THURSDAY, MAY 22, 1913.

THE ROYAL SOCIETY'S SUBJECT INDEX.

Royal Society of London. Catalogue of Scientific Papers, 1800–1900. Subject-Index, Vol. iii., Physics. Part i., Generalities, Heat, Light, Sound. Pp. c+550+vii. (Cambridge University Press, 1912.) Price 18*s.* net.

THE most obviously essential qualities of a work of reference such as this are accuracy, comprehensiveness, and a lucid arrangement of the contents, so that anyone using the book may readily find the information he is in search of. The test of accuracy must lie in the result of long usage, but, in the present case, so far as an *a priori* guarantee can go, we have it in the auspices under which the book is produced. As to comprehensiveness, while absolute completeness is no doubt unattainable, most of those who have occasion to consult the work before us will be satisfied with the statement that it "contains 33,344 entries referring to the papers contained in 1261 serial publications." Even these numbers convey little idea of the comprehensive scale of the whole book of which the volume we are considering forms a part, unless it is borne in mind that it deals with only those parts of the science of physics which are included under the headings generalities, heat, light, sound, leaving the great subjects electricity and magnetism for another volume, and unless we remember, further, that the whole of physics constitutes only one of seventeen sciences included in the schedule of the International Catalogue. These sciences are mathematics, mechanics, physics, chemistry, astronomy, meteorology, mineralogy, geology, geography, palæontology, biology, botany, zoology, anatomy, anthropology, physiology, and bacteriology.

The volume relating to pure mathematics was published in 1908 and contains 38,748 entries referring to 700 serials, and the volume on mechanics, published in 1909, contains 21,295 entries referring to the papers contained in 959 serials. This makes a total of 93,387 entries contained in the three already-published volumes of the catalogue, or, if we assume that the second half of "Physics" will yield as many as the first half, we get an estimated total of more than 126,000 entries for the first three sciences in the above list. Of the remainder, some will no doubt provide a smaller number than the average of those already dealt with, but others will probably furnish quite as many. This may suffice to give some idea of the comprehensive character and immense scale of the work which the Royal Society's committee has undertaken in the compilation of this catalogue.

The arrangement of the matter has obviously required very careful consideration. A purely alphabetical arrangement of such an immense number of entries relating to such a great variety of subjects would clearly have resulted in a series of bewildering lists wherein the search for a particular item would have been like that for a needle in hay. The arrangement actually adopted is founded on an elaborate attempt at a rational classification of the subject-matter of the sciences dealt with. This is carried out by a series of successive divisions and subdivisions, the nature of which can be best shown by an example. Thus the general subject of Heat is first distributed among the following main divisions: General; Sources of Heat and Cold; Thermometry; Relations involving Expansion and Stress; Calorimetry and Specific Heat; Phenomena of Change of State; Thermal Conduction and Convection; Thermo-dynamics. Each of these main divisions is subdivided into numbered headings; thus, to take a comparatively compact example, Calorimetry and Specific Heat comprises the following headings: 1600, General, Units of Heat; 1610, Calorimetric Methods; 1620, Specific Heats of Solids and Liquids; 1640, Specific Heats of Gases and Vapours; 1660, Chemical Constitution and Specific Heat; 1670, Heats of Fusion; 1680, Heats of Vaporisation; 1690, Heats of Dissolution; 1695, Heats of Transformation.

The numbers greatly facilitate cross-reference. It will be seen that they do not run continuously and that the intervals between them are not uniform. These intervals make it possible to expand the index in future by inserting additional entries without disturbing those to which numbers have already been assigned. For some rather occult reason the reference numbers all have four figures, the first half-dozen being 0000, 0010, 0020, 0030, 0032, 0040. These numbered headings are in most cases again subdivided, sometimes to a considerable extent, before we come to the references to individual papers.

The extreme terms of this series of divisions and subdivisions, namely, a branch of science and a particular paper relating to some matter falling under this branch, are determined by the nature of the case; but there is room for almost any amount of difference of opinion as to how many intermediate terms should be interposed, and where they should be placed. The ultimate criterion in this matter should be, in our opinion, the degree of ease and convenience with which a

student wishing to follow up a particular subject can find references to what has been already published in relation to it. To facilitate this kind of reference is, in fact, the whole purpose of the book. Some degree of arrangement and classification of contents is needful to make the index usable at all, and this begins when one science is marked off from another; but the more minutely the classification is carried out, and the smaller the resulting classes become, the more chance there is of uncertainty as to the class in which a particular paper should be placed. If the question is answered in one way by the compilers of the index and in another way by a person who wishes to use it, the natural consequence is that he does not find the information he wants in the place he turns to first. The fact is that any possible classification is in a great degree arbitrary and conventional. The grouping of scientific results that at any time seems most natural and logical inevitably reflects not only the then existing state of knowledge, but also the successive stages by which that state of knowledge has been reached. New additions to scientific knowledge are not like bricks added to a building each of which occupies a fixed position and a sharply defined space; each newly recognised fact sheds light on what was known before and may greatly alter the apparent relative importance of previous acquisitions.

That such considerations are not irrelevant to the arrangement of this index is shown by the entry of thirteen references to papers on heat developed on moistening solids, under the general heading **0300 Capillarity,** and also under **Phenomena of Change of State, 1800 General.** There are, in fact, hosts of phenomena which are essentially related to more than one division of science, and papers dealing with them must necessarily be entered under more than one heading unless the index is to be encumbered by a tangle of cross-references.

We are fully conscious that the Royal Society's committee and the compilers of the index, who have considered the matter as a whole, may have good reasons for deciding on subdivisions and schemes of arrangement the advantages of which are not at once evident to anyone who has only partially examined a part of their work. It is therefore with the greatest diffidence that we venture to raise the question whether the classification on which the arrangement of the index is founded is not in some cases too minute. Thus the first entry under the heading **2410, Mechanical Equivalent of Heat,** gives a reference to Joule's classical paper in the Philosophical Transactions for 1850, and lower down, under the same general heading, we find references to Rowland's determination and to Reynolds and Moorby's; but Joule's final measurement (Phil. Trans., 1879) is given under a separate sub-heading, **Determination of Mechanical Equivalent,** under which we also find Griffiths (Phil. Trans., 1894), Miculescu (1892), and many others, and, under a sub-sub-heading, "Electrical Method," Joule's determination of 1867. We do not doubt that there are intelligible reasons for the separations and collocations of which these are examples, but we confess that to us personally they are more bewildering than helpful. For a long time we were not able to find any reference to Schuster and Gannon's measurement by the "electrical method," but at last we discovered it, as well as Rowland's and various other determinations, under "Specific Heat of Water." This is quite an appropriate place, but it is not easy to see why this paper should not also have been entered among determinations of the mechanical equivalent.

It is no doubt in consequence of our not having mastered the classification adopted by the committee that we have not been able to find references to such historically important investigations as those of Dulong and Petit into the expansion of mercury, the laws of cooling, and the specific heats of metals. The real difficulty of finding a thoroughly satisfactory system of arrangement arises partly from the enormous mass of material to be dealt with, but still more from the extreme complexity of the material. A strictly alphabetical arrangement offers an alluring simplicity, but a very slight examination of the contents of this volume must convince anyone that it would be hopeless to apply it until the matter has undergone a preliminary process of arrangement and sifting. The only questions that can arise are as to how this process shall be conducted, and how far it shall be carried; and probably scarcely any two men would answer these questions in exactly the same way.

There is no question that the index is a very remarkable and admirable piece of work, on which the Royal Society's committee, the director, Dr. McLeod, and all his colleagues deserve to be heartily congratulated. It will not only be of immense service to those engaged in the study of special questions, but it will help to keep alive a knowledge of the work of the men who laid the foundations of physical science. This work, like foundations generally, is apt to be buried out of sight as the superstructure rises, but it is well that modern builders should cherish the memory of those who made their work possible.

We find it difficult to close this volume without comparing it with Dr. Thomas Young's "Catalogue of Works relating to Natural Philosophy and

the Mechanical Arts," published a little more than a century ago (1807), which, for its time, and as the work of one man, was as wonderful as the present index. The comparison affords a more trustworthy indication of the advance of natural knowledge during the nineteenth century than could probably be obtained in any other way.

G. C. F.

A NEW TEXT-BOOK OF MINERALOGY.

Mineralogy: an Introduction to the Theoretical and Practical Study of Minerals. By Prof. A. H. Phillips. Pp. viii + 699. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1912.) Price 16*s.* net.

PROF. PHILLIPS'S text-book on mineralogy follows, on the whole, the usual lines of such works, and in price and size comes intermediately between Miers's well-known treatise, which appeared eleven years ago, and Dana's small book, a new edition of which, prepared by Ford, was published recently. By his experience in teaching the subject the author is well qualified to write a book suitable for students who wish to acquire a sound working knowledge of mineralogy.

As will be evident from the titles of the three parts into which it is divided, viz., crystallography, descriptive mineralogy, and determinative mineralogy, the book is comprehensive in its scope. Since each forms a subject wide enough to fill a book in itself, the author of a work dealing with all three is confronted with the difficulty of deciding how to keep the size within reasonable dimensions. On the whole, Prof. Phillips has succeeded in well covering all the ground necessary for the average student of mineralogy. We must acknowledge a debt of gratitude to him for resisting the temptation—irresistible to most writers on crystallography—of devising a brand new set of names for the thirty-two classes of crystal symmetry; he has wisely followed Miers, because the latter's nomenclature embodies the type of symmetry, and is therefore more easily remembered. Some surprise may be felt that little trace of Penfield's teaching should be evident in the discussion of the method of drawing crystals; the old one, in which an axial-cross is used, alone is considered, and no mention is made of the simple and convenient methods based upon the stereographic or gnomonic projections.

The whole subject of the goniometrical measurement of crystals is treated in a very elementary manner, and is confined to the instrument with a single circle; the theodolite goniometer, with two circles, which is used by many crystallographers in the United States, especially those who have studied under Goldschmidt, is not referred to, and it would seem that few students at Princeton University prosecute their studies very deeply into crystallography. The optical characters of crystals, on the other hand, are more fully dealt with, the reason no doubt being that an adequate knowledge is essential to the practical petrologist in the determination of the constituent minerals of a rock from a microscopic study of a thin-section.

The first part includes an interesting chapter on the relations of individual crystals, in which attention is directed to the parallel growths of one mineral on another, the full importance of which subject has largely been brought out by Barker's researches during recent years.

The second part includes three chapters which we should have imagined more in place in the first part, viz., the relation of the minerals to the elements, which covers such matters as topic parameters and the classification of minerals, the origin of minerals, and, lastly, the physical properties—for instance, cleavage and fracture, hardness, specific gravity, structure, colour, phosphorescence, &c. The part proper is devoted to concise descriptions of the characters and localities of the principal mineral species. At the head we have an abstract of their properties—chemical composition, crystalline system and type of symmetry, common forms, hardness, specific gravity, streak, colour, lustre, transparency, refractive indices—and then follows a general description of the crystals from the principal localities; in certain instances a few words are said about the use of the mineral or the metal derived from it.

Part iii. is given up to the methods of blowpipe analysis, the apparatus used, and the tables necessary for the identification of the various minerals, and is founded on Brush's well-known book. The tables provided include also one for the determination of minerals from their physical characters, dependence being placed mainly upon the hardness, streak of the softer and colour of the harder minerals, specific gravity, and cleavage, and another for the determination of the principal rock-forming minerals from their optical characters as given in a thin-section. The book ends with a full index, the use of which is facilitated by the employment of a different type for the numbers of the pages in each part of the book.

So far as we have tested it, the book seems satisfactorily accurate. Two curious mistakes have, however, crept into the description of the Cullinan diamond, the date of the discovery being wrongly stated to be June 6, instead of January 25, 1905, and the weight given being too high.

HEREDITY AND RELATED STUDIES.

(1) *Vererbungslehre. Mit besonderer Berücksichtigung des Menschen, für Studierende, Aerzte und Zuchter.* By Dr. Ludwig Plate. Pp. xii+519+3 plates. (Leipzig: W. Engelmann, 1913.) Price 18 marks.

(2) *Genetics: An Introduction to the Study of Heredity.* By Prof. H. E. Walter. Pp. xiv+272. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s.* 6*d.* net.

(3) *The Fitness of the Environment: An Inquiry into the Biological Significance of the Properties of Matter.* By Prof. L. J. Henderson. Pp. xv+317. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s.* 6*d.* net.

(4) *Moderne Probleme der Biologie.* Prof. C. S. Minot. Pp. vii+111. (Jena: Gustav Fischer, 1913.) Price 3 marks.

(5) *Vorträge über Deszendenztheorie.* By August Weismann. Dritte umgearbeitete Auflage. Erster Band and Zweiter Band. Pp. xiv+342+vii+354+3 plates. (Jena: Gustav Fischer, 1913.) Price 13 marks.

(1) PROF PLATE'S excellent book gives a clear and comprehensive account of the present state of the study of heredity. The author is already known as an experimental investigator on the genetics of coat colour in mice, and as a student of heredity in man. Moreover, as the volume shows, he has a wide knowledge of the literature. The chief feature of the book, in which it differs most from works of a kindred nature, is the amount of space allotted to human heredity. Nearly one-fifth of the book is devoted to this subject, and most cases of which anything is known in man come in for review. It is certainly the best general account of this side yet written, and for this reason, if for no other, should be of special value to students of eugenics and to medical men. We notice that the author still adheres to the ingenious theory which he put forward some two years ago to account for the peculiar phenomena of inheritance in cases such as colour-blindness and hæmophilia, where the unaffected females transmit the affection to their sons. The theory is largely based upon the unusual proportions of the sexes in certain matings among such families. Lenz, however, has recently suggested that these proportions are due to the way in which the material is necessarily selected, and that Plate's explanation is probably incorrect. The volume is attractively and clearly written, and is well illustrated with more than 170 figures and three coloured plates.

(2) Prof. Walter states explicitly in his introduction that he is not engaged in research in the subject of which he treats. The book professes to be but a summary which may be useful in college courses, and of interest to the general reader, nor does the author aim at more than "out of the jargon of many tongues to raise a single voice which shall attempt to tell the tale of heredity." As a tale to be told the book cannot be judged a success. It gives one the impression of lecture notes carefully taken and displayed under appropriate labels. There is a little about much, and on the whole the information given is sound second-hand. The only attempt at originality is to be found in some of the diagrams. It is always refreshing to get away from the hackneyed stock, but we cannot help feeling that in some cases the author has got a little too far away. Fig. 2 is intended to illustrate the continuity of protoplasm, but it inevitably challenges comparison with a Cubist picture. Fig. 31, "a diagram to illustrate various ideas about species," calls to mind what is occasionally to be seen in an elementary student's notebook naïvely labelled "Amœba," while fig. 45 looks like the plan of a theatre auditorium somehow disarticulated. But perhaps it is ungrateful to criticise originality, and the book will doubtless be found of use by the student who wishes to "get up" the subject for examination in the shortest time.

(3) The genesis of this volume is explained in the opening sentences of the preface.

"Darwinian fitness is compounded of a mutual relationship between the organism and the environment. Of this, fitness of the environment is quite as essential a component as the fitness which arises in the process of organic evolution; and in fundamental characteristics the actual environment is the fittest possible abode of life. Such is the thesis which the present volume seeks to establish."

Rather on the lines of the old Bridgewater treatises, which he has evidently studied, the author proceeds to argue that the more recent discoveries in the realms of physics and chemistry all confirm the idea that from the inorganic side this is the fittest of all possible worlds to form an environment for living matter. Water in respect to all its many properties is the fittest of fluids to exist in the quantities that it does, and in the author's opinion it would be to introduce a serious element of unfitness were it replaced, for example, by liquid ammonia. Carbon dioxide also shows itself

"in its physico-chemical traits variously fitted for the organic mechanism. Less various, to be sure, and less obvious than those of water, such fitnesses as it does possess are quite as genuine."

Of the three elements carbon, hydrogen, and oxygen, the author concludes that:

"Each by itself, and all taken together, possess unique and prëeminent fitness for the organic mechanism."

Nor is the ocean forgotten, but comes in for a whole chapter and a warm encomium. The latter part of the book is devoted to a discussion on vitalism and teleology, and the author uses the "fitness" of things physical as an argument for a mechanistic interpretation of things organic. For the "fitness" of the physical world appears to imply teleology. Nevertheless, mechanism is enough. Hence the semblance of teleology is misleading, and therefore mechanism must suffice for biology also. Perhaps Dr. Henderson's position with regard to vitalism may best be illustrated by the remark of Laplace, which he himself quotes. When the philosopher was asked by Napoleon why the name of God did not occur in his *Mécanique céleste* he replied: "Sire, je n'ai pas besoin de cet hypothèse."

(4) Prof. Minot's book is the outcome of six lectures delivered by him at Jena in the capacity of "Exchange-Professor." After a preliminary lecture on the nature of cells he develops his views on the changes that occur in the life cycle from fertilisation until death. With fertilisation comes the inception of a process of rejuvenescence characterised by the formation of a number of undifferentiated cells, and with a great proportional increase in the total amount of nuclear material in the organism. Then comes a stage where the tissues develop, where they undergo a process of differentiation or cytomorphosis, as the author terms it. This is eventually followed by degeneration and ultimately by death. Death is the price paid for differentiation. Such is the tale. We rot and rot, but Prof. Minot sees the rotting starting earlier than the poet does. Senescence is the outcome of cytomorphosis, and as this is most active in comparatively early embryonic stages it follows that we are rotting most rapidly before we are born. After that we are let down more gently. The book rambles a good deal, and a chapter is devoted to the determination of sex, though it seems scarcely germane to the main thesis. Possibly it owes its place to its being an attractive subject for a course of semi-popular lectures.

(5) The last edition of this well-known work appeared in 1904, and was reviewed in NATURE for June 29, 1905. The greater part of the present edition is a reprint of the earlier one, but in one respect there is a change. Lectures 22–24, dealing with heredity, have been rewritten, and a fresh lecture added. The change was necessitated by the great progress made in these studies during the past few years owing to the discovery of Mendel's work. Weismann's second edition appeared four years after that discovery, and the matter was then dismissed in a few lines. To-day the position is accepted, and the author endeavours to bring the new facts into line with his theory. That the conception of segregation fits in a general way with his views on the nature of chromosomes is obvious. But, as he himself recognises, difficulties begin to appear as soon as the matter is more carefully considered.

One of the difficulties at the root of the chromosomal interpretation of hereditary factors is the fact that in some species already, *e.g.* Triticum, Lathyrus, and Antirrhinum, the number of factors identified is greater than the total number of chromosomes. Some investigators, notably Morgan, have sought to reconcile such cases with the chromosome hypothesis by means of Jansen's theory of "chiasmatypie," while others are inclined to question the sufficiency of the chromosome theory to explain segregation. Fresh facts, however, must decide the matter, and it is likely that the next few years will be critical years for Weismann's views. The present volume is of historical interest in showing the attitude of a great speculative mind when brought to face a new and unfamiliar body of facts, and it is much to be regretted that in shaping their interpretation a brain of such synthetic capacity is little likely to be available.

VON RICHTHOFEN'S "CHINA."

China: Ergebnisse eigener Reisen und darauf gegründeter Studien. Von Ferdinand Freiherr v. Richthofen. Dritter Band. Das südliche China. Herausgegeben von Ernst Tiessen. Pp. xxxi + 817 + 5 plates. Fünfter Band. Enthaltend die abschliessende palaeontologische Bearbeitung der Sammlungen F. von Richthofens, die Untersuchung weiterer Fossiler Reste aus den von ihm bereisten Provinzen sowie den Entwurf einer erdgeschichtlichen Uebersicht China's. By Dr. Fritz Frech. Pp. xii + 289 + 31 plates.

Atlas von China. Orographische und geologische Karten von Ferdinand Freiherr von Richthofen, zu des Verfassers Werk "China: Ergebnisse eigener Reisen und darauf gegründeter Studien." Zweite Abtheilung. Das südliche China (zum dritten Textband gehörig). Bearbeitet von Dr. M. Groll. Pp. 12 + plates 27–54. (Berlin: Dietrich Reimer, 1911–12.) Price, Bands III. and V., 32 marks; Atlas, 52 marks.

THESE volumes complete what may well be called the monumental work of Baron v. Richthofen on China, for the word is equally appropriate whether we regard the extent and

importance of his researches, which will stand for all time as the foundation of our knowledge of the geology of the Chinese Empire, or whether we regard the fact that the author himself was only able to publish a portion of his work, the greater part having been prepared for and put through the press by the devoted industry of his friends and former pupils.

Of the two volumes before us, one contains v. Richthofen's account of his travels through southern China, edited and amplified by references to the observations of later travellers by E. Tiessen. These additions are most extensive in the account of the salt and gas fields of the upper Yangtsekiang, which v. Richthofen was prevented from visiting, where the ingenuity and indomitable perseverance of the Chinese have enabled them, in spite of the primitive nature of their appliances, to rival the achievements of the modern driller and to obtain a supply of natural gas from depths of 2000 ft. and even 3000 ft. The detailed observations of so acute an observer must always be of interest, and although all the more important results of his journey have already been published in one form or another, we welcome the completion of publication of the record, which will always be of importance and value to the student of the geology and physical geography of Eastern Asia.

The other volume is entirely the work of Dr. Fritz Frech, to whom Baron v. Richthofen entrusted the elaboration of the palæontological material collected by him. The description of the fossils is supplemented by a series of essays on the distribution and development of the different rock systems in China and Eastern Asia, and by a general review of the geographical evolution and the geological history of sea and land in China.

OUR BOOKSHELF.

Die gnomonische Projektion in ihrer Anwendung auf kristallographische Aufgaben. By Dr. H. E. Boeke. Pp. iv+54. (Berlin: Gebrüder Borntraeger, 1913.) Price 3.50 marks.

THIS little book on the gnomonic projection of crystals is a welcome addition to crystallographic literature. The standard work on the subject, "Ueber Projektion und graphische Kristallberechnung," by Prof. V. Goldschmidt, of Heidelberg, was published in the year 1887, before the advent of the two-circle goniometer, which has both simplified the method and enlarged the field of usefulness of the gnomonic projection. The greater number of the subsequent improvements in the method we owe to Dr. G. F. Herbert Smith, Mr. H. Hilton, Dr. A. Hutchinson, Dr. J. W. Evans, Sir Henry Miers, Prof. von Fedorow, and Prof. F. E. Wright.

The gnomonic differs from the stereographic projection in that the plane of projection is a tangent plane to the sphere (within which the crystal is supposed to be concentrically situated), and the eye is imagined to be placed at the common centre of the sphere and crystal; while in the stereographic projection the eye is situated at the north or south pole of the sphere, and the plane of projection is that containing the equatorial great circle. Just as we have the most useful stereographic nets of Hutchinson, Penfield, and von Fedorow, so we have the gnomonic net of Hilton, and Herbert Smith has furnished us with a table to facilitate the plotting of the gnomonic diagram from the results of the measurements of the crystal made on the two-circle goniometer, an excellent type of which he has invented. With the exception that no mention appears to be made of the important work of Herbert Smith (no index is provided), Prof. Boeke has given in the concise space of fifty-four pages a very fair account of the principles of the method, together with some useful tables of chords and tangents. The illustrations are simple ones from original drawings of the author, and are very practical, but an obvious omission is that of a few typical gnomonic projections of fairly complex crystals belonging to each system of symmetry. Such a series of concrete examples would have afforded students a more comprehensive idea of the scope, possibilities, and actual application of the gnomonic projection.

A. E. H. T.

The Extra Pharmacopoeia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and Dr. W. Wynn Westcott. Fifteenth edition. Vol. i., pp. xxxi+1114. Price 14*s.* net. Vol. ii., pp. viii+370. Price 7*s.* net. (London: H. K. Lewis, 1912.)

THIS valuable work has now reached its fifteenth edition, eloquent testimony of its worth. The subject-matter has grown to so great an extent that it has been necessary to divide it into two volumes: the first, of more than 1000 pages, contains the description of the chemicals and drugs and the sections on vaccine and serum therapy, therapeutic index, &c.; the second embodies analytical and experimental work and a *résumé* of investigations on infective and other diseases. For the medical man and pharmacist, the book contains a wealth of information scarcely to be found in any other work, while numerous data are scattered through it which render it a volume of reference which will be found of the greatest service in the chemical and the biological laboratory.

R. T. H.

Practical Physiological Chemistry. By S. W. Cole. Third edition. Pp. xii+230. (Cambridge: W. Heffer and Sons, Ltd., 1913.) Price 7*s.* 6*d.* net.

UNDER the title "Practical Exercises in Physiological Chemistry," this book was reviewed in the issue of NATURE for March 2, 1905 (vol. lxxi., p. 412). In the present edition Mr. Cole directs particular attention to analytical methods. He urges that medical students should be taught the micro-chemical methods of urinary analysis introduced by Folin, and that more conclusive qualitative methods should replace Fehling's sugar-test.

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.]*

Reflection of X-Rays and Related Phenomena.

IN a letter to NATURE of April 17, M. de Broglie described bands or fringes observed in the photographs produced by reflection of X-rays on certain crystals. Further experiments seem to show that there are two or even three different types of bands present, which must be attributed to different causes.

First, there is the ordinary dispersion, with the difference that in the case of a three-dimensional grating the spectrum of the primary beam, presumably continuous within certain limits, will appear as a series of bands as certain wave-lengths are destroyed by interference. This would lead to an apparently abnormal lengthening of the spots at a distance from the centre, which has, in fact, been observed. It would not, however, account for bands in the principal regularly reflected spot.

Secondly, the bands of interference described by Hupka and Steinhaus must be present whenever the primary beam is divergent. As was to be expected, these appear to be present in all the spots if the focus of the kathode rays on the anti-kathode is sufficiently small. They seem to indicate the existence of X-rays of considerably shorter wave-length than the average wave-length in the primary beam, and may possibly be due to fluorescent radiation.

Thirdly, very strongly marked bands are often observed, which must probably be attributed to invisible cracks along the planes of cleavage in the crystal. In certain circumstances the movement of the focus of the kathode rays in consequence of changes of hardness in the tube may enhance this effect. The fact that the bands are nearly equidistant in a large number of different crystals of the same substance might possibly be attributed to the varying velocity of growth of the crystal on account of the seasonal changes during its formation.

As M. de Broglie pointed out, analogous figures to those obtained by photographing the reflection of X-rays on cubic crystals may be produced by reflection of visible light on a square crossed grating. Laue's theory, which seems to be equivalent to Bragg's, if one assumes cubical packing, shows that only a limited number of lines of definite wave-lengths appear on the plate if one has a three-dimensional grating or space-lattice. Reflection on some crystals, *e.g.* the base of a prism of phosgenite, $(PbCl)_2CO_3$, appears to show all the spots a two-dimensional grating would lead one to expect, *i.e.* only the surface layer appears to come into play. Whether this is due to its opacity to X-rays or to the fact that the mean distance apart of the atoms in the direction vertical to the reflecting plane may be an irrational fraction of the distance in the reflecting plane, has yet to be investigated. If, however, one accepts the hypothesis that we have here reflection on the surface layer only—an hypothesis which the number and position of the spots would seem to justify—then we have in this case true spectra of the X-rays emitted by the tube and not, as in Laue's experiments, X-rays of definite wave-lengths sorted out by the grating. The spectra appear to comprise about one octave with a mean wave-length of $\lambda = 0{\cdot}037c$, where c is the distance of two neighbouring reflecting atoms. It appears difficult to obtain good photographs with this crystal, as with most others containing elements of high atomic weight. This may be due to the increased amount of secondary fluorescent radiation and to the greater sensitiveness of the photographic plate to these rays.

The examination of a series of crystals of the regular system confirmed the consequence of all theories and the experiments of various physicists, that the figures obtained must depend only on the position of the plate and the crystal with respect to the primary beam. It is difficult to give definite data as to the reflecting power of different crystals, though it seems that it may be taken as a general rule that those composed of elements of lower atomic weight reflect better than those containing heavier atoms. The relative intensity of different spots varies in different crystals, probably according to the distribution of energy amongst the different wave-lengths in the primary beam. But even in one and the same crystal the intensity of different spots varies according to its position. Thus with an ordinary square crossed grating the spectra are at the points of intersection of a series of concentric circles and hyperbolæ. By turning the grating in its own plane by 45° the circles open out into hyperbolæ and *vice-versâ*. When the plane of incidence is parallel to the lines in the grating spots of equal brilliance are on the circles; at 45° the same spots, still of equal brightness, are on the hyperbolæ. The same experiment carried out with X-rays reflected on rock-salt shows that the spots of approximately equal brightness are on the circles.

M. DE BROGLIE.
F. A. LINDEMANN.

Stratigraphical Problems in New Zealand.

THOUGH I do not in any way object to the review of my book on the geology of New Zealand published in NATURE (January 30, p. 591), I should like to explain further one or two points, for, from the manner in which they are quoted in the review, they are obviously open to misapprehension.

It is stated that "it is hard to comprehend why unconformity should be demanded as a proof of the distinction between two successive geological systems." The fact is that those who have wished to split the system of our younger rocks into distinct parts have insisted upon the existence of unconformities. Careful work has, I think, now shown conclusively that such breaks do not occur in these rocks. It is therefore the wish of some of us to represent these rocks as in fact they are: a simple conformable sequence. The lithological nature of all the lower members shows that they were deposited during a uniform and continuous movement of depression.

It is true that the lowest members of this sequence contain Cretaceous fossils. These Cretaceous sediments are followed by a considerable thickness (500 to 2000 ft. in different sections) of unfossiliferous rocks. Cainozoic fossils then begin to appear—in small numbers at first—but soon a luxuriant Miocene molluscan fauna is developed. It is, however, well to bear in mind, as is frequently mentioned by Hutton, that several of the genera appear in the Eocene sediments of Australia. Associated with the "Miocene" mollusca is an echinoid fauna consisting of thirty-two members, which, in a critical article by Tate, is said to be Eocene with a Cretaceous complexion; at any rate, all the members of it are extinct.

The point on which I wish to insist is this. All the lower members of this conformable sequence were deposited during the continuance of uniform physical conditions and in direct continuous succession. Some time after the Cainozoic fauna had appeared elevation commenced. A series of rocks deposited under such conditions should surely constitute a geological system

in the country in which it occurs, even though it cannot be properly packed into European compartments.

My statement that "too much attention has been paid in the past to the palæontological evidence" is, when removed from its surroundings, obviously absurd. The point I wished to emphasise is merely that correlation based upon homotaxis can be pushed too far, and that it is unscientific to break up a uniform series of rocks that occurs in New Zealand into sharply separated divisions on the basis of the occurrence of fossils that in Europe are found at different horizons. It is in this sense only that I suggest that too much emphasis has been laid on the palæontological evidence in the past in New Zealand, especially as all the collections of fossils are still far from complete. I may add that for twenty years, owing to the influence of my old and revered teacher, the late Capt. Hutton, F.R.S., I endeavoured to apply his divisions of the younger rocks of New Zealand to the districts where I was at work. As difficulties finally became insuperable, I visited his typical localities in the expectation of getting information that would solve them. It was to my intense disappointment that I was forced to the conclusion that his divisions of the "system" were based upon what I considered to be incorrect observation of the field evidence.

P. MARSHALL.

Otago University, Dunedin, New Zealand.

PROF. MARSHALL'S clear statement of the palæontological difficulties in this case should stimulate the search for further fossiliferous horizons. The Ordovician and Gotlandian beds of the British Isles were laid down in many places "during the continuance of uniform physical conditions and in direct continuous succession"; none the less, two systems have been conveniently maintained. The unwieldy "Karroo system" of South Africa would no doubt be split up were marine representatives of its strata available close at hand. G. A. J. C.

Dana's Proof of Darwin's Theory of Coral Reefs.

I THINK Mr. Crossland, in his letter to NATURE of April 3, is mistaken in assigning a fault origin to the narrow "khors" which form the harbours along the Rea Sea coast. I visited a number of these during a land journey from Halaib to Port Sudan in 1908, and although I had not much time for detailed investigation, I saw nothing which pointed to any other origin than erosion and subsidence. The steep-sided character of the shallow valleys, which Mr. Crossland takes as indicative of a fault origin, is, I think, merely a consequence of the toughness of the coral-rock and the smallness of the rainfall in these regions. It is a character common to many inland "wadis" where there is no suspicion of rift action.

The occurrence of coral-reef coverings on the coast-hills is, of course, a proof of elevation of the land; but on what does Mr. Crossland base his conclusion that the elevation has been *continuous*? Has any systematic slickensiding or brecciation of the rocks, such as usually accompanies a fault, been observed along the sides of the valleys? Or has it been proved that the floors of the valleys consist of the same beds as occur at higher levels on either side?

Like Mr. Crossland, I write from the wilderness, and cannot now refer to the papers which he cites. But as an admirer of the devotion and skill with which Mr. Crossland has pursued his important biological researches on that desolate shore, I read his two last papers very carefully at the time of their publication. If my memory is correct, the papers contain no real evidence as to a fault-origin for the "khors." Rather does Mr. Crossland seem to take faulting for granted, and then to adopt it as the explanation for all the topographical features of the coast, even going so far as to regard Ras Raweiya as a piece torn from the mainland and shifted several miles out to sea—a view in which I imagine few geologists will agree.

Unless further facts can be adduced, I think the "khors" of the Red Sea coast are most reasonably explained as valleys which were eroded by streams when the land was at a greater elevation than it is now, and have since been submerged by subsidence. JOHN BALL.

Wadi Baba, Sinai, April 20.

Sub-Red Crag Flint Implements and the Ipswich Skeleton.

I NOTICE that NATURE of May 8 contains an account of a paper read by Mr. W. H. Sutcliffe before the Manchester Literary and Philosophical Society, in which he refers to the sub-Red Crag flint implements and the pre-Chalky Boulder Clay human skeleton I have discovered.

Mr. Sutcliffe argues that because the rostro-carinate flints are found below the Red Crag, and (as he asserts) in the Palæolithic gravel of Hackney Downs, they cannot be of human origin, because it is "inconceivable that a human production should have retained exactly the same form throughout this immense period."

Apart from the fact that the rostro-carinate specimens have *not* retained exactly the same form during the periods in which they were used, it appears to have escaped Mr. Sutcliffe's notice that a river-gravel is composed of material of the most varied ages, and that therefore the examples of this type found in the Hackney Downs deposit need not necessarily be of Palæolithic age.

But even if they do belong to this period that has no bearing upon their "humanity"—the ordinary round-ended scraper was made in the most remote times, and is still used by the present-day Eskimo. Mr. Sutcliffe has also apparently "found" that the rostro-carinate flints are "not adapted to any likely use," and cannot therefore be held to afford good evidence of Pliocene man.

This is a very shaky and unsound objection, as it is open to anyone to "find" that the ordinary Palæolithic implement is practically useless, and therefore non-human.

Mr. Sutcliffe has evidently not carefully read the published accounts of the evidence in favour of the high antiquity of the Ipswich man. It has never been suggested that the skeleton was lying *on* a land surface of loose sand, and exposed to the direct action of moving ice, but that the bones had probably either been buried in that surface or covered by blown sand to a considerable depth.

If Mr. Sutcliffe had examined the evidence I have mentioned with an open and unbiassed mind, he would have recognised that the actual provenance of the Ipswich bones is as well established as any prehistoric skeleton yet unearthed. J. REID MOIR.

Openings Required for Laboratory Assistants.

YOU have in the past been kind enough to insert a letter of mine with regard to the London County Council laboratory monitors, whose services the council is unable to retain after the age of seventeen, and whom it has requested this association to place in

work. Thanks to the publicity which was given by NATURE to the needs of these young men, I was able to place a certain number of them in good commercial laboratories, and it is satisfactory to know that in nearly all cases they have justified my opinion of them and are doing well. More than thirty have been placed during the past three years, and are under my supervision still.

The council has recently referred to me a large number of these lads who are shortly leaving its service, and I should be glad to be permitted to make this fact known among readers of NATURE, as I am confident that should any employers desire promising assistants for their laboratories they would be able to obtain satisfactory applicants through this source. Applications should be made to the hon. secretary, Apprenticeship and Skilled Employment Association, 61 Denison House, 296 Vauxhall Bridge Road, S.W.

G. E. REISS,
Hon. Secretary.

May 14.

The Use of Spectacles with Optical Instruments.

WITH reference to the inquiry in NATURE of May 1 (p. 215), the general rule in cases where a person using spectacles wishes to use an optical instrument is, that for telescopes and instruments used for distant objects, use the distance correction; for microscopes and instruments for near work, the near correction should be worn. Care should always be taken to use the centre of the spectacle lens. If no astigmatism is present there is generally sufficient focussing room to enable the observer to dispense with the spectacles. The most comfortable method is to have a cap made for the eyepiece of the instrument with a lens equivalent to that in the spectacle. This should be set as close to the eye-lens as possible, and in cases of astigmatism they should be marked so that the axis may be correctly set. Any good optician will do this at small expense.

HERBERT S. RYLAND.

9 Alwyne Square, Canonbury Park, N., May 14.

NATURAL HISTORY AND SPORT.[1]

(1) IT is now six years since the publication of Captain Shelley's great monograph of the birds of Africa was suspended by the illness that overtook and ultimately proved fatal to the author. Fears, however, that the work might remain unfinished were happily allayed by the announcement that Mr. W. L. Sclater had undertaken to carry it on to completion. Several years elapsed before the final arrangement could be made, and it was not until 1912 that Mr. Sclater was able to bring out the volume under notice, which deals with the Lanii or drongos and shrikes, and is the second part of the fifth volume. This part is in every way up to the standard of its predecessor, and shows that Captain Shelley could not have committed the task to more competent hands than those of Mr. Sclater, who has a genius for systematic ornithology. The book would certainly have been improved and its cost not greatly increased by the addition of a few outline figures in the text to illustrate some of the structural characters of the birds; but the eight coloured plates drawn by that competent draughtsman and greatly improved bird-artist Mr. A. Grönvold are excellent. Apart from the systematic descriptions and the useful analytical identification keys, a full account of the known distribution of every species is given, and its habits, where observed, have been duly recorded.

(2) As director of the museum at Port Elizabeth, Mr. F. W. Fitzsimons has had exceptional opportunities of studying the snakes of South Africa, and his volume is the outcome of observations, extending over many years, upon these reptiles both in their native haunts and in captivity; and, thanks to his freedom from the restrictions imposed in some other countries, he has been able to make a long series of experiments upon the venom of the poisonous species. These experiments have shown, amongst other things, that none of the snake-killing mammals and birds of South Africa, like the mongooses, zorillas, hedgehogs, and secretary birds, is immune against snake venom, as has been stated and is often believed, but that one and all owe their ability to escape from and overcome even such redoubtable antagonists as the puff-adder and yellow cobra either to their extreme quickness in warding off or avoiding the stroke or to their protective armature. The experiments have also convinced Mr. Fitzsimons that the anti-venene recommended by Dr. Martin and Major Lamb "by no means possesses the high standard of venom-killing power some people claim for it." These are only samples of the interesting matter contained in the volume, which is a medley of varied information, anecdotes relating to habits and field experiences being sandwiched between technical diagnoses of genera and species, often taken verbatim from the British Museum catalogue, the whole subject-matter being presented in such a manner as to make a volume both useful to the specialist and readable to the ordinary layman.

(3) The tale of Mr. Sutherland's ten years' adventures as an elephant-hunter in Portuguese and German East Africa is told with a simple charm and ease of style which give his volume a foremost place amongst books of African sport; and the interest of his experiences, some of them unique and most of them exciting, is heightened by the knowledge that he met them single-handed, with only one or two trusted natives to act as trackers and carriers. So vividly are the scenes depicted that on regretfully turning the last page one cannot but echo the sentiment of the author when he writes: "After so many years of a wild, free life, I find it difficult to accommodate myself to the stuffiness and constraint of a modern city; I prefer the forest to the imprisonment of streets, the twinkling stars to lamps, the sigh of the primitive forest to the tramp of thousands of human feet."

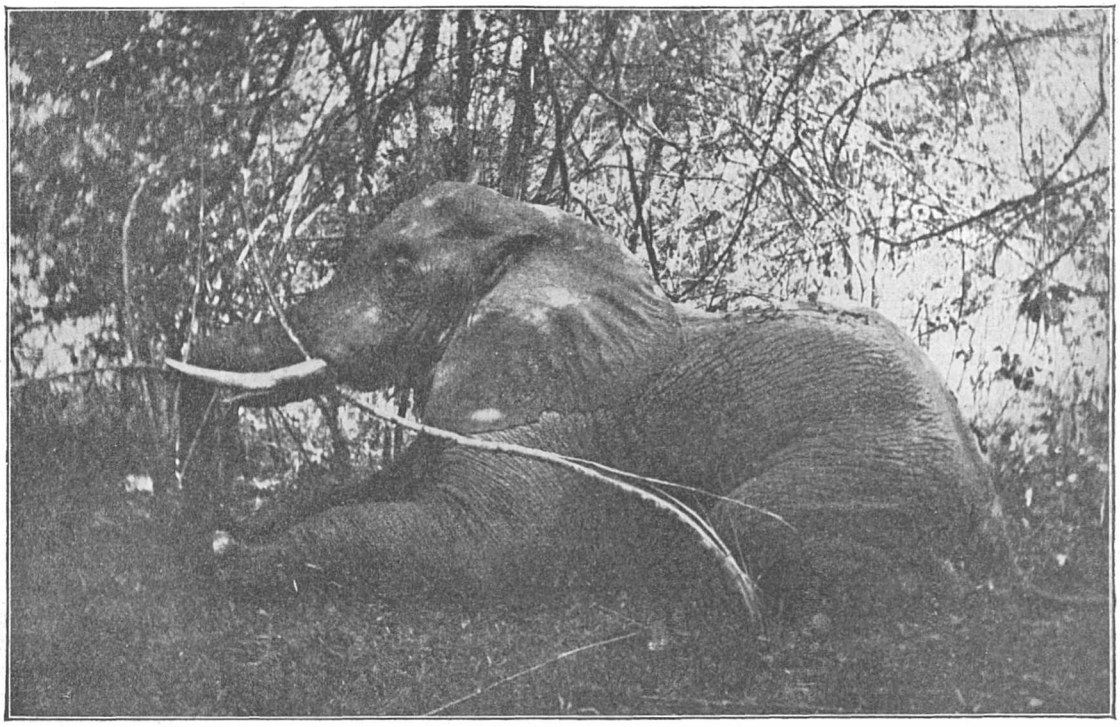
[1] (1) "The Birds of Africa." Comprising all the Species which occur in the Ethiopian Region. By P. E. Shelley. Vol. v., part ii., completed and edited by W. L. Sclater. Pp. viii+165–502. (London: H. Sotheran and Co., 1912.) Price 31*s.* 6*d.* net.

(2) "The Snakes of South Africa." Their Venom and the Treatment of Snake Bite. By F. W. Fitzsimons. New edition. Pp. xvi+547. (Cape Town and Pretoria: T. Maskew Miller; London: Longmans, Green and Co., 1912.) Price 12*s.* 6*d.*

(3) "The Adventures of an Elephant Hunter." By J. Sutherland. Pp. xix+324. (London: Macmillan and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(4) "Baby Birds at Home." By R. Kearton. Pp. xv+128. (London: Cassell and Co., Ltd., 1912.) Price 6*s.*

From repeated encounters with African big game of all kinds, Mr. Sutherland concludes that the pursuit of the elephant is beyond doubt the most dangerous. Next come buffaloes and lions, which are about on a par; but it will surprise many of his readers to learn that the risk in shooting rhinoceroses is very small, smaller indeed than that attending the shooting of leopards. The volume is not, however, devoted wholly to sport. It contains much valuable information about the superstitions and social organisation of the natives, as well as harrowing descriptions of inter-tribal raids, throwing a lurid light on the life of uncivilised man.



Kom-Kom: the terror of Nagoromenia's kraal. From "The Adventures of an Elephant Hunter."

(4) "Baby Birds at Home" is a book for children. It is written in suitable style, but its chief merit is perhaps the excellence of the photographs with which it is illustrated. R. I. P.

THE PRODUCTION OF APPARENT RELIEF BY "KINOPLASTIKON."

AT the Scala Theatre—the home of "Kinemacolor"—there is now being exhibited a new feature, termed "Kinoplastikon," which is advertised as "singing, talking, moving, picture figures without a screen," and has been described in notices in the daily Press as stereoscopic. We visited the theatre recently in order to see this display and discover, if possible, how the stereoscopic effect was produced. We hoped to see some new optical principle illustrated, but in this we were disappointed.

After a number of the now well-known colour films had been exhibited there was a short interval, and then the curtain drew up, showing the stage set as an ancient temple, with two rows of columns and a background. This was all decorated in quiet colours such as brown and terracotta, and was only feebly lighted. Two attendants brought on a pair of tables, set them between the back pair of pillars and retired. Then two somewhat ghostly pierrots, dressed in white, appeared to come on the stage, and to play a xylophone duet on instruments on the tables. A gramophone produced the music and kept time with the movement of the players.

The optical effect appears to be produced by a variation of the old "Pepper's Ghost." A huge sheet of plate-glass—it must be 20 to 30 ft. square—seems to be set up in a vertical plane, making an angle of 45° with the front of the stage, so that any brightly lighted object on the left of the stage, as seen from the auditorium, may be seen by the audience by reflection as if it were upon the stage itself. A diagram will make the arrangement clearer. MN is the front of the stage, AB the background. CD, EF, GH, the pillars of the temple. GL is the sheet of glass. Then a bright object at PQ will be seen by the audience at XYZ as though it were at P′Q′.

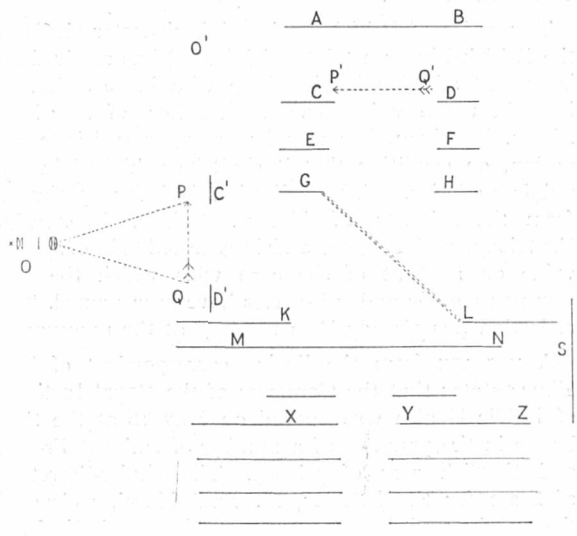
The figures are apparently projected by an animatograph O upon a semi-transparent screen at PQ.[1] Stray light from the lantern coming through the screen could be seen shining

[1] In order to avoid the great length from O to the centre of the stage, it is probable that the lantern is placed to shine down from above, or up from below, or even forwards from O′, a silvered mirror reflecting the light into the required direction.

on the theatre wall at S. As only the figures themselves were seen, the rest of the screen must have been dark, and therefore the background of each picture must have been painted out on the film with black (unless the film was unusually opaque). This painting out would account for the absence of the "rain" effect of the usual animatograph reproduction.

It is obvious from the foregoing that there is no stereoscopic effect in the strict sense, *i.e.* that there is no difference between the picture seen by the right eye and that seen by the left eye, at least so far as the figures are concerned. But as the picture is a long way back on the stage (some 40 ft. or more), so that the difference between the pictures that should be seen by the two eyes would be quite small, and as the temple itself is of course in relief, there is no difficulty in imagining the figures to be in relief also; indeed, as they step backwards and forwards the illusion is very complete.

Some parts of the glass were unfortunately



badly out of parallelism, and when the reflection occurred at these places a doubling of the image was produced, which made the figures very indistinct; this, of course, cannot be avoided in such a large sheet of glass. Some other defects that we noticed could have been avoided. For instance, the image of the edge of the screen PQ did not quite coincide with the pillars CD; so that when the figures walked off the stage they disappeared before they reached the pillars. Apparently the image $P'Q'$ is a little behind the plane CD (for this defect was more evident at X than Z); if so, a pair of pillars $C'D'$ should be so placed in front of PQ as to form an image exactly coincident with CD. Then, wherever the image was viewed from, this parallax would disappear. We also noticed that the barrel in one item, which was placed on the stage, was not quite the shape or size of the one in the picture. The upper part of a pillar at B was rather brighter than the rest of the background, and could occasionally be seen through the figures. It should be painted a little darker.

ERADICATION OF PLANT DISEASES.

THE general assembly of the International Institute of Agriculture in session at Rome has wisely refrained from extending the Phylloxera Convention to all cases of plant diseases. Signor Cuboni's report on the diseases of plants and the best method to prevent their propagation gave rise to a lively discussion, but it was felt that rough-and-ready measures would do more harm than good. Ultimately a memorandum was adopted conveying the following recommendations:—

(1) The establishment of a Government service of phytopathology by all Governments of countries adhering to the International Institute of Agriculture.

(2) The convening at an early date of an international conference of specialists with the view of arriving at an international agreement upon the means of preventing plant diseases. The wish was expressed that the French Government would follow up the initiative it has already taken by calling such a meeting.

(3) At each general assembly of the institute the specialists of the various Governments should meet in a separate commission to discuss the results of their researches and studies on the diseases of plants.

(4) Countries adhering to the International Institute should at once begin to study the various questions which the International Commission of Phytopathology will have before it, basing their study upon the materials which the International Institute of Agriculture will be able to furnish.

The subject is one for concerted action. The study of plant diseases is not a simple one. It concerns the entomologist and protozoologist as well as the botanist, and among botanists not merely the students of fungi or bacteria, but the physiologist and the investigator on Mendelian lines; for the production of disease-resisting forms is one of the surest ways of eliminating the disease-factor. Furthermore, periodical meetings of the workers in these various fields of investigation will tend to encourage the worker, and will ensure that the results of the work are put to the best advantage. Comparison of results obtained in the same line of research under the various conditions offered by different countries will be specially helpful; and if international legislation is to follow, these various conditions must be carefully considered.

It should be obvious also that an organised service of phytopathology is an essential, and an *ad hoc* training of experts is a prime necessity. The study of plant diseases offers ample scope for investigation, and a Government service would find work for a supply of experts at home and abroad. One example will suffice. The Jamaica banana industry has been recently threatened with disaster because the Department of Agriculture had no expert in plant diseases to recognise on its outbreak a well-known disease which had already caused serious loss to the same industry in Central America.

NOTES.

AT a meeting on Monday, May 19, the council of the Royal Society of Arts passed the following resolution:—"On the occasion of the fiftieth award of the Albert medal of the Royal Society of Arts, the council of the society desire to offer the medal to H.M. King George V., for nine years president, and now patron of the society, in respectful recognition of his Majesty's untiring efforts to make himself personally acquainted with the social and economic condition of the various parts of his dominions, and to promote the progress of arts, manufactures, and commerce in the United Kingdom and throughout the British Empire." The Albert medal was established in 1862 as a memorial of H.R.H. the Prince Consort, who had been president of the society for eighteen years. It is awarded annually for "distinguished merit in promoting arts, manufactures, or commerce." In 1887 it was awarded to Queen Victoria on the occasion of her jubilee, and in 1901 to King Edward VII., when, on his accession to the throne, he relinquished the presidency of the Society of Arts, which he had held for thirty-eight years.

MR. EDWIN TATE has just made a donation of 10,000*l.* to the Imperial Cancer Research Fund, for the endowment of the research.

MR. H. H. LAW has been appointed chief engineering inspector to the Local Government Board, in succession to Mr. G. W. Willcocks, C.B., retired.

THE KING has appointed Commander E. R. G. R. Evans, R.N., a Companion of the Order of the Bath (C.B.), in recognition of his services with the British Antarctic Expedition, 1910–12.

PROF. BATESON'S postponed lectures on the heredity of sex and some cognate problems will be delivered at the Royal Institution on Monday, June 2, and Wednesday, June 4, at three o'clock.

THE Berlin correspondent of *The Times* announces that Prof. H. Weber, professor of mathematics at Strassburg University since 1894, died on May 17 at seventy-one years of age.

WE learn with regret that Dr. Lester F. Ward, professor of sociology at Brown University, Providence, R.I., and formerly palæontologist of the U.S. Geological Survey, died in Washington on April 18, in his seventy-second year.

THE fifty-eighth general meeting of the Institution of Mining Engineers will be held on Thursday, June 5, at 11 a.m., in the rooms of the Geological Society, Burlington House, Piccadilly, London, W. The institution dinner will be held at the Waldorf Hotel on the evening of the same day.

WE learn from *Science* that a tablet in honour of Dr. S. P. Langley was unveiled in the Smithsonian Institution on May 6. Addresses were delivered by Dr. Alexander Graham Bell and Dr. J. A. Brashear. At the same time Langley medals were awarded to M. Gustave Eiffel and Mr. Glenn H. Curtiss. Later in the day the Aëro Club of Washington arranged an aviation display in the grounds of the Army War College in honour of Dr. Langley.

THE Paris correspondent of *The Times* announces the death of M. Alfred de Foville, perpetual secretary of the Académie des Sciences Morales et Politiques. M. de Foville, who was in his seventy-second year, was one of the most eminent political economists and statisticians of his day. From 1877 to 1893 he was chief of the Department of Statistics and of Legislation in the Ministry of Finance, and for a time he concurrently occupied the chair of industrial economy and of statistics at the Conservatoire des Arts et Métiers.

AN influential international committee has been formed to endeavour to establish a uniform notation in the theories of potential and elasticity. The committee has already sent out a circular to all those likely to be interested in the subject asking what are the notions and notations with respect to which uniformity is desirable. Discussions on the subject will be arranged to take place at the international congresses of mathematicians in 1916 and 1920, and it is hoped that the final report of the committee will be issued in 1921.

THE series of British land and fresh-water shells in the British Museum (Natural History) has received an important addition in the shape of a large collection brought together by Mr. F. H. Sikes, of Burnham Abbey, Burnham, Bucks, who has presented it to the nation, on condition that it shall be exhibited in the public galleries. The collection includes specimens from the cabinets of Messrs. Cairns, Fitzgerald, Grateloup, and Rogers, and is reported to be of special value on account of the care with which the less common species and subspecies have been named. The collection has already been received at the museum.

A MESSAGE from the Paris correspondent of *The Times* states that the Congress of the Royal Institute of Public Health was opened on May 16 at the Sorbonne in the presence of a number of eminent French and English men of science. The Under-Secretary of State for the Interior, M. Paul Morel, welcomed the members of the congress to Paris on behalf of the Government. Prof. W. R. Smith said, in reply, that the holding of the congress in Paris was a further proof of the closeness of the relations existing between the country of Lister and the country of Pasteur. Speeches were also made by Prof. Landouzy, president of the French section of the congress, Sir Thomas Oliver, who is president of the industrial section, and the Lord Provost of Glasgow. At the close of the meeting Prof. Smith handed to Prof. Roux, director of the Pasteur Institute, the gold medal of the Royal Institute of Public Health.

AN impressive collection of photographs of scenes connected with Capt. Scott's ill-fated Antarctic expedition is reproduced in yesterday's *Daily Mirror*, May 21. The pictures include a striking view of the cairn, surmounted by a cross, erected over the tent where the bodies of Capt. Scott, Dr. Wilson, and Lieut. Bowers were found; photographs of the explorers on skis dragging their sleigh towards the south pole, and standing near Amundsen's tent, which they found upon arriving at their goal; the last photograph of the party of five taken at the pole; and the tent in

which Capt. Scott and his two companions waited until the icy hand of death relieved their sufferings. When the search party found the tent, it was nearly buried in snow, and in a few months all trace of it would have disappeared. All the illustrations are remarkably fine, and they serve to show the nature of the region near the south pole, as well as to stimulate pride in human endeavour.

CAPT. J. K. DAVIS, commander of the *Aurora*, the vessel attached to Dr. Mawson's Australasian Antarctic Expedition, reports the results of his endeavours to relieve the two parties in January and February of this year. He had already visited the main party, and taken part in the search for Dr. Mawson himself and his two companions, Ninnis and Mertz, whose tragic loss has already been reported. Prevented by bad weather from taking off this party, Capt. Davis was forced to leave them in order to hurry to the relief of the other, under Mr. F. Wild, 1500 miles westward of Commonwealth Bay. These men were found all well, and were taken off just in time to escape the closing ice, though the ship did not escape very severe weather on the return to Hobart. Some anxiety must be felt for the main party: Dr. Mawson himself, by travelling alone for twenty-two days, bereft of his two companions, has undergone an experience scarcely less terrible than that of any of his predecessors in polar exploration, but the base is well equipped. The wireless telegraphic station on Macquarie Island maintains communication between the base and Australia, and is signalling daily weather reports, while among other scientific work, sufficient soundings for a section of the ocean bottom between Hobart and the Antarctic are mentioned by Capt. Davis. He himself is visiting England with the especial and laudable purpose of raising funds to aid the cost of the prolonged stay of the main party in the south polar region.

THE President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease:—The causes of premature arterial degeneration, Dr. F. W. Andrewes; insects in relation to disease (Prof. Nuttall, F.R.S., on the life-cycle of the body louse and bug; Dr. Bernstein and Mr. Hesse on the *Empusa muscae* in flies); infantile diarrhœa, Mr. F. W. Twort and Dr. Edward Mellanby; the virus of poliomyelitis, Drs. Andrewes and M. H. Gordon; the character and life-history of certain filter-passing micro-organisms, Mr. F. W. Twort; respiratory exchange in man under varying conditions, Prof. Leonard Hill, F.R.S.; the biochemistry of syphilis, Mr. J. E. R. McDonagh; the possibilities of serological diagnosis of scarlet fever, Dr. L. Rajchman; the relation between the clinical symptoms and the bacteriology of the acute respiratory affections, Dr. D. M. Alexander.

A CABLEGRAM has been received at Bishop's Stortford from Bangalore, announcing the death, from snake-bite, at the early age of thirty-seven, of Mr. Herbert Kelsall Slater, geologist to the Mysore Government. Mr. Slater was educated at Bishop's Stortford College, which he left in 1894. After spending the next seven years at Bangalore with his father, the Rev. T. E. Slater, he was sent in 1901 to the Royal School of Mines, where he studied geology under Prof. Judd. On the recommendation of Mr. Foote, he was appointed in 1902 geologist to the Mysore Government, for which he did much valuable work. The results of his work are given in the records of the Mysore Geological Department (see NATURE, vol. lxxviii., p. 470). He surveyed and mapped large districts, and among important ores which he found to be widely distributed are gold and manganese ores. He also discovered and described important felsite and porphyry dykes; and the palace of the Maharaja is built from stone discovered by him. He spent December to May each year in prospecting, and it was while camping on one of these expeditions in the district of Shimoga that he met with the accident that caused his death. Not long ago Mr. Slater spent about six months in a tour in Canada in order to gain additional light upon his sphere of work in India by the study in the field of great Archæan complex.

THE work of the British School of Archæology in Egypt this winter, under the personal direction of Prof. Flinders Petrie, has been attended with some interesting results. At the close of the last season's work a first dynasty cemetery had been partly excavated at Tarkhan, about forty miles south of Cairo, and this year the site has been systematically worked; eight hundred graves, grouped on each side of an axial road, have been carefully cleared and studied, and much pottery and strings of carnelian, garnet, and blue-glazed beads have been recovered. The damp of the valley in which the cemetery lies has prevented the removal of the bones, but these were all carefully measured, and some seventy of the skulls, preserved by solidifying with paraffin wax, will be brought to England for further study. The new material thus obtained will be a valuable supplement to the careful and exhaustive collections made by the American excavator, Prof. Reisner, mainly in Upper Egypt, and published, with Prof. Elliot Smith's collaboration, two or three years ago. Meanwhile the excavators interpret the new evidence as proving the existence at Tarkhan of the conquering tribe of the dynastic people of ancient Egypt, who had advanced northward from Abydos, subduing the Nile Valley, until Mena founded the new capital of United Egypt at Memphis. It is interesting to note that, according to the discoverers, the men of the dynastic race were an inch or two shorter than the indigenous population; and this supports the persistent native tradition that the conquerors owed their success to superiority in armament rather than in physical qualities. At Gerzeh, another site a few miles further south, some interesting finds were also made, dating from the twelfth and eighteenth dynasties, the most remarkable being a gold pectoral inlaid with coloured stones, like the celebrated Dahshur jewellery.

MR. E. W. DEMING gives, in *The American Museum Journal* for March, an interesting account of the scheme now being undertaken to prepare, on the walls

of the museum, a series of panels illustrating the life of the American Indians. Each panel will tell the story of the life of a particular stock—their mode of living, customs, decoration of their lodges, life in the tipi, transportation, in short, all the minor details which will give colour and reality. The general control of the work rests with Mr. Deming, who has lived for some fifty years with various Indian tribes. He will utilise the material collected by Mr. Louis Akin, a skilled painter, who was received as a member by the Hopi tribe, and unfortunately died at Flagstaff, Arizona, in January last. His untimely death, at the age of forty-five, is a serious loss to American art and anthropology.

The National Geographic Magazine for March publishes an article by the late American Minister to Guatemala, Mr. W. F. Sands, on the prehistoric ruins of that country. This is the preface to an account by Mr. S. G. Morley, assistant director of the Quiriqua Expedition of 1912, of the excavations at this place, situated fifty-seven miles from the Caribbean Sea. It was one of the early centres of the Maya civilisation, which flourished in south Mexico, Guatemala, and north Honduras during the first fifteen centuries of the Christian era. The place was unknown since Hernando Cortez passed within a few miles of it in 1525. A series of temples has now been disinterred containing many interesting carvings and hieroglyphs, the interpretation of which is still, in a great measure, unknown. So far the excavations are merely tentative. But the School of American Archæology proposes to pursue the work, which cannot fail to throw much new light on the problems of Maya culture.

THE Palæolithic skull from Piltdown, Fletching, Sussex, just described in the Quart. Journ. Geol. Soc. by Dr. A. Smith Woodward as the type of a new genus and species (*Eoanthropus dawsoni*), has been placed on exhibition in a special case in the central hall of the Natural History Museum.

ACCORDING to the report for 1912, work at the Sarawak Museum has been somewhat interrupted by the absence on leave of the curator; it is hoped, however, that this will be more than compensated by the information acquired during his visit to Europe. A strenuous effort is being made to place on exhibition a mounted series of the local birds.

IN the May issue of *The Selborne Magazine* it is announced that the Selborne Society now possesses no fewer than ninety-five editions of Gilbert White's "Natural History of Selborne," and even this is believed not to exhaust the list. On another page Mr. Rashley Holt-White writes to express his belief that the print recently declared to be a portrait of the Selborne naturalist is not correctly identified.

THE recently published report of the advisory committee for the Tropical Diseases Research Fund for 1912 shows, as usual, great activity in research in the schools, universities, and laboratories at home and in the Colonies, supported by pecuniary contributions which can scarcely be considered creditable to a great Empire. The total revenue of the fund for 1912 was 3425*l.*; the expenditure was 3833*l.* 6*s.* 8*d.* The excess of expenditure over income was met by drawing on the accumulated balance of the fund, and it was necessary to warn the schools of tropical medicine that it would not be possible to repeat in 1913 grants on the same scale. Appended to the report of the committee are those of the professor of protozoology in the University of London, the Quick Laboratory, Cambridge, the London and Liverpool Schools of Tropical Medicine, and of seven Colonial laboratories. As usual, these reports describe many important investigations, especially in the transmission of parasites and the causation of disease, which it is to be hoped will find their way also into the ordinary channels of scientific publication, where they will be less likely to be overlooked.

IN *The New Phytologist* for February (vol. xii., No. 2), Mr. H. Takeda gives an interesting general account of the vegetation of Japan, which has also been issued as a reprint (Wesley and Son, London, price 1*s.*, post free). The author describes the geographical features and climate of Japan, laying special stress on the influence of the warm and cold currents which wash the shores of the long chain of islands composing the Japanese Empire, and exert a marked influence upon the vegatation, as well as on the great variety of climatic conditions which obtain owing to the fact that the islands extend over thirty degrees of latitude —the southernmost islands being subtropical, while the most northerly have a climate like that of Nova Scotia or Iceland, the harbours being blocked by drifting ice from November to April. He then describes the various plant formations occurring in the northern, middle, and southern regions, into which, for convenience, the country is divided from the phytogeographical point of view, with numerous examples illustrating the range from arctic through subarctic, cold temperate, warm temperate, and subtropical to tropical types of vegetation. The vertical zonation of the vegetation on the higher mountains is illustrated by a description of the plant communities seen on ascending Mount Fuji. The paper also contains a discussion of the origin and affinities of the Japanese flora, and short accounts of the cultivated crops and of the introduced and garden plants.

A PAPER recently presented to the Royal Geographical Society by Lieut. H. A. Edwards gave a very clear idea of the important character of the survey work of the commission on the northern boundary between Bolivia and Brazil, in 1911 and 1912. The work is to be continued, but already a considerable area, previously unmapped and practically unknown, has been covered between the sources of the Bahia and Rapirran rivers. In 1911 a primary station was established on the latter river, which was then followed and mapped up to its source, after which the British commissioners, without their Brazilian colleagues, crossed the watershed to the valleys of the Abuna and Xipamanu. In 1912 the boundary line following the River Acre was mapped from Cobija to Tacna, and a party crossed to the Bahia, and thence to the confluence of the Ina and Xipamanu, from which point the Riparran was again visited, and a junction effected with the starting

point of the work of the preceding year. A general description of the country, with facts concerning its geology, climate, flora, and fauna, was furnished by Lieut. Edwards, and some idea as to the extreme difficulties attendant upon exploration, and particularly upon careful survey, in this region, was afforded by his account. Progress, whether along the rivers or through the forests, meets with continual opposition from nature in one form or another; insect pests attack the travellers and their animals, and food supplies are often far from easy to keep up.

THE measurements made last year by Prof. McClelland and Mr. Kennedy of the number and mobility of the large ions present in the atmosphere cast some doubt on the generally accepted interpretation of the records of the various types of instruments intended to measure the ionisation in the atmosphere at any time. The number of small ions of mobility about 1·6 cm. per second in a field of 1 volt per cm. may be taken as 1500 per c.c. in normal circumstances, while the authors find that the air of Dublin has in it about ten times as many large ions of mobilities of the order of 1/3000 cm. per second. There is strong evidence that they consist of a nucleus, originally uncharged, which attracts to itself one of the small, more mobile ions. The nucleus itself probably consists of an invisible drop of water, which it is known may exist in air even when the air is unsaturated. Further investigation is, however, necessary before the absence of ions of intermediate sizes can be satisfactorily accounted for. The description of the methods of measurement adopted will be found in the December, 1912, number of the Proceedings of the Royal Irish Academy.

IN No. 15 of the *Revue Scientifique* is published an address delivered by Prof. Victor Grignard on the occasion of the presentation to him at Stockholm of the Nobel prize. In this address he gives a brief summary of the different types of synthesis by means of magnesium, with which his name is associated, and which have led to extremely fruitful developments in the domain of organic chemistry. During the past ten years no fewer than seven hundred papers have appeared dealing with the "Grignard reaction," whilst in practice it has found important application in the commercial synthesis of such drugs as stovaïne and alypine, which have many advantages over cocaine, and of many compounds of importance in perfumery.

WE have received from the Agricultural Experiment Stations of the Louisiana State University a copy of Technical Bulletin No. 135, which contains a report of investigations carried out by Dr. W. E. Cross and others on methods of analysis of sugar-cane products. The report includes a number of papers, of which the following are the most important:—The determination of dry substance by means of the refractometer; the application of dry basic lead acetate defecation to sugar-house analysis; a rapid method for the estimation of glucose in juices; a modification of the Clerget method of determining glucose in molasses; the effect of urea and betaine on the rate of inversion of cane-sugar by hydrochloric acid; and the direct estimation of cane-sugar in presence of reducing sugars. Useful tables are appended to the report.

IN the current number of the *Comptes rendus* (May 13), Ph. Barbier and R. Locquin give a new method for stepping down the series of the fatty acids. Starting with the acid $R.CH_2.CO.OH$, they convert this into the methyl (or ethyl) ester, and treat this with two molecules of magnesium methyl iodide, forming the tertiary alcohol $R.CH_2.C(OH)(CH_3)_2$. This, or the hydrocarbon $R.CH=.C(CH_3)_2$ formed by dehydration, on oxidation with chromic acid, gives acetone and the acid $R.CO_2H$, the next lower homologue of $R.CH_2.CO_2H$. The ketone $R.CH_2.CO.CH_3$ may also be used as the starting point for the production of the same acid, $R.CO_2H$. The reaction is a general one, and can be applied with success to dibasic acids; thus β-methyladipic acid gives methyl-succinic acid.

A LECTURE on the economics of engineering, delivered by Major W. J. A. O'Meara, C.M.G., at Faraday House, on February 26, has reached us in the form of a reprint from *The Royal Engineering Journal* for April. It is an excellent thing that the application of the principles of economics to individual trades should be considered, and Major O'Meara has done well to choose that of engineering for his lecture, since it plays so important a part in the production of the national wealth. He confines himself largely to electrical engineering, and deals mainly with the efficiency of management and organisation. He also deals shortly with the question of markets, showing the special and peculiar conditions attaching to this branch of the industry, and just touches very briefly on one or two other points. The main question treated in his lecture is divided into three sections—organisation, management, and technical aspects—and each of them is considered in reference to the conditions which conduce to the maximum efficiency. The former, for instance, deals with the establishment of a "direct chain of command" among those responsible for the work, the proper choice of officers for the various departments, the proper subdivision of the work, to render possible among other things the easy ascertainment of the costs of each class of work. Technical aspects, again, include economy in materials, design, the operating of plant, and methods of execution, in connection with which the necessity of avoiding, so far as possible, the dismissal of skilled workmen is forcibly urged. Indeed, brief though it is, the paper is highly suggestive, and arouses the hope that in the future Major O'Meara will give us a full and detailed treatment on these lines of the whole engineering trade.

SOME novel towing tests conducted at the experimental tank in the Navy Yard at Washington form the subject of an illustrated article in *The Engineer* for May 16. The questions to be investigated were whether existing piers in the Hudson River should be lengthened to meet the demands of bigger liners, and also to settle the problem of granting renewed permission for the continuance of two temporary extensions of 100 ft. each beyond the pierhead line approved by the Secretary of War in 1897. These questions involved the reproduction in the tank of both shore lines of the Hudson River throughout the berthing section of the big Transatlantic steamers,

and the models towed represented those ships now in service as well as a yet unbuilt craft 1000 ft. long. Suction was investigated by means of floating models and submerged buoys. The movements of these during each run of the towed model were recorded by use of moving-picture cameras, so situated that every essential movement could be caught. An index finger moving over a dial on the towing carriage showed the position of the model at every instant. While the full results are not yet published, it may be noted that the Government authorities have again refused permission for the temporary pier extensions to be made permanent.

UNDER the title of "The Land of the Blue Poppy," the Cambridge University Press will shortly publish Mr. F. Kingdon Ward's record of his experiences and observations while engaged in plant-collecting in western China and south-eastern Tibet during the year 1911. The book is dedicated to the memory of the author's father, Prof. H. Marshall Ward.

MESSRS. WITHERBY AND CO. have been appointed European agents for *The Emu*, the organ of the Royal Australasian Ornithologists' Union, and copies of that publication can now be obtained at 326 High Holborn, London, W.C.

OUR ASTRONOMICAL COLUMN.

COMET GALE (1912*a*).—An ephemeris for Gale's comet (1912*a*) is given in the *Astronomische Nachrichten*, No. 4651, by Herr M. Ebell, of Kiel, but the object is very dim, being fainter than magnitude twelve. It was observed on April 26 in Uccle by G. van Biesbroeck, and in Bothkamp by Dr. H. H. Kritzinger, and, according to the former, the ephemeris was in error by -3s. and $+1{\cdot}5'$. Dr. Kritzinger describes the comet as an elliptical nebula $1'$ and $0{\cdot}7'$ diameter, the brightness of the nucleus being 12·8 mag., the total brightness amounting to 12·5 mag. In answer to a telegram sent to Algiers, Herr F. Gonnessiat reports that on May 2 the comet was on the extreme limit of visibility.

The ephemeris up to the end of this month is as follows:—

	α true	δ true	Mag.
	h. m. s.	° ′	
May 22 ...	6 53 30 ...	+45 44·5 ...	—
24 ...	6 55 59 ...	45 27·7 ...	12·6
26 ...	6 58 26 ...	45 11·2 ...	—
28 ...	7 0 53 ...	44 55·1 ...	—
30 ...	7 3 18 ...	44 39·3 ...	—

THE SPECTRA OF SPIRAL NEBULÆ AND GLOBULAR STAR CLUSTERS.—Dr. E. A. Fath has been continuing his discussion of the spectra of spiral nebulæ and globular star clusters secured with spectroscopes attached to the 60-in. reflector of the Mount Wilson Observatory; his latest results appear in the April number of *The Astrophysical Journal* (vol. xxxvii., No. 3, p. 198). The spiral nebulæ here investigated are seven in number, the exposures ranging from 7h. 40m. to 38h. 14m., while the total exposures for each of the four clusters ranged from 13h. 5m. to 16h. 17m. In the case of the nebulæ they for the most part exhibit the spectra of solar type stars, but he refers to two, namely N.G.C. 1068 and 4736, as peculiar, giving evidence of "gaseous" radiation. Up to the present he has investigated altogether twelve globular clusters, and the result so far shows that as a whole the brighter stars of the globular clusters have spectra ranging only from the F- to the G-type. Dr. Fath hopes that as the clusters observed are nearly all readily reached in latitude 34° north, some southern observatory will undertake the investigation of those south of $-20°$, to find out whether they also exhibit this small range of spectral type so striking a feature of the northern clusters.

REPORTS ON INDIAN OBSERVATORIES.—Dr. G. T. Walker, the Director-General of Indian Observatories, has just forwarded his reports for 1912 on the observatories of Kodaikanal, Madras, Bombay, and Alibag, accompanied by the reports of the several directors. In the case of the first-named, he directs attention to the energies of Mr. Evershed, to the transfer of the Poona instruments to Kodaikanal, and to the appointment of Mr. Royds. He states that a serious effort is going to be made to teach the assistants to undertake the measuring of the numerous photographs, which up to the present has only been done by the gazetted officers. He hopes further to make the observatory an ordinary second-class instead of a first-class meteorological station in order to free the fourth assistant for solar work. The transit instrument at Madras in the beginning of 1910 suddenly changed its level, and the occurrence was repeated in 1911 and 1912. As this had never taken place before, it was thought that underground water currents had affected the earth neighbouring the concrete foundation. This is now going to be investigated and in the meantime the Madras clock will be rated by wire from Kodaikanal. No special features are mentioned regarding the other two observatories, unless the reference to the absence of trouble from white ants at the Colaba Observatory be noted.

"L'ASTRONOMIE" FOR MAY.—The current number of the *Bulletin de la Société Astronomique de France* contains the address delivered by M. Camille Flammarion on the occasion of the twenty-seventh year of the existence of the French Astronomical Society. The subject of his discourse was confined to the progress of the society, and the success that the society has achieved is well known this side of the Channel. A very valuable feature in the journal is a series of reproductions of all the past presidents of the society. On the same occasion M. Puiseux summarised the advances made in solar studies during the past year, and this will be found useful to those not closely following the progress of solar physics. Other contents to which attention may be directed are "Les Photographies à poses variées," "Les Céphéides considérées comme Etoiles Doubles," "Comparaison d'un Chronomètre aux signaux rythmés," &c.

THE PARALLAX OF THE NEBULA G.C. 117=N.G.C. 221.—Dr. Gustaf Strömberg communicates to *Astronomische Nachrichten*, No. 4650, his results of the determination of the parallax of the nebula G.C. 117, or N.G.C. 221, which he secured at the Stockholm Observatory. This nebula lies in the region of the Andromeda nebula, like a satellite to it, and is much easier to measure than the nucleus of the large nebula. The plates which Dr. Strömberg measured were those that were used by Prof. Karl Bohlin for his determination of the parallax of the Andromeda nebula. In his measures Dr. Strömberg employed a comparison star in the neighbourhood of the nebula, the coordinates being Neb. (G.C. 117)$-*$: $\Delta\alpha = -11{\cdot}56$s., $\Delta\delta = -18{\cdot}3''$. The investigation embodied fifty determination of differences of R.A. and forty-six of differences of declination, and the parallax he secured was $+0{\cdot}073'' \pm 0{\cdot}055''$. Details of the research will be published later in the publications of the observatory.

TEACHING OF MATHEMATICS IN GERMANY.[1]

IN previous issues we have referred to papers on English education in mathematics which were laid before the 1912 International Conference on Mathematical Teaching. We have now before us, in five volumes, the German contribution to that conference. They give an account of mathematics at the primary and secondary schools, at the universities, in technical education, and in training colleges for teachers. They deal mainly with Prussia, but include also the non-Prussian parts of the German Empire, with an occasional reference to Austria.

Germany also has its reform movement in mathematics, and most of the changes that have been made lie to the credit of a body which bears the euphonious name of "der Damnu," into which its full title "Deutscher Ausschuss für den Mathematischen und Naturwissenschaftlichen Unterricht" has for the sake of brevity been telescoped. This body was formed in 1907, by the united action of a number of voluntary scientific associations, and is playing much the same part that the British Association committee has played in this country.

The aims and the present position of the movement are well illustrated by a scheme of teaching proposed by Dr. Schimmack for the Oberrealschule. The scheme covers the nine school years between the ages of nine and eighteen.

In geometry the scheme begins in the manner to which we are now accustomed in England, with measuring, drawing, practice with instruments, and work which familiarises geometrical concepts.

It is noticeable that there is two years' work in geometry before algebra is begun. This procedure, so excellent because of the more abstract and difficult nature of algebra, is not the result of the reform movement, but has long been the practice in Germany. It is a promising sign that the report of the curriculum committee of the Headmasters' Conference advocates this procedure, and gives us leave to hope that in this matter England will follow Germany's lead.

Algebra, then, is begun in the fourth school year, geometry having been begun in the second. It leads off well, with signless quantities, and it is rather a pity that the subject is not carried on for a year or so with such quantities before the distinction between positive and negative quantities is introduced.

The trigonometry of right-angled triangles is to be introduced in the sixth year, as is also "projective geometry" (or cross-ratio geometry). The former proposal would find much support in this country; the value of the second item is not so clear.

In the seventh year the calculus is begun, differential and integral at the same time, a proposal which many in England will approve. Not so many will, however, approve of Dr. Schimmack's relegation of arithmetical and geometrical series to their proper place beside the calculus.

The scheme closes with "discussion of the foundations of geometry," too metaphysical perhaps for most boys; but we must remember that the scheme is intended for the Oberrealschule, and that less ambitious schemes would be appropriate to the Gymnasium and Realgymnasium.

An important note is appended to the scheme to say that throughout the course geometrical figures are to be thought of as variable and not rigid, and that attention is to be directed to the interdependence of the parts as the form of the figure changes.

The consideration of this scheme goes to justify our English reformers in their view that they are not sacrificing thoroughness to the desire to cover ground. It is much that the Germans, with their love of beginning from the very foundations, should declare for "functional thinking" from the start, for the introduction of trigonometry at fourteen or fifteen, and of the calculus at fifteen or sixteen, and should feel it possible to prune the course sufficiently to allow that.

The language of these volumes is at times curiously heavy. One happens on long, long sentences the meaning of which cannot be extracted by ordinary reading; they have to be logically dissected. And such sentences are frequent. Is the accusation true that command of language is spoilt by a mathematical training? Or have the Germans spoilt their language by the replacement of foreign words by sesquipedalian words of home manufacture? Whatever the cause, these volumes contain also the germs of better things. "Der Damnu" has been referred to. "Die IMUK" is a portmanteau word for die Internationale Mathematische UnterrichtsKommission, and "Der DATSCH" for der Deutsche Ausschuss für Technische SCHulen. Some extension of this idea will quickly reduce the most unwieldy sentence to manageable size.

[1] "Abhandlungen über den mathematischen Unterricht in Deutschland-veranlasst durch die Internationale Mathematische Unterrichtstkommission." In twenty-five parts. Herausgegeben von F. Klein. (Leipzig and Berlin: B. G. Teubner, 1909-12.)

"Berichte und Mitteilungen veranlasst durch die Internationale Mathematische Unterrichtskommission." In four parts. (Leipzig and Berlin: B. G. Teubner, 1910-12.)

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE annual conference of the above association was held at Bradford during Whitsuntide. The address of the president of the association (Mr. P. Coleman, Northern Polytechnic, London) dealt mainly with the organisation of technical education, the value of "internal" examinations for technical students as compared with "external" examinations, and the London University Commission report in its bearing upon polytechnic work. He remarked in reference to this:—

"The report and the recommendations based thereon unfortunately show a bias that can only be due to a complete misconception of the work and standing of the London polytechnics. . . . The reasons given in the report appear to be based on insufficient evidence, and at variance with the facts as known to those who have a close acquaintance with the polytechnics."

Mr. Coleman urged the development of "non-vocational courses in the technical schools, partly because in many towns these schools are the only suitable institutions in which to hold such courses for adult students (whether technical students or not), and also in order to bring home to students whose main interest is necessarily the study of science or technology that "the work associated with their future occupation should not lead them to forget every other means of culture." As a practical measure in this direction, he suggested that the technical institutions "should definitely associate with themselves the University Extension Lectures of the locality, or such work as that of the Workers' Educational Association."

Papers were read to the conference upon vocational education, by Mr. Arthur C. Coffin, director of education, Bradford; co-ordination within a county area, by Mr. F. W. Cook, chief officer for technical education for the West Riding of Yorkshire; and the corporate life of technical institutions, by Mr. W. Hibbert, Regent Street Polytechnic, London. A number of sectional meetings were held, attended by teachers of special subjects, at which questions such as the qualifications for the registration of teachers, the syllabuses

and courses of work put forward by various examining authorities, and methods of teaching were discussed.

The principal resolutions passed by the conference dealt with the educational proposals of the Government, and the London University Commission Report. The conference urged the "necessity for improved provision for technical education and the organisation of technical education on a national basis." In addition, attention was directed "to the urgent necessity for increased grants from the State in aid of technical education," higher salaries for teachers to be a first charge upon these increased grants. With regard to the London University Commission report, a resolution was passed unanimously opposing any limitation of the existing facilities for obtaining external degrees, and the proposed exclusion of external students from the examinations in the faculty of technology, including engineering. This resolution also stated that many of the criticisms made in the report concerning London polytechnics and technical institutions are obviously founded on an incomplete knowledge of the work done in these institutions. The association strongly deprecated any weakening of the connection between these institutions and the University in view of the excellent results which have followed in the past as a result of the present relationships between the polytechnics and the University. The higher work in these institutions, whether day or evening, should form an integral part of the organisation of the faculties of science and technology.

A public meeting was held in connection with the conference in the large hall of the Bradford Technical College, the principal speaker being the Right Hon. J. A. Pease, M.P., the President of the Board of Education. During the course of his speech, Mr. Pease emphasised the importance of technical education, especially in the day-time if possible, and the necessity of "gradually bringing into the educational net nearly the whole of the population which left school between the ages of twelve and fourteen." New regulations would shortly be issued which, by means of larger grants and more elastic conditions, would favour the development of junior technical schools, "which would be linked up with the colleges and classes of a superior character." Mr. Pease criticised external examinations "as a waste of money and effort, and resulting in very little good." In concluding, he suggested that the key of the educational situation is to give more power, coupled with greater financial aid from the State, to the local authorities. J. WILSON.

THE NATIONAL PHYSICAL LABORATORY.

THE annual meeting of the general board of the National Physical Laboratory was held recently at the rooms of the Royal Society, when the report and accounts for the year 1912 and the statement of work for 1913 were presented and approved for transmission to the president and council of the Royal Society.

In former years this meeting has usually been held at Teddington during the month of March, and has been combined with an inspection of the laboratory by the members of the board. In consequence of a change in the financial year, the annual inspection will in future be held at a later date. This year it is to take place on Thursday, June 26, when the Right Hon. A. J. Balfour will open the new buildings recently erected.

These buildings complete a scheme initiated in 1909 to provide laboratories for metallurgy and optics, with administrative offices, at an estimated cost of 30,000*l*., exclusive of equipment; of this sum the Treasury undertook to provide 15,000*l*., provided the remainder were forthcoming from other sources.

In 1910 the late Sir Julius Wernher generously provided 10,000*l*. for the erection of the metallurgy laboratory, and on learning lately that the actual cost had exceeded the sum available by 936*l*., Lady Wernher most kindly defrayed the deficit.

To secure the further sum necessary for the completion of the scheme, and to obtain funds for the equipment of the buildings, an "Additional Funds Committee," of which the late Sir William White was chairman, was appointed during 1912. In its report this committee states that the Royal Commissioners for the Exhibition of 1851 had generously given a donation of 5000*l*. to the building fund, thus completing, with the gift from Sir Julius Wernher, the 15,000*l*. required to meet the Treasury grant.

Generous help towards the equipment has been received from many sources, including a number of the City companies. The committee, however, points out that considerable sums are still necessary to provide adequately the equipment which is essential for the proper development of the work.

The block of buildings for optics and administration is now nearly complete, and it is to open these that Mr. Balfour has promised to be present on June 26.

ATMOSPHERIC REFRACTION IRREGULARITIES.

THE anomalies of atmospheric refraction are numerous, and at various times irregularities extending over periods of one minute, one day, and one year have been discussed, that of the order of one second being generally known and causing "unsteady seeing." The variation of the order of one minute was discovered by Nusl and Fric experimentally in 1908, and they concluded that this irregularity had an amplitude of nearly a second of arc. The existence of such a large amplitude and its importance in meridional work suggested to Prof. Frank Schlesinger a redetermination by a perfectly independent method, and this he has done and described in a recent number of the Publications of the Allegheny Observatory (vol. iii., No. 1). He has based his measures on photographs of ordinary star trails made with the help of stationary long-focus instruments, and these he has had secured for him, according to a programme, by Prof. Slocum with the 40-in. Yerkes refractor, and Prof. Seares with the Mount Wilson 60-in. reflector, the star trails being those of the Pleiades group. The result deduced from the Yerkes plates, as is illustrated by curves in the publication, is to show the presence of this slow fluctuation, every one of the seven trails remaining at times above or below its mean position for a considerable fraction of a minute.

The same series of photographs was used to determine whether neighbouring stars showed the same fluctuations and whether the minor fluctuations were real. The curves plotted from these photographs thoroughly endorsed both these views, one figure showing the fluctuations of Merope and Alcyone as absolutely identical. To decide whether such one-minute fluctuations were common to mountain sites as well as low-lying situations, the Mount Wilson photographic trails were employed, and handled in the same way. The conclusion drawn was that the irregularities were of the same character, the amplitude being of the same order and the extreme range about one second of arc. Prof. Schlesinger thus directs attention to the fact that these results set a limit of accuracy to meridian work and show that photographic determinations of the distance between

two widely separated objects are much more accurate than micrometer (excluding double image or heliometer) observations with the same instrument, because the former are affected alike, the same time element being common to each.

PROPERTIES AND STRUCTURE OF ICE.

AN interesting account of a number of experiments by Prof. R. S. Tarr and Dr. J. L. Rich, of Cornell University, appears in the *Zeitschrift für Gletscherkunde* (Band vi., p. 225). The results agree mainly with those obtained by Mügge and MacConnell, and show that, as urged in 1869 by W. Mathews, those of Prof. Tyndall and Canon Moseley were inconclusive, through not taking sufficient account of the time-element in the problem. These recent experiments, which were both numerous and designed to test the various properties of ice, show that it welds readily at a temperature of 0° C.; that when a block of ice has been cut through by a wire and regelation has occurred, optical continuity is re-established, the new-forming crystals being controlled by those previously in existence, and that the welding, at temperatures well below the freezing point, to some extent resembles what has been observed in marble after being crushed.

The authors tentatively advance four propositions; the first, that the observed deformation is of the nature of plasticity, *i.e.* it is not initiated until a certain strain is reached, the plastic yield-point lying near the breaking point of the ice; the second, that the ease with which deformation may be produced varies with the direction in the crystal; the third, that the optical properties of a crystal are affected by such deformation, the effect being dependent upon the direction in the crystal in which the deformation takes place; and the fourth that granular ice, composed of interlocking crystals, is subject to deformation equally with a single ice-crystal. Pond-ice was mostly used in the experiments, but granular snow- and glacier-ice were also employed. The authors notice a suggestive fact in regard to the first, that in a cake 30 cm. thick, about 10 cm. at the top consisted of finely granular ice; the next 15 cm. of coarse prismatic crystals of ice, standing perpendicular to the water surface, and the remainder of finely granular ice with diversely oriented crystals.

THE WINDS IN THE FREE AIR.[1]

IT was noticed in very early times that the wind in the upper air may be very different from what it is on the surface. Lucretius says: "See you not too that clouds from contrary winds pass in contrary directions; the upper in contrary way to the lower." Bacon advocated the use of kites in studying the winds; but it is only in quite recent years that any systematic attempt has been made to investigate the free air above the surface of the earth. Kites have been flown to a height of four miles, but it is a matter of some delicacy to get even so high as two miles.

The temperature of the free air may be recorded by a meteorograph attached to a small rubber balloon, which continues to ascend until the pressure of the gas inside bursts the envelope, and the instrument descends again to the surface. The beautiful instrument constructed by Mr. W. H. Dines, F.R.S., the pioneer of upper air research in this country, is so light that the torn fabric of the balloon is sufficient to act as a parachute and check the speed of descent.

[1] Discourse delivered at the Royal Institution on Friday, April 11, by Mr. Charles J. P. Cave.

The general result of the observations has been to show that the temperature of the air decreases with height up to a certain point, above which the temperature distribution is nearly isothermal; however much higher the balloon may ascend, there is little further change of temperature. This upper layer, discovered by M. Teisserenc de Bort, whose recent death meteorologists of every country lament, is called the stratosphere; the lower part of the atmosphere is the part that is churned up by ascending and descending convection currents, and is called the troposphere. The height at which the stratosphere is reached, as well as the temperature of the layer, varies from day to day and from place to place. In these latitudes it is met with at heights varying from about 8 to 14 km., with temperatures varying from −40° to −80° C.

It is not, however, with temperatures that I am chiefly concerned to-night, but with the wind currents in the different layers of the atmosphere. If one of the balloons carrying instruments, or a smaller pilot-balloon, is observed with a theodolite, its position from minute to minute can be determined, and from its trajectory, or its path, as it ascends, the winds that it encounters can be calculated.

The theodolite used is constructed specially for the purpose; a prism in the telescope reflects the light at right angles, so that the observer is always looking in a horizontal direction, even if the balloon is overhead. It is important that the observer should be in as comfortable a position as possible, for an ascent sometimes lasts more than an hour and a half, during which time the observer can only take his eye from the telescope for a few seconds at a time, otherwise he may lose sight of the balloon and be unable to find it again.

The balloon having been started from one end of the base, observations are taken from both ends at exactly the same times, usually every minute. From the positions of the balloon at each successive minute, which are plotted on a diagram, the run of the balloon during the minute can be measured, and hence the wind velocity during that minute can be obtained. After the wind velocities have been measured off, and the wind directions obtained from the directions of the lines on the diagram, another diagram is constructed showing the relation of the wind velocity and direction to the height.

It is not necessary, however, to have two observers if the rate of ascent of the balloon is known; in such a case, the complete path of the balloon can be calculated from the observations of one theodolite. It is not, however, possible to know the rate of ascent with complete accuracy, as up and down currents in the air will affect the normal rate. In practice, especially in clear weather, the method is fairly satisfactory. The method of one theodolite requires less preparation, and the subsequent calculations of the path of the balloon are less laborious, than in the case of observations taken with two theodolites from opposite ends of a base line.

The best time for observations is towards sunset, so that the balloon reaches its greatest height after the sun has set on the surface of the earth; at such times the balloon, still illuminated by the sun, shines like a planet, and on one occasion I should have found it impossible to tell which was the balloon and which was Venus, except for the movement of the balloon. The distances at which balloons may be seen through the telescope of the theodolite are remarkable. A striking instance was when the flash of the sun on the small meteorograph was seen, not once, but repeatedly, when the balloon was about nine miles above the sea and at a horizontal distance of about thirty miles.

In considering the structure of the atmosphere, as it has been revealed by the observations I have carried out, principally at Ditcham on the South Downs, we may divide the subject into two parts: first, the wind structure in the lowest kilometre, and secondly, the general wind distribution up to the greatest heights reached by the balloons.

It is a matter of common observation that the wind increases above the surface, and in these days of aërial navigation it is important to know the law of this increase. It seems that at Ditcham, the increase in velocity is at first linear or nearly so, and that the line representing the linear increase passes through zero velocity at sea-level. That is to say, if we plot the wind velocity at the surface and draw through it a line from zero velocity at sea-level, the wind velocities at other heights, up to half a kilometre to one kilometre, will lie very nearly on this line; this approximately linear increase has been found to agree with observations at several land stations, but over the sea other conditions probably prevail.

But there are occasions when this state of things does not apply at all; this is often the case in light breezes, and at times when the surface wind is very shallow, giving place to an entirely different wind *régime* in the first kilometre of height. At such times it often happens that the wind velocity is greatest a very little way above the surface. The fact that there are two separate conditions emphasises the danger of taking means. By taking the mean value of a number of separate observations we might get as a result that the wind neither increased nor decreased in the first kilometre of height, which in reality is only true on very rare occasions. As has been truly said, "La méthode des moyennes c'est le seul moyen de ne jamais connaître le vrai!"

Another question of great importance to aviators is the effect of hills upon the winds blowing over them. The balloons used in my investigations ascend at the rate of 500 ft. per minute, and in a few minutes are carried beyond the reach of ground eddies; in some cases, however, I have found that a balloon rose with more than its normal velocity when passing over hills if a strong wind was blowing, and the effect is visible sometimes even when the balloon is more than a kilometre above the surface; on other occasions very little effect has been observed. More light is being thrown on this question by the observations of Mr. J. S. Dines on slowly ascending balloons.

The lower layers of the atmosphere up to one or two kilometres are the most important to aviators. To meteorologists the higher layers offer problems of greater interest. In considering the winds in the free air it is convenient to have some datum to which to refer them. The observed surface wind is not convenient for this purpose, being too much affected by local conditions near the ground. A better datum is what is known as the gradient wind. Under the influence of the barometric gradient the air is being pressed towards the areas of low pressure, but the wind is actually blowing more or less along the isobars at right angles to the force. In much the same way, water in a basin, when allowed to escape through a hole in the centre, and when given a slight movement of rotation, moves round the basin at right angles to the forces which are pressing it towards the centre. In the case of the atmosphere the turning movement is given by the rotation of the earth under the moving air. For any pressure condition to be maintained the air must be moving with a certain definite velocity, depending on the shape of the isobars and the steepness of the barometric gradient. This rate can be calculated for the conditions obtaining at the time, and the wind so calculated is called the gradient wind. It has been found that there is a fairly good agreement between the wind so calculated and the observed wind at a height of ½ km. or so, but owing to friction the surface wind is usually of a smaller velocity, and directed more towards the low pressure.

In order to show in a clear manner the changes of wind at different levels, I have prepared some models which give a better mental picture of the conditions than a diagram. The atmosphere is supposed to be divided up into layers each 1 km. thick and the average wind in each layer is represented by a coloured card; the length of the card represents the velocity of the wind, 1 cm. representing 1 metre per second, 1 metre per second being about 2¼ miles per hour; the direction of the card shows the direction of the wind, the arrow flying with the wind. The red cards represent winds that may be supposed to bring air from an equatorial direction, that is winds from east-south-east through south to west-north-west, the blue cards winds that may be supposed to bring air from a polar direction.

For convenience I have divided the wind structures into five types; they are perhaps rather artificial, as I shall show later, but it is convenient to make some sort of classification, even when further knowledge must change it. In the first three types of wind structure, the wind increases above the surface and equals the gradient velocity at a height of ½ km. or so; above this in the first class the wind remains more or less equal to the gradient velocity, up to a height of 7 or 8 km.; in the second class the wind in the upper air greatly exceeds the gradient wind, and in the third class it falls off again to a lesser value; but in all three classes the direction remains much the same as that of the gradient wind.

The first type may be called the solid current; it does not seem to be associated with any particular type of isobars, but in a preponderance of cases the wind is easterly, and the remaining cases are nearly all westerly; it is rare to find the solid current with winds from the north, or from the south.

In rare cases there is scarcely any wind up to the greatest heights reached, and the little wind there is often blows from varying directions in different layers; this type, which may be looked on as a subclass of the first type, sometimes occurs in still anticyclonic conditions in summer.

In the second class the gradient wind, after being reached at a height of about ½ km., is greatly exceeded in the upper air; in some cases the wind at 2 or 3 km. is double the gradient value, or even more. This type is likely to occur when there is a low pressure to the north of the station and when there is a strong temperature gradient, such that the low temperatures correspond to the low pressures, and *vice versâ*; such conditions should theoretically cause an increase in wind velocity in the upper air, but it is not possible to calculate what the effect should be without knowing the temperatures, not only on the surface, but in the upper air over the region in question. One may, however, calculate what effect surface temperatures would have on the isobars at, say, 3 km., assuming that the vertical temperature gradient is the same at every point; a map constructed to show the isobars which have been thus calculated must be looked on as a rough approximation only to the real conditions. A map of the isobars at 3 km. for May 11, 1907, shows how much steeper was the gradient on this day in the upper air than it was on the surface, a fact which quite accounts for the rapid increase in wind velocity from 2 metres per second at the surface to 19 metres per second at 3 km.

Winds belonging to this class may come from any point of the compass.

The third class comprises those cases in which the wind, after reaching the gradient velocity in the first ½ km. or so, falls off more or less rapidly in the upper air. This class is almost entirely associated with easterly winds on the surface, when there is high pressure to the north and low pressure to the south. An east wind is usually, though not always, a shallow one; a south-west gale increases in the upper air, but when an easterly gale is blowing, causing such high seas and such dangers to shipping, it is curious to reflect that such a short distance up we should meet with light breezes, or even a complete calm.

We now come to the class of reversals when the wind in the upper air is very different in direction from that near the surface, and when it often bears no relation to the surface pressure distribution. In a typical case, after an initial increase for a short distance above the surface, we find the wind gradually decreasing as we ascend, until a layer is met with in which there is a complete calm; above this we find an entirely different wind, which usually increases as we go higher, as in the case of winds in the second class. It looks at first sight as though there were a discontinuity in the atmosphere, but I hope to show later that this is more apparent than real. A typical example of a reversal occurred on November 6, 1908, when the surface wind was easterly with a velocity of 17 metres a second, just below 1 km.; above this it fell off to a complete calm at 3 km.; at 4 km. there was a light north-west wind, which increased to a wind of 15 metres per second at 10 km. The weather map for this day is remarkable: over this country there is no sign on the surface of the westerly wind above, but it appears that in Germany, where the pressure was highest, the westerly wind must have been descending and must have divided into two currents, one flowing on as a westerly wind over eastern Europe, the other flowing back as the easterly wind recorded in this country.

There are other cases of reversal which are not so simple as the one described above. In many cases this type is associated with small depressions, or with small areas of high pressure which seem to be relatively shallow. The surface winds are related to these shallow systems, while the upper winds are controlled by larger areas of high and low pressure, shown on the weather maps at places lying farther from the point of observation.

On September 30, 1908, for instance, a southerly surface wind, after remarkable backing, gave place to a calm at 3 km.; above the calm another southerly wind is met with; in this case the surface wind is probably related to the high-pressure system over Germany; the upper wind to the depression approaching from the Atlantic. There was another somewhat similar case on November 16, 1908, though with winds from a different direction; the northerly surface wind backed, and a calm was met with; above this, very unexpectedly, came a thin stream of southerly wind, above which again was a north wind, increasing in velocity with height. In this case the lowest wind was part of the circulation of an anticyclone which was approaching these islands from the Atlantic; the intermediate southerly wind was perhaps the last remaining effect of the anticyclone over the Continent, while the upper wind was the outflow from above a depression near Iceland, a wind which belongs to another class to be noticed later.

In cases of reversal we find that the warm wind flows over the top of the one that comes from a colder region; there must somewhere be a line where the warm current is rising, where it must be cooled dynamically, and where its moisture may condense into cloud or rain. It is interesting to note that in most cases rain occurs somewhere in the region of the reversal, and in summer thunderstorms are frequent. Thunderclouds may often be seen to be in a wind coming from a contrary direction to the wind on the surface, and it seems possible that for anything like a sustained thunderstorm something in the nature of a reversal must exist; it is difficult to see how a difference of potential, sufficient to produce lightning, can be kept up unless winds from different directions are bringing masses of air at different potentials near to one another.

It has been noticed in Hampshire that when the sound of gun-firing in the Channel is distinct, it is, in summer, a sign of thunder; an explanation may be hazarded; if there is a reversal so that the upper wind is coming from the south, the sound waves travelling from this point with a slight upward tendency will be refracted on entering the upper current, and thus, instead of being dissipated in the upper air, may again reach the surface at a considerable distance from their point of origin. Such conditions of wind are those productive of thunderstorms. This may also possibly account for the superstition that gun-firing produces rain; the sound of guns is only carried to great distances under the conditions I have mentioned, which are precisely the conditions favourable for heavy rains.

A north-east wind with rain lasting many hours is a common and a very unpleasant type of weather; it is not obvious where the moisture comes from with such a wind, for the air from the dry regions of the Continent could scarcely become saturated in its short passage over the North Sea. I believe the moisture comes from the Atlantic in a south-westerly wind in the upper air. Balloons cannot be followed for any length of time in such weather, but I have sometimes observed that the north-easterly wind slackens considerably below the cloud level, and sometimes, when breaks in the clouds have enabled balloons to be followed a little farther, there have been unmistakable signs of reversal. A careful watch for upper clouds, seen through rifts in the lower cloud sheet, will often indicate an upper southerly wind. So sure do I feel of these facts that, though living only twelve miles from the Channel, I never hesitate to send up an instrument-carrying balloon in rainy weather with a north-easterly wind, feeling certain that, though the balloons may go towards the sea at first, they will ultimately return and fall on dry land. My confidence is usually justified by the balloons coming to earth in the Midlands or eastern counties.

The last type of wind structure to be considered is the outflow that seems to take place from the upper layers over a low-pressure system, causing west to north winds in the upper air on the east and south sides of the depression. Depressions out in the Atlantic, which cause south-west winds on the surface, give rise to west or north-west winds in the upper air over England; even cyclones so far off as Iceland produce such winds, and as they pass along the Arctic circle, between Iceland and Norway, they show their presence by an upper northerly wind over this country. As the upper wind is often quite different from that on the surface, reversals are frequent in this class, and are associated as usual with rains, and with thunderstorms in the summer. It may be that much of the rain that falls in the cyclonic depression is due to the rising of this outward flowing current over the very different surface current on the east and north-east sides of the depression.

In connection with the subject of reversals, I may mention the wave and ripple clouds that form such beautiful skyscapes. It used to be supposed that these were formed by winds from different directions flow-

ing over one another and setting up waves; but the observations of pilot balloons have shown that between two currents from different directions there is either a layer of calm, or else the wind changes round gradually; two very different currents are not found in close juxtaposition: there is no abrupt transition between them.

To show the relation of the different types of wind structure to the surface pressures a model has been prepared; on the map are shown a depression and an area of high pressure, with arrows to show the wind directions; above the map is a sheet of glass to represent the first 5 km. of the atmosphere; on this are marked the winds one would expect to meet with at this level under the conditions of pressure supposed; above this sheet of glass is another representing the thickness of the atmosphere from the 5-km. level to the stratosphere. The model is on the scale of one-millionth, the vertical scale through the glass being approximately the same as the horizontal scale.

The churning up of the air resulting from the heating of the surface layers by contact with the earth heated daily by the sun, does not presumably reach into the stratosphere; there being no vertical movements, we should expect to find only such horizontal movements as are consistent with a suitable distribution of density. In the simplest cases the wind increases in velocity until a maximum is reached just below the stratosphere; above this the wind begins to diminish, and sometimes falls off in a very marked manner. There are occasions when all real wind seems to have ceased, and the balloon as it ascends through this curious region moves first in one direction and then in another, so that the relation of wind direction to height can only be represented on a diagram by a disconnected series of points.

What takes place still higher? Does this region of calm extend to the very confines of the atmosphere? We have practically no evidence to go on. In February, 1909, a meteor left a magnificent streak which was visible for two hours and a half; this trail, which was some forty miles above the surface of the earth, moved in a manner suggesting very high wind velocities, with sudden variations in the different layers through which it passed. But it is possible that the streak of a meteor may partake of the nature of an aurora, the luminous patches of which sometimes move in a remarkable way, and probably under forces other than those of the winds.

Having for purposes of classification divided the wind structure of the atmosphere into different classes, I must now attempt to put them together, and to show that some of the types that seem very different are in reality closely connected.

Following on inquiries made by Mr. W. H. Dines on the correlation between the surface pressure and various meteorological elements at a height of 9 km., it was suggested by Dr. W. N. Shaw, F.R.S., that the changes of pressure to which our changes of weather are due have their origin, not near the surface of the earth, as hitherto supposed by many meteorologists, but just below the level of the stratosphere, at a height of 9 km. or so above the surface. This view is in accordance with the observed facts of the wind distribution in the different layers of the atmosphere.

Supposing that on a certain day there is a pressure distribution just below the stratosphere, which at that level produces a westerly wind of a certain strength; this pressure distribution will be transmitted through all the lower layers of the atmosphere, and unless modified by other conditions will produce a west wind at the surface; the velocity of this wind will, however, be only about one-third of that at the 9-km. level owing to the greater density of the air near the surface. If, however, the air to the north at every height were at a lower temperature than the air at a corresponding height over the place of observation, there would be at all levels a tendency for easterly winds. This will have the effect of reducing the westerly wind as we descend through the atmosphere, and when the surface is reached the west wind will have a much lower value than it would have had were it only for the increased density of the air. If the wind at the 9-km. level is not very strong, or if the tendency to produce an easterly wind is strong, as would be the case if the air to the north were very cold, we may get a calm at the surface, or the calm may even be reached at some distance above the surface, in which case the tendency for easterly winds may actually produce such a wind, which will increase in velocity as we descend towards the surface under the layer of calm, and be strongest a little above the surface of the earth, at a point where surface friction begins to cause a diminution of velocity.

If, again, at the 9-km. level, there is a pressure distribution producing an easterly wind, cold air to the north will produce a tendency for an increase of easterly wind as we descend through the atmosphere; but the greater density of the air at the lower levels will produce a decrease of wind velocity from whatever direction the wind may be coming; the two tendencies may neutralise one another, in which case we get a solid current of east wind between the stratosphere and the ground level.

If there is no wind at the 9-km. level, cold air to the north will produce easterly winds in the lower levels, in which case we should find easterly winds increasing in velocity as the surface is approached.

These considerations give some idea of the mechanism by which the different types of vertical wind structure may be produced. The wind increasing in height, the solid current, the wind decreasing with height, are seen to fall into their places. The reversal, with an east wind near the surface and a west wind higher up, is only an extreme case of the slackening of the westerly wind near the surface; and the point of reversal, far from marking a point of discontinuity in the atmosphere, is seen to be merely the result of forces extending right through the lower part of the atmosphere, between the stratosphere and the earth.

If the winds are resolved into components at right angles to each other, that is north-south and west-east components, it is found that in most cases the west-east component decreases below the stratosphere and is a minimum near the surface, an east wind in this case being considered as a negative west wind. This is what should be the case if the ideas I have been considering are correct, for the air to the north is generally colder than the air over this country. In the case of the north-south component we find no such general rule, but this also is as it should be, for the air to the east and west may be either of the same temperature, or warmer, or colder than the air over the station; in other words, there is a normal north to south temperature gradient but not a normal west to east gradient, in our islands.

The supposed cases mentioned are, of course, simple types, and it can readily be understood how varying conditions of pressure and temperature may in similar ways produce varieties of vertical wind distribution. In considering the pressure distribution just below the stratosphere as the regulator of the winds and the weather in the lower part of the atmosphere, I fear I have nothing to add concerning the laws governing these pressure distributions; the idea is a new one, and has yet to be worked out in its details, and to stand the test of criticism and fuller investigation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l*. a year tenable for two years is offered each year by the governing body of Emmanuel College to a research student commencing residence at Cambridge as a member of Emmanuel College in October. Applications, accompanied by two certificates of good character, should be sent to the master of Emmanuel not later than September 24.

The next combined examination for fifty-six entrance scholarships and a large number of exhibitions at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 2, and following days, commencing at 9 a.m. on Tuesday, December 2. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences. A candidate for a scholarship or exhibition at any of the six colleges must not be more than nineteen years of age on October 1, 1913. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained. The forms of application must be sent in on or before Saturday, November 22.

Mr. W. Dawson has been appointed reader in forestry in the University until September 30, 1917.

OXFORD.—Additional buildings are about to be provided for research and teaching purposes in connection with the School of Forestry. The expense will be met partly out of the funds at the disposal of the Delegates for Forestry, and partly by a grant of 1000*l*. from the Development Fund controlled by the Treasury. The Council of the Surveyors' Institution has contributed 210*l*. towards the cost of a research laboratory on the diseases of trees.

Convocation has authorised the curators of the University Chest to receive the sum of 6000*l*. from the trustees of the University Endowment Fund, to be applied to the building and equipment of the new laboratory of engineering science, as soon as the allotted site shall have been legally secured to the University.

DR. J. ARGYLL CAMPBELL, junior assistant to Prof. Schäfer, in the University of Edinburgh, has been appointed professor of physiology in the University of Singapore.

THE fortieth annual dinner of the old students of the Royal School of Mines will be held on Monday, June 9, at the Café Monico, Piccadilly Circus. Mr. Frank Merricks will be in the chair. Tickets may be obtained from the hon. secretary, Mr. T. A. Rickard, 820 Salisbury House, E.C.

THE St. George's Gallery, New Bond Street, was the scene last week of an interesting exhibition of photographs of the Holy Land. These photographs were the work of Miss Sophie Nicholls, who travelled in Palestine in 1910–11 as a Frances Mary Buss travelling scholar. The scenic and panoramic views force upon the mind the aridity of the land, the apparent unchangeable character of the works of man in the towns or villages which are tucked, as it were, into crannies of the bleak hill slopes. A set of twelve of the most typical views has been compiled for the use of schools and colleges, and an explanatory book containing topographical maps showing the position of the camera and its range of view is in preparation. Particulars of these publications may be obtained from Messrs. J. A. Sinclair and Co., Ltd., 54 Haymarket, S.W.

THE Board of Education has issued (Cd. 6795) its regulations for the training of teachers for elementary schools, to come into force on August 1 next. Substantial changes will then be made with regard to the curriculum and examinations of students who will follow the ordinary two years' course of the training college. The majority of students entering the training colleges now have had four years' education in a secondary school, whereas, when the old regulations for training colleges were drawn up, the general education of their students on entry was often very meagre. The changes are in the direction of diminishing the time devoted to general education by the training-college student and increasing that given to what are called "professional" subjects. More prominence, too, is to be given to practical work in teaching while at college. It has been found necessary to add to the equipment of the primary-school teacher a knowledge of hygiene and physical training, and both these subjects are classed as professional. Elementary science is rightly considered a subject of general education. Physics, chemistry, botany, rural science, and housecraft are called "additional," or "subjects which are not ordinarily needed by elementary-school teachers, but which may in certain cases be included in the training-college curriculum, either because they would be useful for teachers in schools of a special type, or because the student may desire to study them with a view to improving his own general education."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 8.—Sir Archibald Geikie, K.C.B., President, in the chair.—A. D. **Waller**: The various inclinations of the electrical axis of the human heart. This paper is in substance the direct continuation of a communication made to the society in 1889 (Phil. Trans., p. 169), in which it was shown (1) that the electrical effects accompanying the beat of the human heart can be demonstrated and studied by "leading off" from the mouth and from the extremities; and (2) that in consequence of the oblique situation of the heart in the thorax these "leads" are to be classified as favourable and unfavourable or strong and weak. Of the six possible leads from the four extremities, three are strong (transverse, axial, right lateral) and three are weak (inferior, equatorial, left lateral). Of the four possible leads from the mouth and one extremity, one is weak (right superior) and three are strong (left superior, right and left inferior). The electrical equator is an imaginary line of zero potential across the chest from left shoulder to right side. The electrical current axis is from right shoulder to left side, at right angles to the equator.—Surgeon-General Sir D. **Bruce,** Majors D. **Harvey** and A. E. **Hamerton,** and Lady **Bruce**: Trypanosome diseases of domestic animals in Nyasaland. III., *Trypanosoma pecorum*.—T. **Goodey**: The Encystation of *Colpoda cucullus* from its resting cysts and the nature and properties of the cyst membranes. The ectocyst ruptures and sets free the transparent endocyst. Both ectocyst and endocyst are composed of carbohydrate substances and are resistant to acids, weak alkalies,

and many other reagents; failing to give any reaction with iodine in potassium iodide solution. The endocyst is composed of a new carbohydrate for which the name Cystose is proposed. During encystation the endocyst wall is digested by a powerful enzyme secreted by the enclosed organism, and by this means the latter is enabled to escape. The name Cystase is proposed for this enzyme.—C. **Shearer**, W. De **Morgan**, and H. M. **Fuchs**: The experimental hybridisation of Echinoids.

CAMBRIDGE.

Philosophical Society, April 28.—Dr. Shipley, president, in the chair.—A. H. **Evans**: Notes on additions to the flora of Cambridgeshire. The author stated that the combined efforts of the staff of the botany school, research students, and undergraduates had resulted in a large addition to the list of species given in his "Short Flora of Cambridgeshire" (Proc. Camb. Phil. Soc., xvi., part 3), while others of great interest had been discovered in new localities or rediscovered in their former stations. Of these perhaps the most interesting was the rare *Prunella laciniata*, but lately known to have occurred in England, while Mr. Moss had found with it what appeared to be undoubted hybrids with *P. vulgaris*.—H. Hamshaw **Thomas**: Some new and rare Jurassic plants from Yorkshire. In this communication Eretmophyllum, a new genus of plants allied to the Ginkgoales, is described. It is founded on leaves which possess the nervation, secretory tracts, and stomatal structure characteristic of Ginkgo leaves, while in their linear or oblanceolate shape they rather resemble those of Podozamites.—C. E. **Moss**: Some plants new to the British Isles. Rev. M. J. **Le Goc**: Observations on *Hirneola auricula-judae*, Berk. (Jew's ear). The author deals in his paper with the biology of *Hirneola auricula-judae*, Berk., "Jew's ear," with special reference to pure cultures in various media, to the fructifications obtained in these cultures, and to the action of the hyphæ on the tissues of the host.—Prof. A. C. **Dixon**: (1) The greatest value of a determinant the constituents of which are limited. (2) Expressions for the remainders when θ, θ', $\sin k\theta$, $\cos k\theta$ are expanded in ascending powers of θ.

May 5.—Prof. Nuttall in the chair.—Prof. **Nuttall**: Observations on ticks: (*a*) parthenogenesis, (*b*) variation due to nutrition. The occurrence of parthenogenesis in ticks was recently observed by Aragão, in Brazil, in a new species of Amblyomma (*A. agamum*), the males of which have not as yet been discovered. Three complete generations of this tick have been raised experimentally and thousands of females were brought to maturity in the absence of males. This constitutes the first record of parthenogenesis in ticks. Prof. Nuttall described how he had succeeded in obtaining a parthenogenetic offspring from *Rhipicephalus bursa*, a species (prevalent on sheep in countries bordering the Mediterranean) in which both sexes occur in fairly equal numbers upon the host. Larval ticks issued in limited numbers from the eggs laid by unfertilised females. Experiments were further recorded in which it was shown that the genus Rhipicephalus shows a considerable natural variation in size, and that imperfect feeding of the tick in its immature stages leads to the development of very small adults which, whilst fertile, are so different from the normal forms that they could readily be taken for other species.—E. **Hindle**: Exhibition of a Chinese flea-trap. The author exhibited an ingenious device for catching fleas commonly employed by the natives of Setchuen, western China. The apparatus consists of two pieces of bamboo one inside the other. The inner bamboo is coated with bird-lime to which any fleas adhere, whilst the outer one merely protects the sticky surface from coming into contact with bedclothes, &c., but is fenestrated in order to allow the free entrance of fleas.—Prof. A. D. **Imms**: Exhibition of living termites. The author exhibited tubes containing living examples of the termite *Archotermopsis wroughtoni*, Desn. The termites were obtained by him from the Kumam Himalayas, where they occur in dead trunks of the Chir pine (*Pinus longifolia*) at an altitude varying from about 4500 to 5800 ft.—K. R. **Lewin**: The division of *Holosticha scutellum*. The account of the behaviour of the micronuclei at division, given by A. Gruber ("Weitere Beobachtungen an vielkernigen Infusorien," *Ber. Naturf. Ges. zu Freiburg I.B.*, Bd. iii. (1887), pp. 57–70), is not confirmed. In the period between divisions, *H. scutellum* possesses only a small number of micronuclei of about the size of the meganuclear segments, with which they have been confused. There is therefore no necessity to assume that numerous micronuclear divisions occur at the fission of the infusorian.—H. B. **Fantham**: *Sarcocystis colii*, n. sp., a Sarcosporidian occurring in the red-faced African mouse bird, *Colius erythromelon*. The author gave an account of a new species of Sarcosporidia from a new avian host. The Sarcosporidian trophozoites (Miescher's tubes) were distributed throughout the skeletal musculature, being more concentrated in some areas than in others. They occurred also in the heart muscle, and were scattered in the pericardium, peritoneum, and in the intestinal mesentery.—J. T. **Saunders**: Note on the food of freshwater fish. The food of fish varies considerably, many different things being taken by one species as an article of diet. But a single fish does not eat indiscriminately everything that it comes across; on the contrary, its meals are found usually to consist of one kind of food only. A mixture of food is not often found in the stomach, and this will only occur when the fish is very hungry or under artificial conditions, such as obtain in a laboratory aquarium. The food also varies according to locality, even in ponds which are separated from each other by only a few yards; the food in the stomachs of fish taken from these ponds may be quite different. This variation affects equally all the individuals that live in the same pond; under the same conditions they will all feed on the same food.

PARIS.

Academy of Sciences, May 13.—M. F. Guyon in the chair.—Paul **Appell**: The polynomials $V_{m,n}$ of Hermite and their analogues connected with spherical functions in space of any number of dimensions.—Armand **Gautier** and P. **Clausmann**: Fluorine in the animal organism. Skeleton, cartilages, tendons. Determinations of amounts of fluorine in bones and teeth, cartilage, and tendons of mammals and fish. Fluorine has been found in all the organs examined, but the proportions vary widely. Fluorine is localised in a definite manner in the organism; it accompanies the phosphates of the alkaline earths and increases with them.—Paul **Sabatier** and M. **Murat**: The preparation of several dicyclohexylbutanes. Description of the preparation and properties of five out of the nine possible isomeric dicyclohexylbutanes.—L. de **Launay**: Some broken-up rocks of the Central Plateau (France).—M. de **Forcrand**: Trouton's law. The relation L/T = constant (about 22) is known not to hold in many cases, the value of L/T varying from 4·5 for helium to 0·27 for copper. Nernst has suggested $L/T = 9{\cdot}5 \log T - 0{\cdot}007\,T$. This gives a closer approximation to experiment, but is still unsatisfactory. The author further modifies this formula to

$$L/T = 10{\cdot}1 \log T - 1{\cdot}5 - 0{\cdot}009\,T + 0{\cdot}0000826\,T^2.$$

Between 250° and 900°, this gives a value for L/T approximating to 22, the original Trouton constant.—Ph. **Barbier** and R. **Locquin**: The methodical degradation of some monobasic and dibasic acids (see p. 303).—MM. **Fayet** and **Schaumasse**: The provisional orbit of the new comet 1913*a* (Schaumasse). The comet will be best seen about the beginning of June.—Gaston **Cotty**: The reduction of binary quadratic forms with integral coefficients in a real quadratic body.—E. **Landau**: Lambert's series.—Jules **Andrade**: Lateral independence of the balance spring in marine chronometers. Diminution of the variation from isochronism due to inertia.—A. **Cotton** and H. **Mouton**: The magnetic double refraction of liquids. The magnetic double refraction of solutions of nitrobenzene in carbon tetrachloride shows wide variation from an additive law; the specific double refraction of the nitrobenzene appears to be reduced by the addition of an inactive diluent.—R. **Fortrat**: The simplification of lines of the spectrum by the magnetic field. A study of the effect on the lines of a very strong magnetic field (40,000 Gauss). In the case of the green band of carbon the field reduced all the doublets to single lines, and the triplets were also reduced to single lines when the three lines were fairly close together. Similar effects were also noted in the blue band of the Swan spectrum, and the spectrum of the negative pole of nitrogen. The phenomenon appears to be general in band spectra.—M. de **Broglie** and F. A. **Lindemann**: The optical phenomena presented by the Röntgen rays meeting crystalline media. An examination of the various hypotheses proposed for explaining the production of fringes described in an earlier paper. The hypothesis that the fringes are caused by reflections on the cleavage planes of the crystal agrees best with the experimental results.—L. **Gay**: The calculation of the latent heats of evaporation. A modification of the Clapyron formula is proposed, partly based on Nernst's expression.—Louis **Hackspill**: The solid hydrogen phosphides. The alkaline phosphides of the type M_2P_5, described in a previous communication, give a solid hydrogen phosphide on treatment with dilute acetic acid, and this on analysis gives figures agreeing with the composition H_2P_5.—J. **Bougault**: Phenyl-α-oxycrotonic acid, its preparation and a new isomeride. A study of the best conditions of obtaining the acid from its amide; the hydrolysis of the latter is best carried out by heating with a solution of oxalic acid. An isomeride was obtained in the course of this work which differed from those previously known; it would appear to be the enolic form of benzoylpropionic acid.—Edouard **Bauer**: 1-Benzoyl-2-phenyl-Δ_3-*cyclo*pentene.—Maurice **Lugeon** and Mlle Elisabeth **Jérémine**: The presence of limestone bands in the Swiss part of the massif of the Aiguilles Rouges.—V. **Vermorel** and E. **Dantony**: Fungicidal pasty solutions possessing moistening power. It is important that the copper preparations used in viticulture should moisten the leaves. This effect can be secured by the addition of gelatine to solutions with acid reaction and casein to alkaline solutions.—Ch. **Brioux** and M. **Guerbet**: Sulphur in the soil: study of its oxidation. The oxidation of the sulphur in the soil is shown to be due to microbial action. The phenomenon is complicated, several bacteria appearing to take part in the oxidation.—J. M. **Lahy**: Organic adaptation in states of attention.—Raoul **Bayeux**: The comparative resistance of the dog and the rabbit to intravenous injections of carbonic acid. The ratio between the receptivity of the dog and the rabbit is the same for carbonic acid as for oxygen; in the two cases the volume of the former gas is five times greater than that of the latter.—P. **Chaussé**: The methods to be used for experimental tuberculosis by inhalation. Details of the methods used for the pulverisation of wet and dry virus.—Jacques **Pellegrin**: A new genus of the Centrarchideæ of the Gabon.—Charles **Lepierre**: The replacement of zinc by copper in the culture of *Aspergillus niger*. Copper, like cadmium, uranium, and beryllium, may replace zinc in Raulin's solution, and has the same effect in causing a rapid growth of the mould.—H. **Bierry** and Z. **Gruzewska**: The estimation of glycogen in the muscles.—Em. **Bourquelot**, H. **Hérissey**, and M. **Bridel**: The biochemical synthesis of the glucosides of alcohols (α-glucosides) by the aid of a ferment, α-glucosidase, contained in the yeast from low beer, air dried. α-Propylglucoside and α-allylglucoside.—L. **Cayeux**: The genesis of sedimentary iron minerals.—Pierre **Bonnet**: The structure of the chains between Lake Gœktchaï and the Araxe.

BOOKS RECEIVED.

Atlas Notes. By J. C. Chute. Pp. 82. (London: Oxford University Press.) 1*s*.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Book iii. Africa. (London: J. M. Dent and Sons, Ltd.) 6*d*. net.

The Fishes of the Stanford Expedition to Brazil. By Prof. E. C. Starks. Pp. 77+xv plates. (California: Stanford University.)

The Statesman's Year-Book, 1913. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xcvi+1452+x plates. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

The National Physical Laboratory. Report for the Year 1912. Pp. 123. (Teddington: W. F. Parrott.)

Report for 1912 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. W. A. Herdman. Pp. 318+iii plates+v charts. (Liverpool: C. Tinling and Co., Ltd.)

Flowerless Plants: How and Where They Grow. By S. L. Bastin. Pp. xi+152+plates. (London: Cassell and Co., Ltd.) 6*s*. net.

Metamorphose der Muraenoiden. By Dr. B. Grassi. Pp. x+211+xv plates. (Jena: G. Fischer.) 50 marks.

Papers Set in the Mathematical Tripos, Part i., in the University of Cambridge, 1908–12. Pp. 70. (Cambridge University Press.) 2*s*. 6*d*. net.

A Text-Book of Thermodynamics (with Special Reference to Chemistry). By J. R. Partington. Pp. viii+544. (London: Constable and Co., Ltd.) 14*s*. net.

The Laws of Thermodynamics. By W. H. Macaulay. Pp. viii+71. (Cambridge University Press.) 3*s*. net.

The Principles of Projective Geometry applied to the Straight Line and Conic. By J. L. S. Hatton. Pp. x+366. (Cambridge University Press.) 10*s*. 6*d*. net.

Insects: Their Life-Histories and Habits. By H. Bastin. Pp. xii+349+xlvi plates. (London and Edinburgh: T. C. and E. C. Jack.) 7*s*. 6*d*. net.

Mathematical Physics. Vol. i., Electricity and Magnetism. By C. W. C. Barlow. Pp. vii+312. (London: W. B. Clive.) 4*s*. 6*d*.

An Index to the Scientific Contents of the Journal and Proceedings of the Academy of Natural Sciences of Philadelphia. Pp. xiv+1419. (Philadelphia: Academy of Natural Sciences.) 3.50 dollars.

The Social Guide, 1913. Edited by Mrs. H. Adams

and E. A. Browne. Pp. xxxv+7+264. (London: A. and C. Black.) 2s. 6d. net.

School and Home Gardens. By W. H. D. Meier. Pp. v+319. (Boston, Mass., and London: Ginn and Co.) 4s.

An Introduction to the Mathematical Theory of Heat Conduction. With Engineering and Geological Applications. By Prof. L. R. Ingersoll and O. J. Zobel. Pp. vi+171. (Boston, Mass., and London: Ginn and Co.) 7s. 6d.

Agronomy: a Course in Practical Gardening for High Schools. By W. N. Chute. Pp. xvi+296. (Boston, Mass., and London: Ginn and Co.) 4s. 6d.

A Course in General Chemistry. By Profs. W. McPherson and W. E. Henderson. Pp. viii+556. (Boston, Mass., and London: Ginn and Co.) 10s. 6d.

Lehrbuch der sphärischen Astronomie. By Dr. L. de Ball. Pp. xv+387. (Leipzig: W. Engelmann.) 20 marks.

Ueber das Wesen der Mathematik. By Dr. A. Voss. Zweite Auflage. Pp. iii+123. (Leipzig and Berlin: B. G. Teubner.) 4 marks.

The Riddle of the Universe. By E. Haeckel. Translated by J. McCabe. Pp. xxviii+324. (London: Watts and Co.) 9d. net.

L'Homme Fossile de la Chapelle-aux-Saints. By Prof. M. Boule. Pp. 278+xvi plates. (Paris: Masson et Cie.) 50 francs.

Journal of the British Fire Prevention Committee. No. x. The Record of the Special Commission formed by the British Fire Prevention Committee to Visit Russia, being a Diary and Notes compiled by E. O. Sachs. (London: British Fire Prevention Committee.) 10s. 6d.

Handbuch der Morphologie der wirbellosen Tiere. Edited by A. Lang. Zweite Bezw. Dritte Auflage. Band I. Lief. 1. (Jena: G. Fischer.) 5 marks.

Black's Sentinel Readers. By Prof. E. E. Speight. Book iii. Pp. viii+184. (London: A. and C. Black.) 1s. 4d.

DIARY OF SOCIETIES.

THURSDAY, MAY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Rays of Positive Electricity: Sir J. J. Thomson.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. I. Molecular Architecture: Prof. W. J. Pope.

CONCRETE INSTITUTE, at 4.30.—Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Determination of Water in Coal: P. L. Teed.—Grading Analyses by Elutriation: H. Stadler.—Notes on Sinking Operations at the Spring Mines, Transvaal: B. D. Bushell.—An Early Example of Blast-roasting: H. Vassiliadi.

FRIDAY, MAY 23.

ROYAL INSTITUTION, at 9.—The Secret of the Permanent Magnet: Prof. S. P. Thompson.

SATURDAY, MAY 24.

ROYAL INSTITUTION, at 3.—Radio-activity. I. The α Rays and their Connection with the Transformations: Prof. E. Rutherford

MONDAY, MAY 26.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

TUESDAY, MAY 27.

ROYAL INSTITUTION, at 3.—Recent Advances in the Production and Utilisation of Wheat in England: Prof. T. B. Wood.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Sub-Crag Flints: Sir Edwin Ray Lankester, K.C.B.

WEDNESDAY, MAY 28.

GEOLOGICAL SOCIETY, at 8.—The Age of the Suffolk Valleys, with Notes on the Buried Channels of Drift: P. G. H. Boswell.—The Internal Structure of Upper Silurian Rugose Corals, from the Grindrod Collection, Oxford Museum: D. E. Innes.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MAY 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers: Acineta tuberosa*; a Study on the Action of Surface Tension in Determining the Distribution of Salts in Living Matter: Prof. A. B. Macallum.—Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. IV. The Mzimba Strain: Surg.-General Sir David Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—Notes on *Plasma gondii*: Helen L. M. Pixell.—An Investigation by Pedigree Breeding into the Polymorphism of *Papilio polytes*. Linn.: J. C. F. Fryer.—The Action of Radium Rays upon the Cells of Jensen's Rat Sarcoma: Dr. S. Russ and Dr. Helen Chambers.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. II. Chemistry in Space: Prof. W. J. Pope.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Section.—Irrigation Works in India: Sir John Benton, K.C.I.E.

FRIDAY, MAY 30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting. At 8.30.—Practical Application of Telephone Transmission Calculations: A. J. Aldridge.

PHYSICAL SOCIETY, at 5.—The Origin of New Stars: Prof. A. W. Bickerton.—Electro-thermal Phenomena at the Contract of Two Conductors with a Theory of a Class of Radio-telegraph Detectors: Dr. W. H. Eccles.—The Evaluation of Certain Combinations of the Ber, Bei, and Allied Functions: S. Butterworth.—The Extraordinary Ray Resulting from the Internal Reflection of an Extraordinary Ray at the Surface of an Uniaxal Crystal: J. Walker.

SATURDAY, MAY 31.

ROYAL INSTITUTION, at 3.—Radioactivity. II. The Origin of the Beta and Gamma Rays and the Connection between them: Prof. E. Rutherford.

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