with in use. This is done both before and after each ascent, unless, as sometimes happens, such damage is done by the finder as to render the second calibration impossible. On the Continent, at one station at least, and perhaps at most, the pressure is reduced slowly for the express purpose of meeting the point raised by Mr. Craig. In England, and for the same reason, air is generally left in the aneroid box. Very thin metal is used; the box is dried, the faces are squeezed together so that they nearly touch, and the box is then sealed up. The result is that the pressure scale depends on the elasticity of the enclosed air chiefly, and only slightly on the elasticity of the metal. Of course, there is a large correction for temperature which involves extra trouble in the calibration, but, on the whole, I believe this system to be the more accurate.

The lag of an aneroid box no doubt produces the results described by Mr. Craig, but the error so produced, when expressed as a percentage of the whole deflection of the box, is, I think, small. We have many records in which the isothermal part of the trace covers more than 100 mm. of pressure, and an error of this magnitude could not possibly be produced by the elastic fatigue of the box. Further, in general the balloons burst while they are rising; they start with an ascensional velocity of more than 600 feet per minute, and we have good ground for thinking that the pace is accelerated towards the top. They fall in about half the time they take to rise, and hence, unless there be an isothermal layer, the instrument cannot remain in air at the same temperature for sufficient time for the slow expansion of the box to take place. If further evidence is required it may be given in the fact that the up and down traces show, with hardly an exception, practically identical temperatures, especially in the isothermal region, where, if a lag came into play, they ought to be most divergent.

With regard to ascending and descending currents, we know from our experience with kites that such exist. The pressure of the air must be continuous, but discontinuity in the density may arise from an inversion, the temperature suddenly rising with the height. Five degrees centigrade is a not uncommon amount, but this means a change of density of less than 2 per cent. The free lift of a balloon in these ascents is about equal to the whole weight lifted, and hence a sudden change of 5° C. may mean a change of 4 per cent. in the free lift. To meet this the square of the velocity must change by 4 per cent. and the velocity by 2 per cent. This is of quite a different order to the observed variations in the vertical velocity, which in the lower strata may reach 50 or more per cent. It would be of interest to know the rate at which the gas inside approximates to the outside temperature, and the amount of difference which may arise from solar insolation.

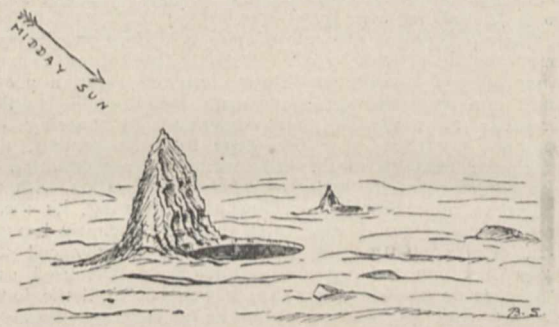
No doubt the point raised by Mr. Craig is an important one, and may lead to serious errors in the height unless especial care is taken to guard against it, but it cannot account for the observed phenomena. In England, at least, we have never claimed great accuracy in the recorded heights, and I do not believe such accuracy to be possible, but our traces show the commencement of the isothermal part at 10 to 12 kilometres, and the balloons often reach 18 kilometres. That elastic fatigue can account for the space between 11 and 18 kilometres is out of the question.

W. H. DINES.

Curious Effect of Surface Ablation of a Glacier.

DURING a traverse of the Gorner Glacier last summer, a peculiar feature in connection with the surface ablation came to my notice which I have never seen described or even referred to. I therefore venture to give a short description of this interesting phenomenon. The surface of the glacier is studded with the usual pools of clear water, due to clusters of small stones which become heated and sink some distance in the ice, the north and south retaining walls of the pool sloping in a northerly direction.

On the southern or sunny side of most of the pools there was a spine-like projection of ice standing vertically from the general surface, and tapering upwards to a jagged knife-edge with an east and west alignment. Upon the northern rather flat (or slightly concave?) sides of these spines there were sometimes vertical ridges, and at irregular intervals the remains of thin, horizontal shelves of ice, which represented former levels of the water in the



Spine-like projections of ice upon the sunny side of pools (formed by clusters of small stones) on the Gorner Glacier, August, 1908. Height about 18 inches.

pools. The sketch roughly shows this disposition. At the time there was no opportunity of making accurate measurements; many of the spines, however, were at least 18 inches high, and there appeared to be a proportional relation between the height, width, and breadth of the spine and the width and depth of the pool. Apparently each projection is the relic of what was the southern wall of the pool when the general surface of the glacier was at a higher level (as shown by the horizontal shelves of ice), and which by some means, perhaps partly because that wall is in shade, has been maintained at a low temperature, and thus enabled to resist the general surface ablation.

BERNARD SMITH.

Blackheath.

Moral Superiority?

Is this worthy of record as exceptional? I fed the birds with soft lumps of bread (not crumbs) this morning; there was a strong frost and 6 inches of snow. The first instant arrivals were two redbreasts and a blue tit. All three flew to the same lump of bread; but the little tit turned with fury on his two (ordinarily) combatant opponents, drove them away, and—while I watched—took his fill of the bread he had won until the usual crowd of sparrows appeared, when he decamped with what was left of his meal, and *then* the redbreasts—as always—ruled the roost.

F. C. CONSTABLE.

Wick Court, near Bristol, December 30, 1908.

SURVEYING FOR ARCHÆOLOGISTS.[1]

VI.—THE FINDING OF DATES.

(1) *By Solstitial Alignments.*

IN the astronomical study of ancient monuments, the archæologist's measures of azimuth and altitude enable him to determine the declination of the celestial bodies the rising and setting places of which are indicated by the direction of avenues or of outstanding stones seen from the centre of a circle.

But this, after all, is but the means to an end; it is only a first step.

The second step is to find, *if possible,* from the declinations, the time at which the sun or a star occupied these declinations. This tells us when the "ancient" stone monument was set out, and because the monument is an ancient one it is certain that the declination of the sun at a solstice and that of the stars were different from what they are now. I will deal with the sun first.

In consequence of causes which need not be gone into here, the angle between the plane of the earth's equator and of the ecliptic—called the obliquity of the ecliptic—is getting smaller. The result is that the sun's declination at a solstice, which defines the value of the obliquity, is less now than it was in times past.

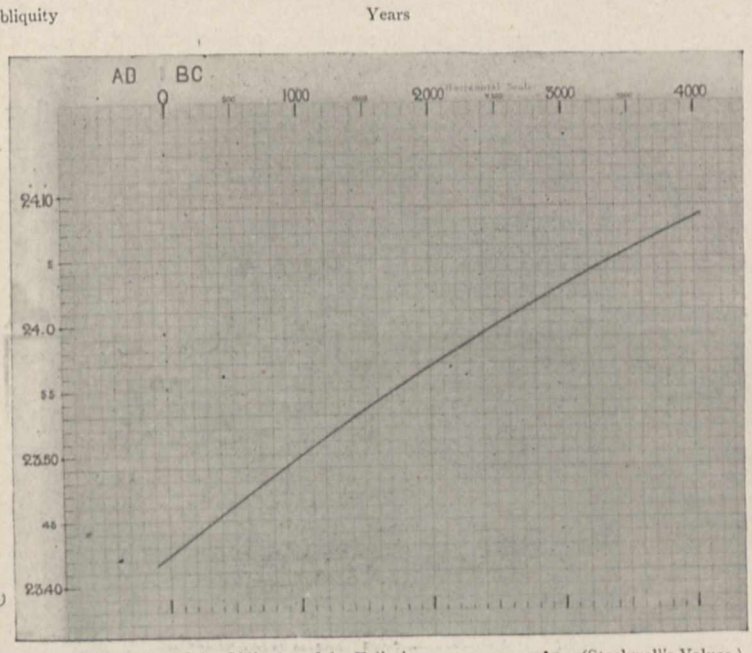


FIG. 25.—Variation of the Obliquity of the Ecliptic, 100 A.D.–4000 B.C. (Stockwell's Values.)

This rate of change is very slow, as will be gathered from the diagram—Fig. 25—a little more than half a degree in 4000 years. The present value is 23° 27′; in 1680 B.C., the date of the erection of the sarsens at Stonehenge, according to the measures made by Mr. Penrose and myself, it was 23° 55′.

Now in these latitudes this change of half a degree in declination produces a greater change in the azimuth. In a previous diagram I have given not only the solstitial azimuth at the present day, in lat. 50° N., but also that of 1680 B.C., showing that there is a difference of nearly one degree; still, this is not certain of detection considering monument conditions.

Hence, in attempting to deduce a definite date from a solstitial alignment, favourable conditions of the monument, such as the avenue at Stonehenge, and exceedingly careful observations are absolutely essential. Any others are practically valueless, because, as will be gathered from the curve, Fig. 25, an error of only 10′ in the derived declination produces an error of some 1300 years in the date.

It is only the solstitial alignment that can help us, in consequence of the sun then arriving at the extreme declination. An equinoctial alignment is of no use, because with any value of the obliquity the sun's declination at the equinox is always 0°.

From May–November alignments it is impossible to derive any date, owing to the rapidity with which the sun's declination changes at those seasons of the year—more than a quarter of a degree each day.

The only serious attempt so far to derive a date by an alignment to the solstice, using the change in the obliquity of the ecliptic, was made by Mr. Penrose and myself at Stonehenge, but there is little doubt that as our knowledge of the monuments increases other alignments as definite as the avenue at Stonehenge will be found.

The conditions of observation at Stonehenge will be gathered from Fig. 26, in which the line drawn through the centres of the naos, circle and vallum, and passing to the north of the Friar's Heel, represents the common direction of the avenue and of the axis of the temple.

(2) *By Stellar Alignments.*

In previous notes I showed how with certain data, including a measured azimuth and altitude, the declination of the star which rose on the alignment indicated by the monument could be found. Having this declination, the next step is to inquire which star occupied that position in times past, and *when*.

In dealing with stars, the problem of finding a date is much more within the possibility of observation than in the case of the sun. The stars change their declination 47° in 25,800 years, that is, 1° in 550 years on the average, and some stars at some times change it much more rapidly.

This relatively very great change in the declination of stars from century to century is brought about by the action of the sun and moon.

The action referred to does not depend upon the actual attractions of the sun and moon upon the earth as a whole, which are in the proportion of 120 to 1, but upon the difference of the attraction of each upon the earth's bulge at the equator, arising from the fact that the equatorial diameter is the larger. As the sun's distance is so great compared with the diameter of the earth, the differential effect of the sun's action is small; but, as the moon is so near, it is so considerable that her precessional action is three times that of the sun.

An important result of the action on the protuberance has now to be considered. The change in the position of the equator caused by the attraction is brought about by a rolling motion, which is necessarily accompanied by a change in the earth's axis.

In Fig. 27, *ab* represents the plane of the ecliptic, CQ a line perpendicular to it, *hfe* the position of the equator at any time at which it intersects the plane of the ecliptic in *e*. The position of the earth's axis is in the direction C*p*. When, by virtue of the precessional movement, the equator has taken up the

[1] Continued from vol. lxxviii., p. 574.

position *lkg*, crossing the plane of the ecliptic in *g*, the earth's axis will occupy the position C*p'*.

The lines C*p* and C*p'* have both the same inclination to CQ. It follows, therefore, that the motion of the earth's axis due to precession consists in a slow revolution round the axis of the celestial sphere, per-

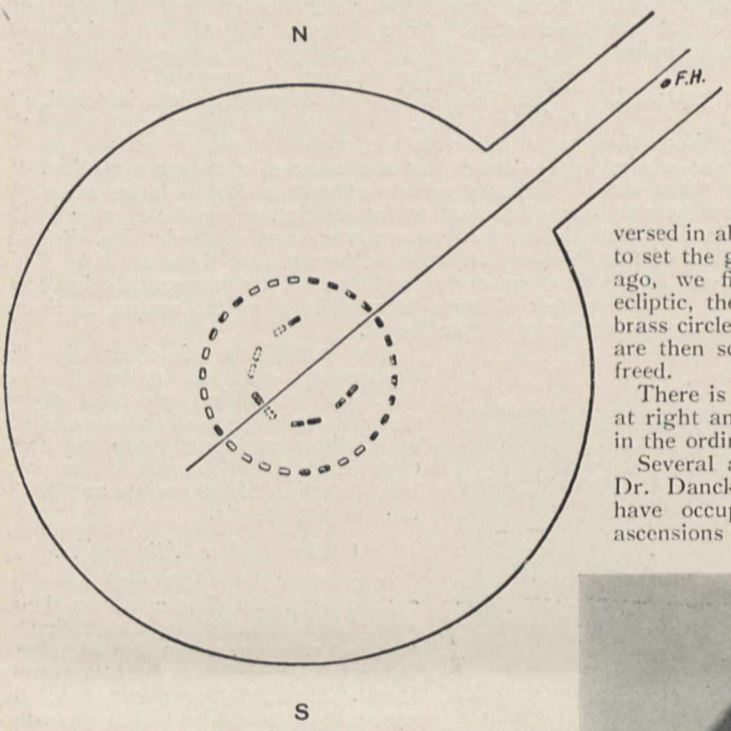


FIG. 26.—General Plan of Stonehenge; the outer circle, naos and avenue; F.H.=Friar's Heel.

pendicular to the plane of the ecliptic. During this movement, while the inclination of the two planes remains nearly 23½°, the position of the celestial pole, and consequently our pole star, are constantly changing.

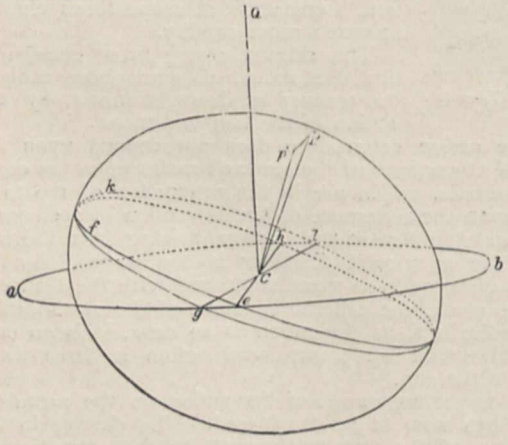


FIG. 27.—Showing the effects of precession on the position of the earth's axis.

An ordinary celestial globe represents the right ascensions and declinations of stars at some epoch near our own time, but some years ago I devised a globe in which the changes brought about by this precessional movement can be shown in a very concrete manner, so that the changes in position can be readily understood.

The precessional globe, as I called it, is, in fact, arranged so that the position of the celestial pole and equator, and consequently the positions of the stars, may be represented at any epoch. In the globe pivots are provided so that it may be turned on the pole of the ecliptic; round these at a radius of 23½° are brass circles (one of which is shown), with holes in them, each of which may also be used as a pivot. One pair of pivots on the latter circles corresponds to the present celestial poles, and represents the heavens as they are at the present time; the globe is arranged to turn on these, the ecliptic pivots being thrown out of gear. Other pivots on the brass circles correspond to other dates, the whole circle being traversed in about 25,800 years. For example, if we wish to set the globe to represent the conditions 2000 years ago, we first swing the globe on the poles of the ecliptic, then turn it until the desired points on the brass circle are brought under the other pivots. These are then screwed into position, and the first two are freed.

There is a brass meridian, passing round the globe at right angles to the horizon, which is graduated as in the ordinary celestial globe.

Several astronomers, including the late Mr. Hind, Dr. Danckworth, Dr. Lockyer, and Mr. Stockwell, have occupied themselves in calculating the right ascensions and declinations occupied by stars in past

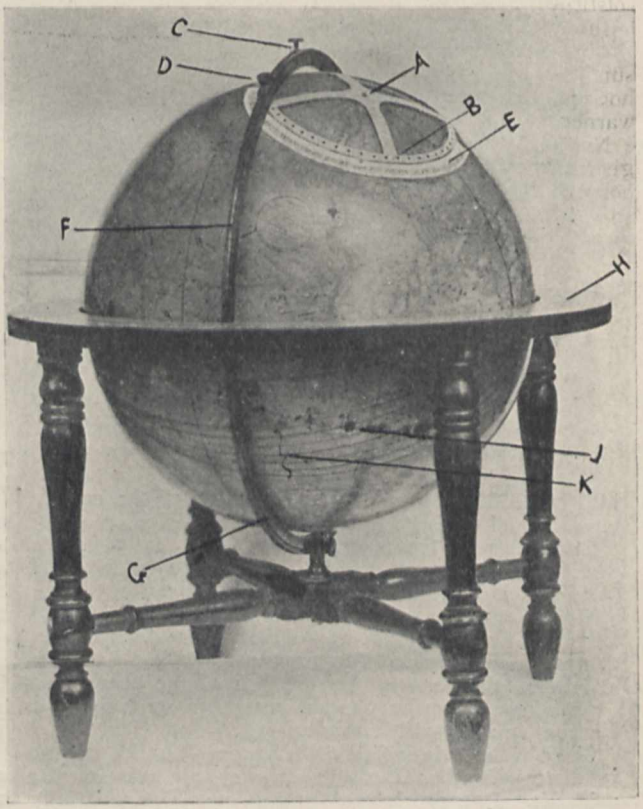


FIG. 28.—The Precessional Globe. A, Pole of ecliptic; B, brass circle, with holes on positions of celestial poles at different epochs; C, screw pivot for N. pole of ecliptic; D, screw pivot for N. celestial pole at different epochs; E, scale of years denoting position of celestial pole at definite epochs (set for 1364 B.C.); F–G, brass meridian; H, H, H, H, wooden horizon; J, ecliptic; K, celestial equators drawn for different epochs.

times. Curves given in "Stonehenge" (pp. 116–117) show the changing declination of the brightest stars—and this is the component of greatest importance to the archæologist—from 250 A.D. to 2150 B.C.

A glance at the curves will show that the same declination is occupied by different stars at different dates; hence it may happen that the declination found fits more than one star within probable date limits, and so we have to decide which is the more likely star to have been observed. It might at first sight seem that it would be difficult to settle which star is really in question. But in practice the difficulty does not often arise. We now know that the stars used were those in high northern or southern declinations for noting the time at night in the way the Egyptian temples have familiarised us with, and stars nearer the equator to serve as "morning stars," warners of sunrise.

The stars with about the dates already revealed by the work of the last few years may certainly be considered in the first instance.

It is really not a remarkable fact that so few stars are in question, for the use made of them was very definite. Capella, Arcturus, α Capricorni, Pleiades, and Antares almost exhaust the list.

The use of the precessional globe saves many intricate and laborious calculations when only an approximation is required. Thus warning stars at any quarter of the May or solstitial year at any given date may be found by rectifying the globe for the latitude of the place of observation, marking the equator at that date by a circle of water-colour paint by holding a camel's-hair pencil at the east point of the wooden horizon, and rotating the globe. The intersection of the equator and the ecliptic gives us the equinoxes at that date, their greatest separation the solstices. With these data we can mark the required position of the sun on the ecliptic.

This done, if we rotate the globe so as to bring the sun's place 10° below the upper surface of the wooden horizon, the star the rising of which can be used as a warner will be seen on the horizon.

Nor does the use of the globe end here. With a given azimuth, which are all marked on the wooden horizon, the globe may be adjusted to different dates and then rotated until at a certain date a star rises at that azimuth.

NORMAN LOCKYER.

GEODETIC SURVEYS.

THE latest volume (vol. xviii.) of the Great Trigonometrical Survey of India contains the records of astronomical observations for latitude extending over the last twenty years. It is, in effect, the continuation of vol. xi., and brings this particular department of Indian Survey statistics up to date. It consists chiefly of tabulated records; 543 pages alone in part ii. being absorbed by tables of astronomical latitudes. There is therefore nothing to offer in the way of remark or criticism on the great bulk of detail contained in this volume except congratulation on the completion of a work involving so much labour in compilation. It is, perhaps, the most interesting of the whole series of Great Trigonometrical Survey records, and the interest of it to the general reader lies in the preface, where Colonel Burrard, in plain and simple language, gives the reasons for the faith that is in him as regards the present position of geodetic work in India.

To those who have pinned their faith to the rigid accuracy of geodetic triangulation as the basis of fixed points for the further extension of minor systems of triangulation and of topographical survey, it may at first sight appear somewhat disturbing to be assured that there is no finality in sight for the value of any fixed point in India, either in latitude, longitude or altitude. Geodetic science can only develop on a system of trial and error. Only by the most rigidly exact systems of measurement possible to human agency can the shape of the earth's figure be precisely determined, and only, when the precise shape of that figure has been determined, can geodetic calculations be satisfactorily computed. Hitherto these calculations in India have been based on an assumed earth-figure known as Everest's spheroid, and although this assumption is not absolutely justified by continuous observation, Col. Burrard rightly maintains that it would be a mistake to break the continuity (and thereby destroy much of the value) of the Great Trigonometrical Survey series by the introduction of tables based on new, and possibly only half-digested, data. Similarly he pleads for absolute accuracy in the determination of latitudes, for it is only when the riddle of the earth's shape shall be solved by the men of science of the future, and the pathway to positive deductions therefrom straightened out, that the full value of this most remarkable body of results (obtained by new and more perfect instruments from observations of stars of which the position is now more certainly known than heretofore) can be effectively utilised.

The deflection of the plumb-line forms one of the principal subjects of scientific investigation of which the record is to be found in this book. This deflection is determined by the difference in latitude obtained for any fixed point between the results of geodetic triangulation and of astronomical observation. For reasons already suggested in connection with the assumption of the earth's figure, as well as the fact that the origin of geodetic latitudes in India (at the Kalianpur base) is itself an assumption, there still remains an element of uncertainty in these determinations. They are exceedingly interesting. "In the Himalayas" (which is, perhaps, a slightly vague definition) the deflection amounts to −35·29s.; at the foot of the Himalayas it is −10·90s.; in central India it amounts to +0·94s. But it must be remembered that in dealing with this matter of rigid accuracy we have still to reckon with minutely small errors, quantities that are immaterial for the practical purpose of supplying a basis for map-making. For instance, the most improved methods of observing with the best of new instruments only displaces the assumed value of the Kalianpur latitude by 0·3″. In the matter of longitude there is, however, a recognised error of 2′ 27″, which is an error too large to be neglected. This has to be eliminated from Indian mapping; although, again, Col. Burrard deprecates any interference with the continuity of Great Trigonometrical Survey records in the series ended by this eighteenth volume. To this extent Indian topography and Indian geodesy must remain discrepant for a space of time.

There is, however, one element of disruption in Indian Geodetic Survey work with which no man of science can deal. This is caused by earthquakes, and the resulting displacement of mark-stones is not easily determined. There may be little relative displacement over a large area, whilst the absolute displacement of the whole area may be considerable. It is impossible to re-triangulate the vast spaces which would be necessary to determine this, nor does it appear to be at all easy to discover what may be the effect of such disturbances in altitude. The most careful levelling (three times repeated) over the eighteen miles separating Dehra from Mussoorie only revealed a probable diminution of 5½ inches in the Himalayan altitudes at Mussoorie after the latest, and most violent, earthquake. Meanwhile geodetic science fulfils its mission admirably in the great practical work of establishing the basis for topographical surveys. These never can be affected by those small geodetic adjustments which are all-important to the scientific theorist, although it

is quite possible that such displacements as are caused by earthquakes might be troublesome to the map-maker. Topography, however, can never be final; never (under some conditions) complete. Col. Burrard, in his admirable preface, aptly quotes the shifting Indus as a case in point. Could the whole Indus valley be surveyed in any one year we could then say "that was the course of the Indus in the year ——." As it is we can never hope to possess an accurate topographical representation of the Indus from the mountains to the sea at any one time—nor does it much matter if we cannot.

The expense and the labour of geodetic triangulation undoubtedly imposes certain limitations on its practical use, and probably no record in scientific history of its misapplication is more remarkable than that which may be found in the Government report on the Boundary Survey between British Bechuanaland and German South-west Africa. Here an elaborate series was extended at a ridiculous cost, and involving the labour of several years, in order to determine the position of a meridian line (running through the Kalahari desert) which had been defined by diplomats in England as the only possible boundary. The possibility of the existence of gold or diamond mines demanded an exact and visible demarcation no doubt; but where that demarcation was carried through the undeveloped and waterless wilderness was not a matter of significance, provided it were somewhere near the defined line. It may be that the meridian (almost the worst boundary definition possible) was without an alternative, in which case a most important word must have been inadvertently omitted from the protocol, or agreement. That word was "approximate." A free use of it in the original definition, and a liberal interpretation of it in the field, would have enabled a topographer to run a plane-table traverse quite sufficiently close to the meridian on a "chronometric" longitude to have fixed up the boundary marks as he proceeded, and so to have completed the whole boundary in, say, one-fifth the time and at one-tenth the expense of the geodetic determination. It is not as if this geodetic determination resulted in rigid (and unnecessary) accuracy. Col. Burrard's preface to his eighteenth volume at once disposes of any such possible pretension; nor is it as if it formed the basis for useful topography, for not a square mile of topography resulted. The only result is a possibly useful basis for the extension of future triangulation in German territory—and for this the German Government should have paid.

T. H. H.

THE RÔLE OF LIQUID CRYSTALS IN NATURE.

THIRTY-SIX years have elapsed since Prof. Otto Lehmann, while a student at Stuttgart, designed a novel form of microscope which permitted of the optical examination of substances at temperatures differing considerably from that of the surrounding air, and thus obtained access to an almost virgin field for research, to the cultivation of which he has strenuously devoted himself. The results of a long series of observations were collected and published in the form of the fine volume entitled "Flüssige Krystalle," which was noticed in NATURE in 1904 (vol. lxx., p. 622). Prof. Lehmann, however, by no means intended that work to constitute his last word on the subject, and, as is testified by the numerous papers which have since that date appeared from his pen in various journals, he has in no way relaxed his efforts in the prosecution of his investigations. Of recent years, moreover, other workers have in greater number been attracted to the subject, and their observations are, on the whole, in harmony with his, and confirm the substantial correctness of the views he has put forward. In particular, mention may be made of Prof. D. Vorländer's extensive investigations of the azoxy-compounds. Although there was in early days, not unnaturally, considerable scepticism regarding the correctness of Prof. Lehmann's observations and the deductions he made from them, there is at the present time little reason to doubt the reality of the existence of anisotropic liquids and the importance of the *rôle* they play.

At first sight it may seem ridiculous and absurd to suppose that any immediate relation can subsist between the properties of liquids and crystallised matter. The study of the characters of crystals has demonstrated that the molecules composing a crystal are regularly arranged at the nodes of the corresponding space-lattice. Such a structure possesses great rigidity, a character incompatible with the mobility of a liquid. It is, indeed, very probable, as Mr. William Barlow suggests, that the spheres of influence of the constituent atoms are all in contact with their immediate neighbours, and the molecule has no separate entity in the crystal. On the other hand, in a gas the molecules have clearly a distinct existence; they are in constant motion, and for the greater part of their course are remote from one another, and, if not kept within bounds in some way, would altogether part company. It is not difficult to suppose that a liquid may be a compromise between such different states; it may retain, though to a lesser degree, both the regularity of the solid and the mobility of the gas. That extreme rigidity is not an essential property of a crystalline structure is evinced by certain minerals—mica being a conspicuous example—which are susceptible of considerable bending without permanent derangement of the structure. Solid substances break when the limit of elasticity is reached, or, in other words, when no further slipping of the spheres of influence upon one another is possible without a collapse of the equilibrium. There are, however, substances with small rigidity in which a greater amount of shear is possible; to these viscous substances, of which the melted modification of silver iodide is a familiar instance, Prof. Lehmann applied the term "fliessende Krystalle." Finally there are substances with almost negligible rigidity in which so much relative slipping is possible without a collapse that, though anisotropic, they are as mobile as water; these he has called "flüssige Krystalle."

No sharp distinction can, however, be drawn between the three groups. Indeed, one curious substance, the ethyl *para*-azoxycinnamate, has been discovered which is solid in the direction of the principal axis, but fluid at right angles thereto. Further, some substances, such as cholesterylcaprinate, have two liquid modifications. Certain of them—*para*-azoxyanisol, for instance—become turbid on melting, but on increased heating suddenly clarify at a definite temperature. The turbid liquid was at first supposed by many physicists to be an emulsion; but recent investigations by Dr. R. Schenk and Dr. A. C. de Kock indicate that the turbid liquid is a homogeneous phase. The mutually repulsive action—possibly an electromagnetic phenomenon—that characterises the molecules of a gas takes in a liquid the form of an "expansion-force," as it is termed by Prof. Lehmann. This force varies in different directions according to the symmetry of the molecule, and consequently the envelope of the liquid crystal, as seen in the microscope, is polyhedral, the corners being rounded owing to the effect of surface-tension. The contour is circular when the expansion-force is nearly

uniform in all directions, or is small compared with the surface-tension. This tension is merely a convenient way of expressing the resultant effect of the mutual attractions between the molecules upon the envelope. The curious myelin forms developed when certain fatty substances are dissolved in water are an interesting illustration of this phenomenon. It has recently been discovered that, while the interior is isotropic, the envelope is liquid-crystalline, and that the typical marrow-like shape results from the preponderance of the latter; the contour is circular when the envelope is thin. It was with some hesitation that Prof. Lehmann proposed the extended signification of the word crystal; it is, however, difficult to suggest an alternative, and, etymologically at least, a good claim may be made out for its use to denote the fluid form.

That crystals, when placed in the saturated mother liquor, grow and have the power of healing fractures are characteristics so similar to the attributes of certain of the lower organisms that they suggest the possibility of crystallised matter being a form of life; but a little consideration raises insuperable objections to such a theory. Prof. Lehmann's researches, however, throw fresh light upon the problem, and he ventures with some confidence to assert, not that crystals themselves are living, but that crystallisation is the agency made use of by living growth. A glass or jelly, or any other amorphous substance, does not grow; on cooling it passes gradually from the melted to the solid condition, and forms about a large number of nuclei, just as happens in the condensation of vapour. Crystallisation is a very different phenomenon; the growth is rapid and the nuclei are comparatively few. The distinction consists in the want of homogeneity of an amorphous substance, which results in the neutralisation of the intermolecular action. In such a substance doubtless several arrangements of the constituent parts are possible for equilibrium, and though there may be uniformity over a not inconsiderable region—judged by molecular dimensions—the resultant effect is chaos. Prof. Lehmann noticed further that liquid crystals, when under the influence of a magnetic field, coalesce and range themselves with their axes in the direction of the lines of force; in other words, the growth of an individual takes place. In fact, the similarity in aspect and behaviour between certain liquid crystals and bacteria is remarkable, and can scarcely be accidental. Prof. Lehmann suggests that in life the directional force is that mysterious essence so much discussed and so little understood—the soul. In support of this bold hypothesis he puts forward many cogent arguments and marshals an array of facts, but much work and consideration are necessary before it can be accepted with any confidence. Nevertheless, it must be admitted that Prof. Lehmann has made an important contribution to the solution of the great question confronting alike science and philosophy—what is life? G. F. H. S.

METEOROLOGICAL REPORTS BY WIRELESS TELEGRAPHY.

THE British Meteorological Office is making arrangements in conjunction with the Deutsche Seewarte, Hamburg, for an experiment in the transmission of meteorological reports by wireless telegraphy. The intention is to make an experiment extending over a period of three months. It was anticipated that arrangements would be concluded in time for commencement with the New Year. It has been found necessary, however, to postpone the actual experiment until February. In the meantime the preparations for the transmission to the Meteorological Office of reports from the ships of the Allan, American, Anchor, Atlantic Transport, Canadian Pacific, Cunard, Dominion, Red Star, and White Star lines have been completed, so far as they can be without trial, and the agents of the Marconi Company in London have already notified their officials to proceed from January 1.

There are many points as to instruments and other matters likely to arise which can only be solved by experience, and the position for effective cooperation will be improved by a trial of the arrangements in view. With this object, instructions as to observations and forwarding the information have been sent to the lines which are so courteously aiding this experiment, and full advantage is being taken to secure observations at once, and to avoid the loss of information for so important a month as January. Wireless telegrams from ships in different parts of the Atlantic may be expected now at any time. The disturbances which exert such an important influence on our weather, especially in the winter, arrive almost without exception from the Atlantic, and it is believed that observations showing the movements of these disturbances will materially add to our knowledge of the weather changes, and aid in weather forecasting.

THE ITALIAN EARTHQUAKE.

NEVER had earthquake taken such toll of human life as that which has just devastated Calabria. Hundreds had been killed by a single earthquake, or thousands, exceptionally the number had run to tens of thousands, but the Yeddo—now Tokio—earthquake of 1703, with its death-roll of 200,000, had stood in a class by itself; yet even this great number seems insufficient to count the deaths on the morning of December 28, 1908, and if to those whose lives were ended by the immediate effects of the earthquake we add the subsequent deaths from injury, exposure, and sickness, the loss will amount to well over a quarter of a million lives.

In face of such a disaster humanity, staggered at first, has thought of nothing but relief or palliation, and the daily newspapers, filled with accounts of destruction, misery and rescue, have contained little information from which we can form a proper judgment of the nature of the shock or its magnitude. This much, however, is clear, that the earthquake was of the first order, not so great, perhaps, as the Californian or Chilian earthquakes of 1906, but far greater than the Calabrian ones of 1905 and 1907, and as great as either of the celebrated earthquakes in 1783, which caused 40,000 deaths in the same districts as have just suffered an even greater loss of life.

From Pizzo the band of destruction extends southwards for about 50 miles through ill-starred Monteleone, which no earthquake seems to spare, Palmi, and Bagnara, to Reggio di Calabria. In Sicily Messina has been destroyed, and Gazzi, but except from this narrow strip of country we have few reports. Catanzaro suffered, to what extent does not appear, and at Cosenza the damage was great; in Sicily houses were destroyed in San Filippo, near Milazzo, and many were damaged in Caltanisetta and Noto, yet Catania escaped uninjured, and at Taormina only one building is said to have suffered any injury. The shock was felt, though slight, at Brindisi and Taranto, at Naples and Castellamare, and at Palermo the population fled in terror into the streets, though no damage was done.

From the interior of Aspromonte no news has come as yet, but the scanty information, summarised above, is enough to show that this earthquake, like most of those in Calabria and Sicily, was polycentric, originat-

ing, not from a single focus or centrum, but from a number of centres of greater intensity, the greatest of which lay close to the coast and for the most part beneath the sea. Moreover, it was no mere earth*quake*, but one of those great disturbances by which the whole world is shaken, which penetrate deep into its substance, and result in a permanent alteration of its shape. This would be sufficiently proved by the great sea wave which washed the shores of the Straits of Messina and the Tyrrhenian Sea, which swept over Messina and Reggio with a height of 30 feet, which caused three deaths at Catania and reached at least as far as Malta. This wave could only have originated in a great displacement of the bed of the sea, the nature of which is indicated by the narrative of the captain of the *Hopewell;* according to him, the boat, which was passing through the Straits at the time of the earthquake, seemed to leap into the air, as if a mine had exploded underneath her, and immediately afterwards a mountain of water was heaped up to starboard and rushed furiously towards Messina, while soundings showed that the bed of the sea had risen ten feet. This last statement requires confirmation, and only careful and extended surveys can define the extent and nature of the displacements which have taken place; but, even without these details, the breakage of all submarine cables, no less than the sea wave, show that the earthquake must have been accompanied by the production, under the sea, of a "fault" or dislocation of the surface, such as is not an infrequent accompaniment of very great earthquakes.

The most interesting and important question raised by this earthquake and its predecessors of 1905 and 1907 is whether the region may now look for respite or whether it is becoming unfit for human habitation, a question the answer of which requires a consideration of what is known of the cause of earthquakes and the past history of Calabria. Whatever may be the ultimate cause of an earthquake, there seems little room for doubt that it is of the nature of a gradually increasing strain, leading, in the end, to sudden rupture and the setting free of forces of which we still know little. Sometimes this strain will grow until the relief comes in a single great earthquake, with nothing visible or noticeable as a preparation or warning; in other cases we have had what, after the event, have been recognised as preparatory shocks. As an instance may be taken the Japanese earthquake of 1891, which gave rise to displacements along a fault-line 65 miles in length, and was preceded by minor earthquakes at either end of the line of this fault; it has been suggested, and the suggestion is plausible, that these gave partial relief to the growing strain, but that the ultimate effect of this partial relief was to equalise the strain along the line of the fault until finally no partial relief was any longer sufficient, and a general yielding resulted in the Mino Owari earthquake and fault.

Similarly, the shocks of 1905 and 1907 might be regarded as preparatory to the greater earthquake of 1908, and the supposition gains weight from the fact that they affected respectively the northern and the southern portions of the area in which the recent earthquake took its origin; but this interpretation suffers from the absence of any certain test by which we may know the preparatory shocks from the earthquake of which it is the forerunner, and be certain that the last of the trio is not itself preparatory to a still greater shock. Some light seems to be thrown on this question by the earthquakes of 1783; on February 5 of that year a severe and destructive earthquake ravaged much the same region as the shock of 1905; it was followed next day by an even greater earthquake, which, like the last, destroyed Messina, and was accompanied by a great sea wave; other lesser but still destructive shocks took place on February 7 and March 28. It will be seen from this that the events of the three days of 1783 were not unlike those of the three years of 1905–8, and the analogy bears closer examination, so we may conclude that, as the great cataclysm of 1783 was followed by a sixty years' respite from destructive earthquakes, and the lesser one of 1638 by a twenty-one years' respite, so the disaster of 1908, though it will be followed by a series of aftershocks, some of which probably will be severe, may reasonably be expected to inaugurate a long era of comparative repose during which the population will have time to recover. But so long as it consents, or prefers, to huddle together in towns and villages which, however gratifying to the artist's eye, are villainously built, and designed in defiance of every precaution which should be taken in an earthquake-shaken country, so long will every earthquake of any degree of severity result in loss of property and of human life. R. D. O.

Few precise particulars as to the physical characteristics and effects of the Italian earthquake have appeared in the daily papers. We are glad to notice that Prof. Ricco, director of the observatory at Catania, has been instructed by the Italian Government to study the causes and effects of the disaster. The following extracts, chiefly from reports in the *Times*, have been selected from a mass of descriptive material relating to the earthquake.

Sea Wave.

An officer of the Italian torpedo-boat *Saffo*, carrying bread to Messina, has given the following account of the catastrophe :—

"At 5.20 a.m. we noticed the sea suddenly rising until it attained an enormous height, giving a violent shock to ourselves and all the shipping anchored in port, finally hurling itself with a deep rolling noise towards the quay, overturning a bridge and smashing to pieces most of the ships.

"A moment afterwards the surface of the sea appeared covered with wreckage and cargo, cases of paraffin oil, and boxes of fruit. An exceedingly dense cloud covered the city.

"Only at dawn was it possible to form an idea of the disaster. Almost the whole city was reduced to a heap of ruins. In the midst of all this ruin were still standing the walls of the Town Hall and the Trinacria Hotel. The streets were completely obstructed in several parts of the city, which were now reduced to ruins. Red flames arose, accompanied by huge columns of smoke."

The captain of the Russian cruiser *Admiral Makaroff* states that the great shock lasted 37 seconds, and was followed by four huge waves, while minor shocks continued to be felt during the whole time that his crew were engaged in the work of rescue.

The sea wave which followed the earthquake invaded Reggio so far as the Corso Garibaldi, namely, more than 10 metres above sea-level. The houses near the sea were flooded up to the first storey, and several were washed away by the waves. Twenty-nine miles of railway have been destroyed, and all the stations near Reggio are in ruins.

A man who was just embarking on a ferry-boat to go from Messina to Reggio when the shock occurred describes how the level of the water seemed suddenly to descend until the ferry touched bottom, and then rose to a great height again—he says eight yards—hurling the ferry-boat on the landing pier, which smashed it to pieces.

Meteorological Conditions.

On Sunday, December 27, heavy rain fell in the afflicted district, the downpour during the night being torrential. At about 5.15 a.m. on December 28 three distinct and long earthquake shocks are said to have been felt at Messina. Only a little rain fell on that day, but there

was heavy rain at night and all Tuesday, when there was also a high wind.

Almost immediately after the earthquake the very cold weather in northern Russia suddenly changed, and the weather resumed its normal state.

AFFECTED AREA.

The sea-wall in front of the city of Messina has been broken up and has fallen, and the sea-walk has sunk under the water. Prof. A. Ricco, the director of the observatory at Catania, states that the docks and other harbour works at Messina have sunk to the level of the water.

At Reggio the destruction seems to be even more complete than at Messina, for the whole of the city has been razed to the ground. The greater part of the sea front is under water. The whole area of the ground below Reggio seemed to have turned over, and a great part of the city is in ruins, covered by the sea. In many places deep chasms appeared in the streets. Of all the villages looking towards Reggio on the coast, not one has been left standing.

The Prefect of Reggio states that the centre of the town has settled down to the sea-level, and only the small villas on the promenade between Reggio and Campi, situated on the highest point of the town, remain standing. The sea front has been swept away, while the water in shore is blocked with sunken débris. Access by sea is impossible, and the town cannot be approached by land, as for a radius of eleven miles the country has a torn and twisted appearance, roads, bridges, footpaths, and railway lines being uprooted. The face of the country has changed, and big fissures in the land have appeared.

The greatest damage was done in the low-lying and unfortunately most important portions, but both at Reggio and Messina this seems to have been due to the actual shock of the earthquake. The subsequent wave flooding the lower houses is said to have risen gently, and does not appear to have added much to the total damage.

In Reggio all the new houses of not more than 32 feet in height have resisted the shock completely. The houses along the Via Marina and the Corso Garibaldi on the sea front fell down to the first floor. Many of the old houses lost their walls on the side which faced the sea to the north. The new dwellings erected at Ferruzzano by the Milan Committee after 1905 have suffered no damage, though they were severely shaken; this is attributed more to the fact of their limited height than to their special construction.

The Admiral-Superintendent of Malta Dockyard has requested the Collector of Customs to make it known that the statement that the Straits of Messina are unrecognisable is incorrect. The topography of the Straits is said by him to be unaltered.

A message from Rome on December 30 states that the submarine cable with the Ionian Isles is broken, and it is feared that the earthquake may have caused damage in the group.

The commander of a torpedo-boat, which was sent to inspect the Lipari Islands, has informed the Ministry of Marine that the shock of December 28 was very severe, and that several buildings were cracked, but that no one was killed.

Prof. Ricco informed a correspondent of the *Daily Mail* that the earthquake had its maximum violence in Sicily and at the southern point of Calabria. The ruin spread from Castroreale, in Sicily, to Palmi, in Calabria, or a distance of forty miles. Damage to buildings occurred from Riposto and Patti, in Sicily, to Pizzo, in Calabria, a distance of eighty-six miles. The earthquake was felt violently from Mistretta and Noto (Sicily) to Cosenza (Calabria), a distance of 186 miles. It was felt, though only slightly, at Marsala and Trapani (Sicily), and even in Naples.

Taormina has escaped unscathed, except that the hotel San Domenico, occupying the site of the old Dominican monastery, has been somewhat damaged.

SEISMOGRAPHIC RECORDS.

The seismographic instruments at Laibach Observatory registered the earthquake at 5.22 and 6 a.m. Of twelve instruments, only one was able completely to register the successive shocks, as the oscillations were more violent than the instruments could measure. The maximum oscillation was registered at 5h. 26m. 16s. The seismic commotion noted at Ekaterinburg, and other observations, indicate that the wave of the disturbance moved south-west to north-east Europe.

The seismograph at Perth Observatory, Western Australia, recorded the earthquake, showing vibrations apparently at two periods of maximum intensity.

SUBSEQUENT DISTURBANCES.

A slight further shock was felt at Palermo on December 30. There was a more violent shock at San Marco Argentino during the night of December 29, accompanied by prolonged subterranean noise. Many houses were damaged, among them the church and the public buildings.

Shocks, less severe but always accompanied by subterranean rumbling, were felt in many places in Calabria during December 31.

Two earthquake shocks were felt at Algiers at about 6.30 p.m. on January 1. The shocks lasted about three minutes, and damaged some telephone wires.

Etna, Stromboli, and Vulcano were quiescent before and throughout the earthquake disturbance. On January 3, however, at 5.22 a.m., a violent shock of earthquake lasting three seconds was felt in the island of Stromboli. It was accompanied by an eruption of the volcano and prolonged subterranean rumblings. Buildings were seriously damaged, many houses being rendered uninhabitable.

At 11.44 p.m. on January 4 a shock of earthquake was felt at Tenerife, lasting twelve seconds. Bells were rung in the houses, and furniture was overthrown.

SUMMARY OF PHENOMENA.

The Rome correspondent of the *Times* gives the following details of the earthquake in telegrams on January 2 and 4:—Among the phenomena which accompanied the movement the most notable is the wave which swept both shores of the Straits. The accounts as to the height to which the sea rose vary enormously. At Riposto, on the Sicilian coast, it was said to be 10 metres high. That seems to be an exaggerated estimate, and no doubt more exact knowledge will be soon forthcoming. All the survivors speak of the subterranean rumbling sound, which they generally describe as a dull roar that seemed beneath and around them, simultaneous with the first shock, and lasting during the subsequent shocks. Of the number, frequency, and violence of the subsequent shocks there are again very varying accounts. The apparatus in the Observatory of Mileto, Calabria, had registered twenty-eight shocks before it was destroyed. Vast fissures in the ground are reported at both Reggio and Messina. At Messina some eye-witnesses declared that the ground seemed to throw out stones, which were hurled to a considerable distance. The weather conditions of those days have their significance. There was a marked depression in the extreme south of Italy two days before. On both December 27 and 28 it rained, and on the night of December 27 it rained in torrents. Rain fell again at intervals throughout Monday and Tuesday (December 28 and 29), and on the latter day it was accompanied by a violent wind.

Prof. G. B. Rizzo, who fortunately escaped from his fallen observatory at Messina, states that the action of the sea wave has been much exaggerated. In his opinion, the shock on the Sicilian side of the Straits caused a movement of water against the Calabrian side, followed by a re-flow against the Sicilian side and Messina, naturally with less violence. Very little loss, he thinks, was caused by the wave at Messina, where the sea hardly advanced ten yards beyond the sea-wall. What is really remarkable, and should be the object of careful study, is the raising of the level of the seashore; Prof. Rizzo noticed that several boats anchored some distance from shore were left high and dry. On the other hand, the ground has sunk in some places in the city, notably near the Municipal Palace and Via Seminario, where in one place it has fallen eleven yards.

DR. GEORGE GORE, F.R.S.

DR. GEORGE GORE, F.R.S., whose death was announced last week, was born at Bristol in 1826, the son of a small cooper. First as errand-boy and afterwards as cooper's apprentice, he devoted himself to whatever scientific studies came within his reach.

He went to Birmingham in 1851, and made his home there for the remainder of his life. His occupations were numerous and varied; at one time he was a practitioner in medical galvanism, at another chemical expert in a phosphorus factory, and again a lecturer in physics and chemistry at King Edward's School. He always, however, employed himself in original investigation, more especially in the province of electrometallurgy, whenever his other work would allow, and his knowledge of electrochemical processes enabled him to be of the greatest service to the electroplating industry in the town of his adoption.

His researches on hydrofluoric acid and the fluorides, definitely proving the analogy of these compounds with those of chlorine, are well known to chemists, and in 1865 he was elected to the Fellowship of the Royal Society in recognition of the value of his work. It may be noted in this connection that many years later he was only just anticipated by Moissan in the isolation of fluorine.

In 1877 the honorary degree of LL.D. was conferred on him by the University of Edinburgh as an acknowledgment of his services to science. Some years later he declined the offer of a knighthood, but in 1891 he accepted a Civil List pension.

From the age of thirteen he had had to rely upon himself for his own education, which occupied all his spare time at a period when he was earning his living by arduous labour. Hence it is not surprising to find that one of his characteristics was an extraordinary degree of energy, which, making him one of the greatest of workers, enabled him to accomplish very much, even for a lifetime of close upon eighty-three years. His was a restless mind, constantly seizing upon fresh subjects for research, and the result of this may be seen in the length of the list of publications associated with his name in the Royal Society's catalogue. It may be, indeed, that this very quality, by distributing his energies, was an obstacle to achievements of still greater importance which might have ensued upon the concentration of an intellect combining so much ingenuity and so great a capacity for work.

He was strongly impressed with the necessity for State endowment of scientific research, and was partly instrumental in procuring for the Royal Society the Government grant of 4000*l.* a year for this purpose.

In addition to his contributions to learned societies, he published a text-book on "The Art of Electrometallurgy," and a volume on "The Electrolytic Separation of Metals"; he also wrote a treatise on "The Art of Scientific Discovery." His mind always had a bent for philosophy, which expressed itself more especially in his later years. He was an unswerving materialist, and his views may be gathered from his recently published work on "The Scientific Basis of Morality." G. A. S.

PROF. J. M. PERNTER.

AS announced with deep regret last week, the death of Hofrat Prof. Josef Maria Pernter took place after a long illness at Arco, South Tyrol, on December 20. From 1897 until compelled in the early part of last year to abandon his work, Pernter was professor of meteorology and geodynamics in the University of Vienna, and director of the Austrian Zentralanstalt for those sciences. The institute is situated in the Hohe Warte, about three miles from the centre of the city of Vienna.

He was born on March 15, 1848, in Neumarkt, Tyrol. In 1864 he entered the novitiate of the Society of Jesus, and became successively professor of philosophy at Presburg, professor of physics and mathematics at Kalócsá, Hungary, and at Kalksburg. He left the society in 1877, and in 1882 became an assistant in the Central Meteorological Institute of Vienna. In 1890 he was made professor of cosmical physics in Innsbruck, but returned to Vienna as director and professor upon the retirement of Hann. Throughout his life he was a sincere churchman, and occupied a position of great influence among Catholic university students.

His best known work is his "Meteorological Optics," an admirable and exhaustive treatise the publication of which is not yet completed. And apart from his official work as director of the Austrian Meteorological Service, there are many valuable papers by him on various branches of meteorology to be found in meteorological journals or in the publications of the Vienna Academy, of which he was a corresponding member. His friends will probably remember him best as a controversialist of the best kind. Himself full of vigour, energy and "Geist," he possessed the power of putting his ideas with perfect fairness into the most lucid and vigorous language, both in conversation and in print. His contributions to the discussion of the question of the cannonade against hail concluded with a masterly summary in "Das ende des Wetterschiessen's" in the *Meteorologische Zeitschrift* of 1907.

He was an active member of the International Meteorological Committee, and presided over the conference of directors of meteorological institutes and observatories at Innsbruck in 1905. His work, both official and unofficial, was characterised by great thoroughness and vivacity.

In recent years he suffered most poignant family bereavement. He lost his young daughter in 1904 and his wife in 1906, and from these losses he never recovered. He leaves an only son, who is still of student age.

NOTES.

M. P. VILLARD has been elected a member of the Paris Academy of Sciences, in the section of physics, in succession to the late M. Mascart.

PROF. A. BÉHAL, of the École supérieure de Pharmacie of Paris, has resigned the general secretaryship of the Paris Chemical Society. He will be succeeded by M. Freundler, of the faculty of science in the University of Paris.

MR. ARTHUR H. SMITH has been appointed keeper of the department of Greek and Roman antiquities in the British Museum, in succession to Mr. Cecil H. Smith, who was recently appointed director of the Victoria and Albert Museum.

AT the initiative of the Association internationale de l'Institut Marey, a subscription list has been opened for the erection of a monument to the late M. E. J. Marey. We learn from *La Nature* that donations may be sent to M. Carvallo, at the Institut Marey, Parc des Princes, Boulogne-sur-Seine. A committee of management has been formed, with M. Chauveau as chairman.

DR. H. W. WILEY, the chief of the bureau of chemistry in the U.S. Department of Agriculture, is directing atten-

tion to the need of isolating consumptives on railway journeys, particularly in travel by sleeping-car across the American continent. He is arranging apparatus to take samples of the air breathed in these cars for the purpose of analysis in the interest of the public health.

A GRATIFYING sign of the increased interest in hygiene in America is reported from Tuskegee, Alabama, where a meeting of the National Negro Anti-tuberculosis Congress was held on December 19, 1908. It was decided to begin the organisation of anti-tuberculosis committees in all negro lodges and business leagues. Hitherto, owing largely to the neglect of normal precautions, the mortality from consumption has been exceptionally high among the coloured population.

THE death is announced of Prof. Richard Pischel, who had occupied the chair of Sanskrit in the University of Berlin since 1902, and was elected a member of the Prussian Academy of Sciences in 1903. Prof. Pischel was born on January 18, 1849, and took his degree at Breslau in 1870. He was for ten years professor of comparative philology at Kiel, and was afterwards at Halle, from whence he was called to Berlin. His "Vedische Studien," published in conjunction with Geldner (1889–1901), played an important part in vindicating the specifically Indian character of the Rig-Veda.

THE Paris correspondent of the *Times* states that on December 31, 1908, Mr. Wilbur Wright accomplished at Le Mans a flight lasting 2h. 20m. 23·2s., the distance covered being officially returned at nearly 125 kilometres. A year ago Mr. Farman flew 1093 yards in 88 seconds, and now Mr. Wright has traversed 136,106 yards in 8423 seconds. There has thus been a decided advance both as regards duration of flight and distance covered. A Reuter message from Brussels states that King Leopold's prize of 25,000 francs (1000*l*.) will be awarded this year to the author of the best work on aërial navigation.

THE Berlin correspondent of the *Globe* states that a series of interesting experiments is being carried out by the German military authorities with regard to the employment of wireless telegraphy by balloons. These experiments are being made by means of registering balloons fitted with a wireless-telegraphy apparatus. When a message has been received by the balloon an ingenious mechanism opens the valve, and the balloon descends. The military authorities hope to be able soon to extend the working of wireless telegraphy to the military steerable balloons.

THE summary of the weather issued by the Meteorological Office for the week ending January 2 gives some interesting temperatures which occurred in the recent severe frost, to which reference was made in our issue last week. The summary states that the lowest of the minima were generally registered on December 29 or 30, and were so low as 3° at Swarraton, near Worthing, on December 30, 5° in the Midland counties, and 7° at Cambridge. Temperatures at other than the usual stations are also given. At Liphook, in Hampshire, about thirteen miles to the south of Aldershot, the thermometer in the screen fell to 1° below zero on December 30, at Buxton and Epsom to *plus* 4°, and at Great Billing, Northampton, to *plus* 6°. The thermometer exposed on the snow at Tunbridge Wells fell to 2° below zero, and at Epsom to 8° below zero. The temperature at Greenwich on the morning of December 30 fell to 12° in the screen, and to 2° on the grass. There have only been four winters during the last fifty years in which the sheltered thermometer has fallen below 12° at Greenwich, and the lowest temperature recorded is 6°·6, on January 5, 1867. Subsequent to the close of the frost on December 30 the weather has been unusually mild for the time of year over the entire kingdom, and the thaw was both sudden and complete.

THE weather statistics kept at Greenwich Observatory during 1908 show the year to have been generally one of normal conditions. The aggregate measurement of rain was 23·8 inches, which is 0·3 inch less than the average of the previous half-century. The largest measurement in any month was 3·66 inches, in July, which is 1·26 inches more than the average; the other months with an excess of rain were March, April, June, August, and December. The month of least rainfall was November, with 0·76 inch, which is 1·46 inches below the average; the deficiency in September was 0·93 inch, and in October 0·81 inch, giving a total deficiency of 3·20 inches for the three autumn months. There were in all 155 days with rain, the greatest number in any month being twenty, in December, and the least six, in June. Snow fell on twenty-three days during the year, and eight of these occurred in March. The mean air temperature for the year was 50°·1, which is in precise agreement with the average. The highest mean for any month was 63°·1, in July, and June and August each had the mean above 60°. The coldest month was January, with the mean 36°·3, which was 2°·1 below the average. The range of temperature was 72°, the absolutely highest reading being 84°, in July, and the lowest 12°, in the recent frost on December 30. Frost occurred in all on forty-four nights, and thirty-two of these occurred from January to March. The temperature was above the average on forty-six nights in the two months October and November, and there were only three nights with frost. The duration of bright sunshine was 1633 hours, which is 132 hours in excess of the average for the previous ten years; the most sunny month was June, and the least sunny December.

MR. F. L. DAMES, Steglitz, Berlin, has sent us copies of catalogues of works on entomology (No. 97) and botany (No. 98).

THE early development of the polycladian Planocera is discussed by Mr. F. M. Surface, who has sent us a copy of his paper, in the Proceedings of the Philadelphia Academy for December, 1907 (issued February, 1908). As the paper reaches us somewhat late, we are unable to refer to its contents.

MESSRS. MACMILLAN AND CO. have just published another of their series of coloured wall-pictures of farm animals, this being the portrait of the shire stallion champion "Hendre Royal Albert." This animal, which is a bay, with a white "blaze" and white "stockings," has been finely depicted by Mr. J. Macfarlane, the painter.

IN an article in the December (1908) number of *Naturen* Mr. O. Nordgaard is led to the conclusion, from the enormous numbers of flint-implements to be met with in certain parts of the country, that during the early human period Norway possessed a Cretaceous formation, which has now been denuded away.

IN NATURE for March 21, 1908, was published a notice, by Dr. P. L. Sclater, of a pamphlet by Mr. W. Rodier on the best means of exterminating rabbits in Australia, while a second notice was communicated by Mr. W. B. Tegetmeier to our issue of November 13, 1902. Both notices are commendatory of the plan, which consists in killing off the females, and thus causing a preponder-

ance of males, which will kill a considerable proportion of the largely diminished number of young. Mr. Rodier has favoured us with a new edition of his pamphlet, entitled "The Rabbit Pest in Australia," published in Melbourne.

THE effect of alkaloids on the early development of the echinoderm *Toxopneustes variegatus* forms the subject of a paper by Mr. S. Morgulis published as No. 14 of Contributions from the Bermuda Biological Station. Previous experiments have shown that the addition to the water of small quantities of pilocarpine hydrochloride results in the increase of the size of the embryos in certain echinoderms, and it was thought that a further study of such abnormally large embryos might contribute information on the problem of growth. The new experiments did not yield the anticipated results, but the author nevertheless gives a summary of his work, which may not be devoid of interest.

SOME interesting experiments on the action of radium rays on developing plants are described by Prof. C. S. Gagee in the December (1908) number of the *American Naturalist*. The general result of these is to demonstrate that radium rays act as a stimulus to plants. If this stimulus ranges between a minimum and an optimum point, an excitation function is the result, but when the optimum point is passed there ensues a depression of function, terminating in complete inhibition of growth as the strength or duration of the treatment is maintained above the point in question. The results of experiments on germinating lupin-seeds, Timothy grass, &c., are illustrated by means of photography as well as by diagrammatic curves.

COLONY-FORMATION among rotifers, according to Mr. F. M. Surface, to whom we are indebted for a separate copy of a paper from vol. xi., No. 4, of the Biological Bulletin, on the formation of new colonies in *Megalotrochoa alboflavicans*, is not common. In certain species of the family Melicertidæ the individuals do, however, become aggregated into colonies, the young being hatched as free-swimming units. In the case of the species described, these young do not leave the colony singly, but come together into a swimming ball which reacts positively to light. Under certain conditions this ball subsequently breaks up into free individuals, which again collect into a permanent colony. In the formation of these colonies the mucus-like secretion of a gland plays an important part.

AFTER the death of the great embryologist Prof. K. E. von Baer, there was found among his papers an unpublished biography of Cuvier, which is of very considerable interest as being an account of a great naturalist by one of his own contemporaries. The memoir was published, under the editorship of Prof. Ludwig Stieda, of Königsberg, in the *Archiv für Anatomie* for 1896, and of this a French translation has appeared in the *Annales des Sciences naturelles, Zoologie*, for 1908. This biography, together with Eckermann's "Conversations avec Goethe dans les dernières Années de sa Vie," published at Magdebourg in 1848, forms the subject of an article by Dr. E. Trouessart entitled "Cuvier et Géoffroy Saint-Hilaire d'après les Naturalistes Allemands," of which the first part appears in the December (1908) issue of *La Revue des Idées*. The first-named of the two memoirs is somewhat severely criticised, the claim put forward by von Baer that Cuvier was in part a German by descent apparently exciting the ire of the French reviewer. A second article in the serial cited is devoted to a review, by Mr. Etienne Rabaud, of de Vries's mutation theory.

MR. C. J. HERRICK has favoured us with separate copies of two papers from vol. xiii., No. 2, of the *Journal of Comparative Neurology and Psychology*, one on the phylogenetic differentiation of the organs of smell and taste, and the other on the morphological subdivision of the brain. Smell and taste, as he points out, are the only two senses in vertebrates the receptive organs of which are adapted to respond directly to peripheral chemical excitation; and he concludes that the agencies which acted to produce these senses are to be sought primarily, not in the stimuli calling forth the reflexes, but rather in the character of the response evoked by the stimulus. In the second paper it is pointed out that whereas the subdivision of the human brain into regions, as made by the early anatomists on the foundation of gross external form, has a certain functional as well as morphological basis, when the attempt was made to study the regions thus named from a comparative point of view, the morphological defects of the scheme became at once apparent. Several alternative schemes have been suggested, but as none of these, in the opinion of the author, is satisfactory, he proposes a new one for the entire nervous system, which is split up into four primary divisions, viz. systema nervorum sympathicum, s. n. cerebro-spinale, s. n. periphericum, and s. n. centrale. For the divisions of the brain itself we must refer our readers to the original paper.

THE second Bulletin of the Sleeping Sickness Bureau, edited by the director, Dr. A. G. Bagshawe, contains a summary of the results of the work hitherto published by investigators upon certain aspects of the sleeping-sickness problem, supplemented by statements based upon the editor's own experience in Africa, and by conclusions of a practical nature deduced from the array of facts brought together. The chief subjects dealt with in the present number are diagnosis and symptoms of human trypanosomiasis, transmission of *Trypanosoma gambiense*, incubation period of human trypanosomiasis, toxin-formation in trypanosome-infection, and recent work on treatment. With reference to the vexed question of the transmission of sleeping sickness, it is concluded that "in devising measures for prevention we may disregard other species and concentrate our attention and energies on *Glossina palpalis*." This publication is especially valuable for those who are investigating sleeping sickness far from centres of civilisation and scientific libraries, and require information with regard to the results of other workers in the same field.

A SYNOPSIS of the Philippine species of Freycinetia (Pandanaceæ), prepared by Mr. E. D. Merrill and published in the botanical series of the *Philippine Journal of Science* (No. 5), assigns twenty-four species to the islands, a number considerably greater than is found in any other region; moreover, they are all endemic. Of the species of Philippine oaks, which are summarised by the same author, most are endemic, but four species are common to the Celebes or Borneo. It is noted that one, a new species, sheds its bark in thin flakes similarly to the ordinary species of birch.

QUOTING from his experience of insect pests in Indian forests, Mr. E. P. Stebbing communicates to the *Indian Forester* (November, 1908) cogent arguments regarding the danger of pure forests, and points out the necessity for taking into consideration the dangers of insect and plant pests before drawing up forest working plans. Special observations in the case of an attack by bark-borers on deodar showed that the ravages were considerably greater where the deodar formed pure forest than on

areas where the deodar was mixed with oak. Sometimes, as in the case of a species of Tomicus bark-beetle infesting blue pine and spruce, more than one of the principal trees in a mixed forest is attacked.

THE notes on annual flowers by Mr. A. Watkins published in the Journal of the Royal Horticultural Society (vol. xxxiv., part ii.) contain hints for the amateur gardener as well as queries for the plant breeder. The author observes that annuals well repay extra attention, especially in the matter of sowing and transplanting so as to give them plenty of room. As a puzzle in variation, reference is made to the Countess Spencer variety of sweet-pea, from which for a long time no fixed type could be obtained; the explanation offered attributes this difficulty to a period of variability for the strain. As a successful instance of selection, Mr. Watkins mentions his production of the Mandarin *erecta compacta* variety of Eschscholtzia.

THE report on the operations of the Department of Agriculture, Madras Presidency, for the official years 1906–7 and 1907–8 shows that steady progress is being made in improving the native husbandry. Experiments are recorded on the growth of paddy, the most valuable and important crop of the Presidency, of sugar-cane, jute, and agave. There are numerous experiments on cotton, some of the famous black cotton soils occurring in this region, and on methods of irrigation. The department keeps in touch with the native cultivator by sending out agricultural inspectors to help the ryots in their cultivation of the various crops; it also distributes seed superior to that in common use, and, in certain cases, gives premiums by way of encouragement to those natives who succeed with the improved methods.

THE Bureau of Soils of the United States Department of Agriculture has recently issued a Bulletin (No. 51), by Messrs. Patten and Gallagher, dealing with the absorption of vapours and gases by soils. The problem is very intricate, and is not likely to be solved until more light has been thrown on the constitution of colloids; in this respect it resembles many other soil problems. Although the present publication does not carry us much further, it serves a useful function in collecting a good deal of scattered work, and directing attention to a problem of great practical and scientific importance.

BULLETIN No. 80 of the North Dakota Agricultural College Experiment Station gives descriptions of the common weeds of North Dakota, and of the methods by which they may be eradicated. It is recommended that recourse should be had to spraying with solutions of either ferrous sulphate, copper sulphate, or sodium arsenite. Sodium arsenate cannot be recommended, since it does not dissolve with sufficient readiness. Spraying is not an uncommon practice in England, and it is on the increase; the necessity of saving labour compels the modern farmer to do by chemical means what his predecessor did by hand.

THE report of the director of agriculture of the Federated Malay States for the year 1907 which has just come to hand shows continued progress in many directions. The climate is probably unsurpassed for rapid growth of vegetation, but these conditions are also favourable to insect and fungoid pests, and the appointment of a Government mycologist will prove a useful step. There is, however, no chemist as yet. The agricultural work appears to be on useful lines, and calculated to aid materially the development of these States. Work has been done on padi and on cocoanuts, both highly valuable crops, but perhaps the most striking advance is seen in rubber cultivation. The acreages in the Federated Malay States (exclusive of those in Johor, Malacca, and Province Wellesley) have been as follows:—

Year	Acreage	Year	Acreage
1897	345	1903	11,239
1898	1,761	1904	19,239
1899	3,227	1905	43,338
1900	4,693	1906	85,492
1901	5,965	1907	126,235
1902	7,239		

There was in 1907 a marked fall in the price of rubber, which, however, only stimulated the planters to improve their methods and decrease the cost of production. The industry is very profitable; even the lowest price yet reached for plantation rubber is more than 100 per cent. above the cost of production. Experiments are in hand to discover still better methods of working and of coping with the root fungus *Fomes semitostus* and the termite *Termes gestroi*, which are at present the worst rubber pests.

PROF. T. J. J. SEE contributes to the Proceedings of the American Philosophical Society a further paper dealing with his interpretation of the cause of earthquakes and the origin of mountain ranges. The paper is illustrated with a series of very striking relief maps of the continents, taken from Frye's "Geography," which are intended to illustrate the author's contention that the highest mountain ranges border the deepest oceans. The series of memoirs by Prof. See, of which this is the last, may be regarded as part of the modern revolt against the doctrine which regarded the earth as an inert mass cooling by radiation into space, and attributed all changes which have taken place in it as due to secular contraction. We wonder whether his last paper may not also be an indication of a return to the fashion of the lengthy titles which delighted our forefathers of a century ago.

AN excellent custom prevails in America, which might well be imitated in other countries, that just when a special piece of scientific work is needed someone is always ready to defray the cost. This is the case with the investigation of the races of the Philippine Islands, which is due to the liberality of Mr. R. F. Cummings, of Chicago. The report on the Tinggian tribe by Mr. F. C. Cole, which is the first of the series, amply justifies the expenditure on the work. The Tinggians are a fairly civilised tribe, practising rice farming on a large scale, and occupying the subprovince of Abra. They are ruled by a tribal council, before which everyone, including all duly married women, may bring their grievances. They revere a sky spirit, known as Kadaklan, but their religious rites are mainly devoted to the propitiation of the evil spirits which infest the earth. These rites are in a large measure of the shamanistic type, and in their domestic ceremonies sympathetic magic plays a leading part. Special attention is paid to the propitiation of the spirits of the dead, for whom blankets and other things likely to be wanted in the other world are hung on a rope suspended over the corpse. Marriage is said to be prohibited between blood relations, and it is alleged that there is no clan system, an assertion which, on the analogy of other races in a similar grade of culture, further investigation will perhaps correct.

THE September (1908) number of the *Philippine Journal of Science* contains a classification of the racial types found among the students at the University of Michigan,

the percentage frequency in each class being stated. It is suggested that the numerous composite types may be explained by the action of inheritance from three primary types, in accordance with the lines laid down by Mendel.

L'Aéro Mécanique is the title of a new monthly paper published at Brussels (Rue royale 214). No. 5 before us contains, among other articles, one by Captain de Vos on the much-vexed question of the flapping wing of the bird, and extracts from current journals, patents, and so forth.

THE *Revue générale des Sciences* reproduces in its issue for December 15, 1908, the address given by Prof. H. Poincaré to the Mathematical Congress at Rome on "The Future of Mathematics." In the introductory part, which precedes the discussion of special regions of mathematical study, the author discusses the aims and objects of the pure mathematician, the reasons for his insistence on rigour and elegance in his proofs, and his relationship to the engineer.

THE equilibrium of a flexible string forms the subject of a paper in the Transactions of the American Mathematical Society, ix., 4, by Prof. E. B. Wilson. It is pointed out that the ordinary solutions for the cases of a rectilinear field, whether parallel or central, fail to lead to interesting problems when the string has a free end, but the paper shows that there is a large class of cases, which may be explicitly integrated by quadratures, where this objection does not apply.

A HISTORY of the origin of the theory of the æther is contributed by Dr. Léon Bloch to the *Revue générale des Sciences*, xix., 22. It deals very largely with the theories of Newton and Hooke. The author shows that as new physical discoveries have taken place, the theory of the æther has undergone a continual process of evolution, and he predicts that the same will take place in the future. A rigorous dynamical theory of this medium which does not admit of modification in the light of new discovery cannot be regarded as final.

PROF. E. B. WILSON, writing in the Bulletin of the American Mathematical Society (December, 1908), discusses the analogy between statistical mechanics and hydrodynamics, an analogy primarily based on the identity between the Eulerian equation of continuity and the corresponding relation between the differential coefficients of momenta and coordinates. According to this view, it is obvious that the determinantal relation of the kinetic theory represents the Lagrangian equation of continuity. The purpose of the paper is to examine whether the equations of motion, and in particular those of irrotational motion, have any analogues on the dynamical side. The search does not appear to lead to any results of great importance so far.

MESSRS. BURROUGHS WELLCOME AND CO. have sent us a copy of Wellcome's "Photographic Exposure Record and Diary" for the year 1909, and an examination of it shows that in this handy little book the owner possesses a store of practical information in the smallest compass for one shilling. In this year's issue a further attempt has been made, and we think with very successful results, to condense statements to the minimum number of words, and this has allowed extra matter on other subjects to be inserted. A new feature of the article on exposure is the insertion of two tables dealing with the relative speed of bromide papers and lantern plates. These should be found very useful, because if the user knows the correct exposure for any one of these, that for any other can be determined at a glance. Other items here tabulated are the various exposures of interiors, copying and enlarging, moving objects, &c., and an excellent list of plate speeds, brought up to date, is added. Perhaps the main feature of this pocket-book is the exposure calculator at the end, which by this time has become of such general use. In this issue the series of illustrations of characteristic subjects is printed on a separate card and placed in the pocket of the book, the use of the calculator being thus facilitated.

WE have received from Messrs. John J. Griffin and Sons, Ltd., of Kingsway, London, a conveniently arranged and profusely illustrated catalogue of models for teaching machine construction and drawing, pattern making and foundry practice, building construction, and mining operations. Teachers of these subjects should find the catalogue of great assistance and very suggestive in developing the practical side of the instruction they give.

WHITAKER'S "Peerage, Baronetage, Knightage, and Companionage for the Year 1909" is now available. The character of this useful work of reference is too well known to make any extended description of its contents necessary. A new feature of the present issue is an addition to the introduction in the form of an "Official Glossary," which provides useful information to persons who are not experts in the various departments with which the volume deals. The work includes an extended list of the Royal Family, the peerage with titled issue, dowager ladies, baronets, knights and companions, home and colonial bishops, and an index to country seats.

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., have published a revised and abridged edition of "The Life Story of Sir Charles Tilston Bright, Civil Engineer; with which is Incorporated the Story of the Atlantic Cable and the First Telegraph to India and the Colonies." The present volume has been prepared by Mr. Charles Bright alone, who, in the task of writing the original work, was assisted by his uncle, Mr. E. B. Bright. The book was reviewed at length, soon after its original appearance, in NATURE for October 26, 1899 (vol. lx., p. 613). This abridgment appears appropriately, since 1908 was the fiftieth anniversary of the Atlantic cable, and the short account of the work of so exceptionally able, energetic, and enthusiastic a man as the late Sir Charles Bright should be welcome to many readers. The price of the new issue is 12*s.* 6*d.* net.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY:—

Jan. 7. 13h. 21m. to 16h. 41m. Transit of Jupiter's Satellite III. (Ganymede).
10. 19h. Jupiter in conjunction with the Moon. (Jupiter 4° 11′ S.).
11. 14h. 23m. to 15h. 32m. Moon occults ν Virginis (mag. 4·2).
22. 9h. 41m. to 13h. 32m. Transit of Jupiter's Satellite IV. (Callisto).
23. 0h. 12m. Minimum of Algol (β Persei).
25. 5h. 59m. to 7h. 2m. Moon occults 30 Piscium (mag. 4·7).
,, 7h. 44m. to 8h. 37m. Moon occults 33 Piscium (mag. 4·6).
26. 6h. 1m. Minimum of Algol (β Persei).
,, 16h. Mercury at greatest elongation, 18° 25′ E.
30. 20h. Mercury in conjunction with Uranus. (Mercury 0° 21′ N.).

COMET MOREHOUSE, 1908c.—From Mr. R. C. Johnson, one of the secretaries of the Liverpool Astronomical Society, we have received an enlarged copy of an excellent photograph of Morehouse's comet, taken by him, at his observatory at West Kirby, on November 15, 1908. The original photograph is one of a series of twenty taken with a 6⅜-inch reflector of 28 inches focal length, and received 42 minutes' exposure, from 5h. 42m. to 6h. 24m. (G.M.T.).

The main streamer of the tail is very bright for a distance of about 40′ from the head, and extends to the edge of the plate, about 3¼ degrees; at the end of the bright portion this streamer divides into three distinct branches, in each of which there are several convolutions. In addition to this, there are several shorter streamers, two of which curve towards the south.

Numerous observations of this comet, made between September 18 and October 30, 1908, at the Royal Observatory, Rome, are reported in No. 4293 of the *Astronomische Nachrichten* (p. 331, December 27, 1908), and afford further evidence of the remarkable changes which took place in the form and brightness of the tail.

An ephemeris, covering the period January 13 to July 13, in ten-day intervals, appears in Circular No. 144 of the Harvard College Observatory. By the beginning of June, when the comet again reaches a declination observable in these latitudes, its computed brightness will be but about one-third that at the time of discovery.

A photograph of the spectrum of the comet, taken with the 8-inch Draper telescope on November 17, 1908, shows six broad bright bands which appear to coincide with Hζ, Hε, Hδ, Hγ, Hβ, and the band at λ 464–473, characteristic of the spectra of stars of the fifth type (Harvard College Observatory, Circular No. 145).

THE TOTAL SOLAR ECLIPSE OF 1911 APRIL 28.—In a reprint from vol. lxix. of the Monthly Notices (R.A.S.), pp. 30–32, with which the author has favoured us, Dr. Downing sets out the conditions for the total solar eclipse of April 28, 1911, as it will be observed at Neiafu, a port on the south-west coast of Vavau Island, one of the Tonga group. At this station totality will last about 3m. 37s., the altitude and azimuth (from N.) of the sun being 43° and 49° respectively. Mail steamers from Sydney call at Neiafu every four weeks, and the town is the headquarters of the Governor and of several English and German trading firms.

A SIXTH TYPE OF STELLAR SPECTRA.—In Circular No. 145 of the Harvard College Observatory Prof. Pickering suggests that, for the purpose of facilitating reference to them, a number of stars already announced as having "peculiar" spectra should be assigned a class to themselves. This class would include a number of doubtful fourth-type stars, the spectra of which contain rays of much shorter wave-length than those of the normal fourth type; stars having spectra somewhat similar to those of the fifth type, but with the bright bands apparently reversed on a continuous spectrum; and stars of which the spectra are generally similar to the above, but show minor peculiarities.

It is proposed that the new class should be designated type VI., class R, and Prof. Pickering publishes a list of fifty-one stars all of which would certainly be included in this class; none of these is brighter than magnitude 7·5. Several of the spectra of this type are reproduced in the circular, together with spectra of types I., IV., and V. for comparison.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.—A brief *résumé* of the proceedings of this society, at its ninth meeting held at Put-in-Bay, Ohio, August 25–8, 1908, is published by Messrs. Jacoby and Sears in *Science* for December 11, 1908 (N.S., vol. xxviii., No. 728). Two special committees were appointed, one to deal with the question of luminous meteors, the other to consider comets.

Brief abstracts of many of the papers read at the meeting are published in *Science*, but they are too numerous to be discussed here; mention of some of them has already been made in these columns.

SPECTROSCOPIC BINARIES.—In No. 5, vol. ii., of the Journal of the Royal Astronomical Society of Canada Mr. Plaskett announces that spectrograms taken at the Dominion Observatory, Ottawa, show that γ Aquarii and ι Andromedæ are spectroscopic binaries.

Spectrograms of the former, taken during July and August, 1908, indicate a variation in the radial velocity between −40 km. and +23 km., whilst spectrograms of the latter, taken in August and October, 1908, indicate a range from −11 km. to +32 km.

THE VARIABLE STAR U GEMINORUM.—The third volume of *Recherches astronomiques de l'Observatoire d'Utrecht* is devoted to a very full discussion, by M. J. van der Bilt, of observations of U Geminorum, made between 1856 and 1907. This discussion occupies 115 pages, and is accompanied by twenty-seven plates giving the variously derived light-curves, one plate showing the normal curves of the long and the short maxima, and a final plate reproducing a chart of the stars surrounding this peculiar variable.

At the end of the discussion the author strongly emphasises the necessity for making constant observations of this star if its peculiarities and apparent anomalies are to be completely understood.

In the preface, Prof. Nijland states that whilst the first of these "Recherches" appeared in 1864, it is hoped that in future the volumes will appear at shorter intervals; vol. iv., dealing with observations of Jupiter, is already in the press.

THE HEAVENS AT A GLANCE.—Mr. Mee's handy card calendar for 1909 is similar to its predecessors in giving a great deal of useful astronomical information in a very compact form. For amateurs who wish to keep *au courant* with astronomical events, this calendar is an extremely useful aid, and may be obtained from Mr. Mee, Llanishen, Cardiff, for sevenpence, post free.

SURVIVALS OF PAGAN BELIEFS AMONG THE INDIANS OF SOUTH CALIFORNIA.

THE Luiseño Indians of South California, who with the kindred Diegueño tribe are the only survivors of those attached to the Franciscan missions, form the subject of a monograph by Miss C. B. DuBois, issued in the third bulletin of the eighth volume of the ethnological publications of the University of California.

Though they have been exposed to European influence for more than a hundred years, and have lived for nearly two generations under rigid Christian discipline, it is remarkable that so many of their pagan beliefs and customs have survived. It is still more noteworthy that, about a hundred and twenty years ago, a pagan missionary movement extended from them to the Diegueño tribe, among whom the new cult which centres round the personality of Chungichnish was introduced. This new faith, like others which have extended beyond their original home, had every requisite of a conquering religion—a distinct and difficult rule of life demanding obedience, fasting, and self-sacrifice—and it enforced its commands by an appeal to the fear of punishment, a threat that avengers in the shape of stinging weeds, the rattle-snake and the bear would punish neglect of its observances.

The most important of the rites connected with the Chungichnish cultus is that of Toloache, or the initiation of youths and girls. In the case of the former, the candidates, in a state of nudity, are dosed with a decoction of the jimson-weed (*Datura meteloides*), which contains a powerful narcotic and excitative principle. After the intoxication produced by this drug has passed away, the secret dances of the tribe are performed and the mystic songs are sung. The Shaman who conducts the proceedings asserts that he is possessed of magical powers, and the initiates are instructed to imitate his feats. During the dance the performers appear to speak in the tongues of beasts and birds, a rite possibly connected with a belief in personal totem animals or guardian spirits, which up to quite recent times survived among this people. These rites are followed by a fast from salt and meat sometimes lasting two or three weeks, and meanwhile the youth is instructed in the tribal code of etiquette and morals. He is told, for instance, that no one should eat immediately

on rising lest the spirit which was absent from his body in sleep should be unable to return. On the same principle, on return from an expedition into the hills he must defer eating so as to permit the wandering spirit to rejoin its mortal body.

This initiation rite is accompanied by an elaborate symbolism, of which Wanuwat, or the sacred net, and a form of painting or modelling in sand are the most prominent features. The net is said to symbolise the Milky Way, a prominent feature in the night sky of that region, which is regarded as the home of the dead; and the main idea seems to be based upon an attempt to free the departed spirits from this earth, and to prevent their return by binding them in the net of the Milky Way. The sand painting may perhaps best be described as a cosmological model in which the tribal conception of the relation of this world to the heavens is portrayed.

The annual commemorative rite for the dead is performed over images representing the departed, a custom common to the Hindus and other savage or semi-savage races. Singing and dancing, with whirling of the bull-roarer, precede the burning of the images, in some cases the clothing and ornaments being consumed, in others removed by the friends. Like the rite of the sacred net, the intention seems to be to expel the spirits of the dead from the neighbourhood of the living.

The Creation legends of the tribe, now for the first time fully recorded by Miss DuBois, are of considerable importance, and must be taken into account by all students of comparative mythology. In the beginning existed only Kivish Atakvish, the Void, who was followed by Whaikut Piwkut, "the whitish gray," who created two great round balls, which were male and female. The union of Sky and Earth then produced the First People, now represented by the magic mortar, wampum strings, the mast used in the death rites, and other sacred objects, animal and vegetable. Then appears a deified hero, Oniot, who is done to death by Wahawut, the witch, and, as in the Hindu Yama saga, death thus entered the world. Besides these is a group of interesting sky myths. The remarkable element in these legends is that they imply a succession of births or existences, some of them psychic, up to the present hardly known in native American thought, and Mr. Kroeber, the editor of the report, goes so far as to suggest that they represent Oceanic or Asiatic influence. But it must be remembered that these rites and legends have been for the first time recorded at a very late period in the history of the tribe, when it had been for a long period exposed to foreign influences. Possibly much of this elaborate symbolism is of native origin, but the interpretation of them now explained by the few survivors of the tribe who were initiated into the mysteries is somewhat obscure, and may not be really primitive.

A strong case can undoubtedly be made out for the independent origin of native American culture, and the theory of early historical relations between its races and those of Asia is beset by enormous difficulties. On the whole, it seems probable that the interpretation of these Luiseño myths will not lead to a modification of the view generally accepted by anthropologists, that they are of indigenous growth. The question is, however, not free from difficulty. They are in themselves of great interest, deserve attentive study, and their collection is another debt which ethnologists owe to the enterprise of the anthropological department of the University of California.

FIELD NATURAL HISTORY.

TO the Transactions of the Edinburgh Field Naturalists' and Microscopical Society, vol. vi., part i., Mr. J. C. Adam has contributed a charmingly written and exquisitely illustrated account of the bird-life of an outlying, and consequently little frequented, island in the Outer Hebrides group. After remarking how little of interest in the way of bird-life is noticeable from the single village, the author proceeds to give his experiences of the purple sandpiper, of which several specimens, in what appeared to be the breeding-plumage, were observed on the high ground of the interior, where it was hoped they would be found nesting. Careful search failed, however, to bring eggs to light, while the actions of the birds themselves did not suggest that they were breeding. On the sea-cliffs the birds absolutely swarmed. The lower levels, at a height of 100 feet, or occasionally 200 feet, form the resort of the oyster-catcher. "Beyond the oyster-catchers' territory was the domain of the big-gulls—the herring and the lesser black-backs; in fact, their respective spheres of influence encroached upon one another, and the clamorous cloud of swirling gulls, which even encanopied the intruder, were invariably 'threaded' by the high-pitched, piercing notes of a 'sea-pie.' The herring gull was by far the most abundant species. . . . When you had passed within the dominion of the gulls, you were on the brink of the cliff-wall, and from some coign of vantage might look down on the perpetual wonder and prodigality of a rock-fowl city. For sheer impressiveness you were perhaps wise to choose a stance as far down as you could reach in one of the great chasms which the ceaseless grind of the tide and the stress of Atlantic weather had gnawed

Razorbills and Kittiwake. From the "Bird life of an Outer Island."

into the very vitals of the island." One of the illustrations from this paper is here reproduced.

To the same Transactions Mr. R. Service contributes some interesting observations on variation in the mole. The largest male obtained measured 7¾ inches in length, but an inch less than this still indicates a large individual; 5½ inches is about the average for the female, the maximum observed being 6¼ inches. Great variation in the tint of black individuals is noticeable. As regards more striking colour-variation, the commonest abnormality is cream-colour, ranging from pale cream to deep rusty yellow, but a comparatively common phase shows a patch of yellow or rufous on the breast or abdomen, or on both. In some instances the light area extends over the whole of the under-parts, while in other cases it takes the form of a narrow or broad line down the middle of the same region, but in all individuals the light area has a longitudinal extension, and it is always sharply defined from the dark parts. A really white mole is very rare. There seems little doubt that the tendency to colour-variation runs in particular families of moles.

HIGHER EDUCATION IN LONDON.[1]

THE London County Council wholly maintains fifteen institutions in which instruction in science, art, and technology is given. The number of students at the council's various technical institutes enrolled up to the end of March, 1908, was 6527, as compared with 6215, and the number in attendance during that month was 4436, as compared with 4152 for the corresponding period of 1907. The number of day students enrolled for the same period in 1908 was 1702, as compared with 1455 for 1907, of whom 1337 were in attendance, as compared with 1109 for 1907.

In addition to providing institutions, the council partly maintains by money grants many other educational centres offering technical, scientific, or art instruction. The grants to polytechnic and kindred institutions are based on a variety of considerations, including the provision of special instruction and the attendance at classes, but the total contribution to any one polytechnic is not in any one year to exceed 7500*l.*, or any smaller sum actually required to enable the governors to meet their liabilities for the period for which the grant is made.

The ten polytechnics to which the council makes grants are distributed all over the county, and comprise the Battersea Polytechnic, the Borough Polytechnic, and the Woolwich Polytechnic on the south, and the Birkbeck College, City of London College, Northampton Polytechnic Institute, Northern Polytechnic, Regent Street Polytechnic, Sir John Cass Technical Institute, and South-Western Polytechnic on the north side of the River Thames. The instruction given in these institutions is of a very varied character, including such subjects as geometry, building construction, mathematics, modern languages, mechanical engineering, electrical engineering, tanning, leather, paint and varnish trades, carpentry and joinery, plumbing, other building trade subjects, including brickwork and masonry, experimental physics, and organic and inorganic chemistry. Where art classes are held special attention is given to the development of the classes on craft lines. The council, by virtue of its large grants in aid, appoints representatives upon the governing body or the committee of management of the several institutions.

For the last completed year (July 31, 1907) the grants to the institutions of polytechnic rank amounted to 68,233*l.*, or 33·4 per cent. of their total income from all sources. Building grants amounting to 9401*l.* were also made in the same period, and equipment grants 9125*l.*, making a total of 86,759*l.*, or 39·6 per cent. of total income, against 40·2 per cent. for the preceding year.

Grants are made to the governors of various polytechnics and technical institutions in aid of equipment required for continuing the work of such institutions at a high point of educational efficiency, having regard to the most recent scientific technological developments.

In addition to the ten polytechnics referred to above, equipment and maintenance grants in aid of the various classes in science, art, technology, and certain other subjects were made to the governors or committees of eighteen other institutions under the council's regulations relating to aid to evening classes in science, art, and technology. The actual grants—building equipment and maintenance—to all institutions in the session 1906–7 amounted to 86,759*l.* The estimated grant for the financial year was 115,476*l.*, as compared with 110,000*l.*, the estimated grant for the year 1907–8. The total number of individual students attending institutions of polytechnic rank aided by the council during the year 1907–8 was 27,275.

Attention has also been given to the extension of facilities for such technical instruction of boys in the daytime as would serve as a connecting link between secondary and higher elementary schools and the higher technical college or university, or would offer facilities for preliminary training in the daytime for those who intend to enter the engineering and allied trades, or trades where skilled workers in artistic crafts are required. Such day technical schools are intended to be auxiliary, and not alternative, to apprenticeship, and their object is to train future foremen, managers, and especially expert workers. So far as possible, the students will be drawn from the higher elementary and secondary schools at the age of fifteen, and they will receive special instruction during a period of two years. The curriculum will include instruction in science, drawing, modelling, English and general subjects, and workshop practice with distinctive trade bias, about half the time each week being devoted to the latter, but no attempt will be made to train fully for any particular trade. The workshop practice will be so arranged as to give the students a fair knowledge of workshop tools and processes. By means of such classes it is hoped that the gap between leaving day school and apprenticeship will be filled in such a manner as to enable the boys afterwards to acquire their practical experience readily and thoroughly, and that the boys will have learned a great deal more of the principles upon which the practice of mechanical engineering depends than could be learned by them if they entered the works at the age of fourteen.

The place of the polytechnics in any general scheme of coordination of technical education in the county, and their place in any scheme for the coordination of all types and grades of education, are matters of grave importance. The necessity for greater coordination between the work of polytechnics themselves, and the concentration of their efforts on carefully graded schemes of instruction in particular subjects, are matters which will receive careful consideration with the view of the prevention of overlapping and the determining of the sphere of work of each particular institution. The constantly improving means of communication between various parts of London will render possible coordination on these lines, as the isolation of the institutions, which has hitherto been a serious bar, no longer exists.

The importance of obtaining definite information relating to the students admitted to the polytechnics, technical institutes, and schools of art aided or maintained by the council, the age at which they enter, the duration of the period they are under instruction, the courses of study followed, their progress and the occupations they intend to follow, has long been recognised as being of great value in the solution of the problem. No systematic inquiries can at present be made so far as evening students are concerned, owing to the large amount of labour which would be entailed upon the officials of the institutes concerned, and the disinclination of the students to furnish the desired information. The governors of the various aided institutions have, therefore, been asked to supply the information for day students only.

The steady increase in the number of students for instruction in scientific, technical, and artistic subjects has necessitated careful consideration of the question of the provision of further facilities for such instruction, both immediately and in future years. In dealing with this matter the committee has been guided by the experience of past years, the extension of such work to meet the requirements of modern science and industrial development, the large increases each year in the number of students in attendance at the various institutions, the needs of particular districts, and, finally, the cost both in respect of capital and maintenance expenditure of such institutions.

The council's scholarship scheme provides for the award of about 2000 junior county scholarships annually, one-third to boys and two-thirds to girls, to those candidates who prove themselves qualified to receive secondary education. A junior county scholarship consists of free education for a period of three years, subject to renewal for two years more, provided that the scholar is satisfactory in conduct and attainments. A maintenance allowance of 6*l.*, 10*l.*, or 15*l.* a year is attached to the scholarship in cases falling within prescribed regulations. Junior county scholarships are tenable in such secondary schools as are or may be conducted by the council itself, and in such others as the council may from time to time approve for the purpose; 1899 such scholarships were awarded in the year under review.

A return is submitted annually to the council showing the incomes of the parents of junior county scholarship holders. The following table shows the incomes of the parents of scholars elected in July, 1907:—

[1] Extracted from the Annual Report of the Proceedings of the London County Council for the year ended March 31, 1908, published in December, 1908.

Annual income of parents	Boys		Girls		Total	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
Less than £160 ...	604	82·1	1062	85·5	1666	84·2
More than £160 and less than £300 ...	99	13·4	151	12	250	12·6
Above £300	33	4·5	31	2·5	64	3·2
Total...	736	—	1244	—	1980	—

Up to 1906 the council offered 1200 probationer scholarships, without income limit, of the value of 15*l*. a year, in addition to free education. These scholarships are tenable for one or two years, and are awarded on condition that the scholars undertake to enter the teaching profession on the completion of the scholarship course. During the year the council awarded 749 such scholarships, together with twenty-eight free places at secondary schools, to students residing outside the county. From 1907 provision will be made for the award of only 800 such scholarships, and the actual number awarded each year may not amount to this number.

The council awards 100 intermediate county scholarships annually to pupils between fifteen and seventeen years of age, tenable until the end of the school year in which the pupils attain the age of eighteen, with possibilities of extension for another year. During the year seventy such scholarships were awarded to boys (including twenty commercial intermediate scholarships) and thirty to girls. The scholarships consist of free education at a cost not exceeding 25*l*. a year, together with maintenance grants rising from 20*l*. a year to 35*l*. a year. The income restriction is 400*l*. a year. The commercial scholarships are tenable in the commercial department of the Camden or Hackney Downs London County Council secondary schools.

The council awards fifty senior county scholarships or exhibitions annually; they confer free education (not exceeding 30*l*. a year) and such maintenance allowance (not exceeding 60*l*. a year), at such rate and for such periods, not exceeding four years, as the council may in each case determine. They are tenable at such universities or university colleges as the council may from time to time approve for that purpose, not more than five such scholarships awarded annually being tenable for one year at the London Day Training College. The council has also at its disposal a certain number of free places for day students at schools of the University of London. As the number of applications was not so great as in previous years, the council awarded during the year thirty-nine senior county scholarships and exhibitions, together with fourteen free places at various colleges.

It is generally admitted that the scholarship systems, both of the late Technical Education Board and of the council, have been remarkably successful. The county scholarship system has really formed a ladder to carry promising scholars from the public elementary to the secondary schools, university colleges, and universities. That the council has secured able candidates for its scholarships is shown by the fact that each year the council's scholars have obtained scholarships in the universities or institutions of university rank. Five such scholarships were obtained at Oxford and Cambridge during the year under review, and many senior county scholars have obtained degrees with honours.

On the more technical side, exceptional distinction has been gained by scholars in research work, while others have obtained good appointments owing to their technical and artistic achievements.

By the regulations of the Board of Education a secondary school "must offer to each of its scholars an education of a wider scope and higher grade than that of an elementary school, and provide a progressive course of instruction (with the requisite organisation, teaching staff, curriculum, and equipment) in the subjects necessary to a good general education upon lines suitable for scholars of an age-range at least as wide as from twelve to sixteen or seventeen. Provision made for scholars before the age of twelve must be similarly suitable, and in proper relation to the work done in the main portion of the school." The pressing need for further inducements and facilities for children to proceed to a secondary school after leaving the elementary school has long been recognised by the council, and by means of a system of scholarships a bridge by which even the poorest children may pass from the elementary to the secondary school has been provided. The course of instruction in secondary schools, approved by the Board of Education, is framed so as to lead up to a definite standard of attainment, and not to stop short at a merely superficial introduction to any branch of instruction.

Apart from the council's own secondary schools, there are a large number of secondary schools in respect of which the council makes both maintenance and equipment grants, and which are regularly inspected by the council's officers; the total number of such schools is now fifty-two. The total amount of grants made in respect of secondary schools for the educational year ending July, 1908, was 93,970*l*.

In accordance with a scheme approved by the late Technical Education Board in 1902, the annual grant of 10,000*l*. to the University of London, to be divided equally between the four faculties of arts, science, engineering, and economics, has been continued. In addition, annual grants have been made since 1895–6, together with occasional equipment grants, to four of the constituent colleges of the University, the council thereby obtaining the right to a certain number of free places.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is proposed, says *Science*, to collect 1500*l*. with which to purchase the valuable chemical library of the late Prof. W. O. Atwater, and present it to Wesleyan University, Middletown, Conn. The library contains more than 5000 volumes, including about 2500 volumes of periodicals.

TWO courses for teachers, arranged in connection with the London County Council Education Committee, will begin at University College on January 23. Dr. Woodland will begin a course of lectures on "The Structure and Natural History of some Common Animals," and Dr. Fritsch will begin a similar course on "Fundamental Principles of Botany." On Tuesday, February 23, Prof. Pearson will deliver a lecture on "The Purport of the Science of Eugenics." This will be the first of a course of lectures on national eugenics, to be given on Tuesdays in the second and third terms, by Prof. Pearson, Mr. Heron, and Miss Elderton.

THE annual meeting of the Public School Science Masters' Association will be held at Merchant Taylors' School, Charterhouse Square, E.C., on January 12. In the morning, at 10 a.m., an exhibition of scientific apparatus and books will be opened, and at 10.30 a business meeting will be held. The president, Sir Clifford Allbutt, K.C.B., F.R.S., will afterwards deliver an address upon the relation of general to technical science teaching. At the close of the morning session Mr. M. D. Hill, of Eton College, will speak on anthropometry in schools. The afternoon meeting will be devoted largely to a discussion upon science curricula in public schools, and the debate will be opened by the following papers:—Mr. G. F. Daniell, on the report of the British Association upon the sequence of studies in science; Mr. W. D. Eggar, of Eton College, on geography considered as a science subject; Mr. R. G. Durrant, of Marlborough College, on to what extent and at what stage should prevalent views on the nature of solution be taught in schools; and Mr. G. H. Martin, of Bradford Grammar School, on science for the "classical side." At the close of the discussion, Mr. C. I. Gardiner, of Cheltenham College, will deal with the question of the refusal of the General Medical Council to recognise public schools as institutions where medical education can be commenced.

THE annual meeting of the Association of Directors and Secretaries for Education was held on January 1 in the council chamber of the London County Council, when an address on "The Finances of Education" was delivered by Mr. W. Avery Adams, chairman of the association and secretary to the Bristol Education Committee. In opening his address, Mr. Adams said that the scheme for raising the Bristol University College to the rank of a university, owing to the generosity of Mr. H. O. Wills, promises shortly to be carried into effect, thus securing for the west of England the same opportunities for intellectual and professional training as are available in other parts of the country. Alluding to the Scottish Education Act, he directed attention to the powers which are to be granted to school boards in Scotland to compel attendance at continuation classes up to the age of seventeen. If such a remedy for the educational leakage which now went on is practicable in Scotland, said Mr. Adams, surely it is not unreasonable to suggest that it is practicable in England. The principal theme of the address was the finances of education, and Mr. Adams insisted that one of the chief hindrances to progress is the financial strain now put upon the local education authorities (1) by the imposition on the part of the State of new and onerous duties; (2) by the continual growth of what may be termed the ordinary items of expenditure; and (3) by the failure of Whitehall to contribute a fair share of the total burden of the increasing cost. The development of our educational system, which has advanced enormously during the last six years, has also entailed a large annual increment to the rates; and, apart from what has already been accomplished, there are still many urgent educational reforms which would doubtless be undertaken by local authorities if it were not for the reluctance of Whitehall to bear a fair share of the cost involved in carrying out the improvements. Among these reforms may be placed:—(1) the reduction in the size of the classes; and (2) the replacement of supplementary teachers by certificated teachers. The Government grant in support of national elementary education is totally inadequate. In conclusion, Mr. Adams emphasised the fact that the exiguous grant given by the State to the local universities, which have now become an indispensable part of our educational system, is not creditable to a wealthy and progressive nation like ours. The outcry heard against the growing burden of the cost of education is not the expression of a spirit of grant-greed, but represents a fear that through inadequate Government support the schools may send forth scholars who will not be equipped properly for the warfare of life or for taking their part in the struggle which has to be made unceasingly for the maintenance of the commercial and industrial position of our nation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 12, 1908.—"The Occlusion of the Residual Gas and the Fluorescence of the Glass Walls of Crookes Tubes." By Alan A. Campbell **Swinton**. Communicated by Sir William Crookes, F.R.S.

In a previous paper[1] the writer has described experiments indicating that the occlusion of the gas is due to its being driven into the glass, in which it forms bubbles on subsequent heating.

The present paper deals with Mr. Robert Pohl's suggestion that the bubbles are not due to the gas at all, but to chemical action on the glass, when heated, of aluminium disintegrated from the electrodes.

The author finds that after prolonged sparking portions of the internal surface of the glass of tubes with external electrodes consisting of caps of tinfoil show numerous but very small bubbles when heated. This, as it would seem, entirely disposes of Mr. Pohl's contention.

The electric discharges passed through the tubes were so weak that the heating of the glass was very slight. The temperature cannot thus have been sufficiently raised either to allow of the gas passing into the glass by ordinary diffusion, as suggested by Sir J. J. Thomson, or of the gas being evolved inside the glass by chemical decomposition due to heat, as put forward by Mr. Soddy and Mr. Mackenzie.

Grinding away the glass to the extent just necessary to prevent the formation of bubbles on subsequent heating also showed that the depth to which the gas is driven into the glass varied from 0·0025 mm. for tubes with external electrodes to as much as 0·015 mm. with internal electrodes, the distances being in all cases considerably less—about one-tenth—than the distances between the surface of the glass and the centres of the bubbles produced by subsequent heating.

By means of a fluorescent screen placed behind a patchwork screen of different thicknesses of aluminium foil, it was ascertained that the maximum thickness of aluminium through which kathode rays will pass is about 0·014 mm., which agrees very fairly with the above-mentioned figure of 0·015 mm.

Thus neither the explanation of Sir J. J. Thomson nor that of Mr. Soddy and Mr. Mackenzie seem necessary, for the gas in the first instance travels into the glass only about the same distance that kathode rays penetrate into aluminium, and it is therefore reasonable to suppose that the gas is driven in mechanically according to the writer's original contention. Diffusion, however, probably takes place when the glass is softened in the flame, when the gas penetrates further and forms bubbles on cooling, in much the same way that air bubbles are formed in ice.

Experiments were also made on the fatigue of the glass in respect to fluorescence. Except in cases where this fatigue was due to deposits of electrode matter or of carbon, it was found necessary, in order to do away with it, to grind away a thickness of glass approximately the same as had to be removed to prevent the formation of bubbles on subsequent heating. It would therefore appear that fatigue is intimately connected with, and is perhaps the direct result of, the penetration and presence of the occluded gas. That part of this fatigue is very permanent is shown by a tube in the author's possession, which still shows fatigue due to bombardment it received in 1898. Though part of the fatigue is permanent, most of it is but temporary. This may be due to the gradual escape of such portion of the gas as has been driven into the glass only such a very short distance that the latter is unable permanently to retain it.

[1] "The Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes," Roy. Soc. Proc., A, vol. lxxix., pp. 134–7.

PARIS.

Academy of Sciences, December 28, 1908.—M. Bouchard in the chair.—The lava of the last eruptions of Vulcano, Eolian Isles: A. **Lacroix**. In the cases of Mt. Pelée, Vesuvius, and Etna it has been proved that in a given eruption any changes in the chemical composition of the lava are very slight, and are not systematic. Observations published by various authors on the products of the last eruption of Vulcano appear to lead to different conclusions. Various specimens of the lava from this eruption have been analysed, and the existence of such marked differences is not confirmed.—Some properties of the tubercle bacillus cultivated on bile: H. **Calmette** and C. **Guérin**. The authors are convinced that experiments in tuberculosis in which cultures in glycerol, gelatin, potato, or broth are used give different results from those of natural infection. They have found that the bacillus grows perfectly on pure bile with 5 per cent. of glycerin and sterilised, and after several successive cultures on this medium it acquires very distinct physiological characters. Full details are given of the mode of working and of the appearance and properties of the bacillus thus obtained. It is easily absorbed through the wall of the digestive tube, and when it has penetrated in sufficient quantity in this way it can create lesions with rapid calcification such as could never be obtained experimentally with cultures in ordinary glycerin media.—M. Villard was elected a member in the section of physics in the place of the late E. Mascart.—Concerning the distribution of the aphelia of the minor planets: Emile **Belot**. A diagram is given of the distribution.—The use of coloured screens and orthochromatic plates for the photographic observation of the fixed stars: Œsten **Bergstrand**. The combination of a yellow screen and an orthochromatic plate produces much greater clearness in the images, and also eliminates the

harmful influence of atmospheric refraction. It is to be recommended in all precise measurements of position, and especially in work on stellar parallax.—The principles of flight with wings: L. **Thouveny.**—A special model of a balloon: M. **Radiot.**—The problem of efforts in the theory of elasticity: A. **Korn.**—The magnetic rotatory power of the vapour of calcium fluoride and of nitrogen peroxide in the neighbourhood of their absorption bands: A. **Dufour.** The vapour of calcium fluoride in the magnetic field possesses a positive magnetic rotatory power outside and near the doublets of all the components of the band D″ and negative in their interior; the rotation may attain a value of 40° to 50° in the centre of the doublets. Similar observations on nitrogen peroxide are described.—The law of the maximum of kathode phosphorescence in binary systems: G. **Urbain.** It is now well established that, in opposition to the views of Sir W. Crookes, pure substances do not give rise to phosphorescence. A brilliant phosphorescence is always the result of a mixture of two substances, and there is a certain percentage of one of them which gives a maximum result.—The electrical resistance of the alkali metals, of gallium, and of tellurium: A. **Guntz** and W. **Broniewski.** These metals were introduced into a U-shaped capillary tube, with suitable precautions as to purity and freedom from oxidation. The resistances of cæsium, rubidium, potassium, sodium, and lithium were measured at −187°, −78°·3, 0°, and a fourth higher temperature, and the results compared with those calculated from the formula

$$r_t = (2F + T) \times \text{constant},$$

in which r_t is the resistance at the temperature t, F the absolute temperature of fusion, and T the absolute temperature of the body. Measurements are also given for gallium in both the solid and liquid state and for tellurium.—The reduction of uranyl chloride: Œchsner **de Coninck.** An attempt was made to determine the atomic weight of chlorine by reducing $U_2O\,Cl_2$ in hydrogen at a red heat, but the results were found to be of no value.—The preparation of ether salts of the cyclic series: A. **Béhal.** A mixture of acetic acid and benzyl chloride, heated to the boiling point, slowly gives off hydrochloric acid, benzyl acetate being formed. The action is accelerated by the presence of certain catalytic agents, bismuth chloride being especially active in this respect.—The preparation and properties of β-gluco-heptite: L. H. **Philippe.** By reducing the gluco-heptonic lactone obtained from ordinary glucose with sodium amalgam, E. Fischer obtained β-gluco-heptose. The author, by pushing the reduction a stage further, has prepared a new heptavalent alcohol, β-gluco-heptite, the physical and chemical properties of which are given.—The facies of natural crystals: Paul **Gaubert.**—The development of the perennial plant compared with that of the annual plant: G. **André.**—The presence of urea in some of the higher fungi: A. **Goris** and M. **Mascre.** Certain species of fungi have been found to contain from 2·7 to 4·3 per cent. of urea. It still remains to be proved whether the urea was present as such in the fungus, or was formed during the process of drying.—A new artificial peroxydase: E. **de Stœcklin.** Tannate of iron acts as a peroxydase, the monophenols being attacked with especial ease.—The green pigment of the bile: M. **Piettre.**—The physiological function of the arborescent glands connected with the female generating apparatus of *Periplaneta orientalis*: L. **Bordas.**—The stratigraphical definition of the Sicilian stage: **Maurice Gignoux.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 7.

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

FRIDAY, JANUARY 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A New Dividing Engine: G. T. McCaw.—Fluctuations in the Moon's Mean Motion: Prof. Simon Newcomb.—Observations of Comet *c* 1908, Morehouse: R. C. Johnson.—Development of the Disturbing Function in Planetary Theory in Terms of the Mean Anomalies and Constant Elliptic Elements: P. H. Cowell.—Note on Major MacMahon's Paper on the Determination of the Apparent Diameter of a Fixed Star: A. S. Eddington.—*Probable Papers*: On a Chinese Planisphere: E. B. Knobel.—Observations of Occultations of Stars by the Moon in the Year 1908: Royal Observatory, Greenwich.—Observations of Saturn's Ninth Satellite, Phœbe, from Photographs taken with the 30-inch Reflector in 1908: Royal Observatory, Greenwich.

MONDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, JANUARY 12.

ZOOLOGICAL SOCIETY, at 8.30.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–5.—Report on the Copepoda: Prof. G. O. Sars.—Studies on the Flagellate Blood Parasites of Freshwater Fishes: Prof. E. A. Minchin.—A Further Note on the Gonadial Grooves of a Medusa, *Aurelia aurita*: T. Goodey.—The Tuberculin Test in Monkeys, with Notes on the Temperature of Mammals: Dr. A. E. Brown.—A few Notes on *Balaena glacialis* and its Capture in Recent Years in the North Atlantic by Norwegian Whalers: Prof. R. Collett.

WEDNESDAY JANUARY 13.

GEOLOGICAL SOCIETY, at 8.—On Labradorite-Norite with Porphyritic Labradorite Crystals; a Contribution to the Study of the "Gabbroidal Eutecticum": Prof. Johan H. L. Vogt.—On the Genus Loxonema, with Descriptions of New Proterozoic Species: Mrs. Jane Longstaff.

SOCIETY OF PUBLIC ANALYSTS, at 8.—(1) The Analysis of Complex Candle Mixtures; (2) The Detection and Estimation of Mercury in Nitro-Explosives: Otto Hehner.

THURSDAY, JANUARY 14.

ROYAL SOCIETY, at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The G. B. System from a Tramway Manager's Point of View: Stanley Clegg.

FRIDAY, JANUARY 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Filtration and Purification of Water for Public Supply: John Don.

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