THURSDAY, MAY 28, 1908.

THE SCIENCE OF THE ELECTRON.

Modern Electrical Theory. By Norman R. Campbell. Pp. xii+332; diagrams. (Cambridge: University Press, 1907.) Price 7*s.* 6*d.* net.

IF Franklin had re-visited this globe a dozen years ago he would have found his view of the electric fluid in the descendent. The work of Hertz and his successors had completed the work which Faraday and Maxwell began in directing the attention of physicists to the æther as the region in which real electrical actions proceed. The conductor was made to take a secondary place only as a region in which electrical energy ceases to be electrical, being dissipated therein into heat. The supposition of one electrical fluid (or more) was scouted, and relegated to the daily Press.

If, however, his visit had been postponed to the present day it would be far otherwise. Once more recourse is had to a fluid to explain electrical phenomena. The story of modern electrical theory is the story of the re-furbishing of an old idea to form the basis of speculative thought. We have Franklin's idea once more in the ascendant; and the only wonder is that this account of modern electrical theory can be written without a single mention of Franklin's name within its pages. The explanation of the wonder is, of course, that the elaboration peculiar to the modern theory is relatively so important that the mere assumption of a fluid at all, once taken for granted, is not worth mentioning.

The main elaboration consists in assuming that electricity, like matter, is made up of discrete portions; and in speaking of "molecules of electricity," as Maxwell did (though he regarded the expression as "gross" and "provisional"), or otherwise in speaking of "electrons." The idea of "molecules of electricity," based originally on the facts of electrolysis, is needed so greatly to explain the phenomena discovered in the last decade in connection with the discharge through gases and radio-activity that no one questions that it is rightly introduced.

The present book might be called "The Science of the Electron." It is not written for the expert. "It was begun with the idea of providing a text-book from which students, well-grounded in the elementary branches of physics, might obtain some knowledge of the later developments"; and although this scheme has been departed from in some respects, the above quotation from the preface represents fairly well the general scope of the book. There is no doubt that a volume with this aim was greatly needed, and we do not hesitate to assert that Mr. Campbell has produced one of the most interesting, the most connected, and most comprehensive of all the recent books on the subject. On questions so speculative as those with which our author treats there are bound to be differences of opinion; and it will be most useful to direct attention to some of these. We will ask Mr. Campbell, therefore, to be content with the above assurance of our appreciation of his efforts, and will proceed to a few critical remarks.

The subject and the methods are so speculative that we are throughout on the fringe of knowledge, and often we pass over to the other side. There is, perhaps, scarcely a sustained argument in the volume which will not ultimately be subjected to considerable modification. It is this daring nature of the speculation which is one of the charms (though a somewhat dangerous charm) of modern physical writings. The idea of the electron has, indeed, been found so fruitful that everyone is employing it for all it is worth. We doubt if there was ever a time in the history of physical science in which so much unproved hypothesis was employed. The very success which attends its employment is the tempter which leads one beyond justifiable bounds. Take, for example, the idea that because the inertia of an electron is explicable in terms of the electromagnetic field which surrounds it, therefore all inertia is explicable in the same way. This idea takes concrete form in the supposition that all atoms are built up of electrons. The author of this idea no longer worships his creation (the present writer never bowed his knee to it); but Mr. Campbell is still attracted by it. The result is that while, according to Drude, and in recent years J. J. Thomson, the number of electrons in an atom is quite small (comparable, for example, with the atomic weight or the valency), to Mr. Campbell the number in a radio-active material, and probably in others, is at least as great as 400,000.

In making this estimate Mr. Campbell assumes that it is unlikely that the energy of each electron in an atom is greater than $4{\cdot}2\times10^{-11}$ ergs, this value being the energy which he calculates as necessary to liberate an electron from the atom. But we must point out that electrons are propelled from radium with nearly the velocity of light, and that therefore, after the work done against the attraction of the positive charge, each possesses energy nearly equal to $\frac{1}{2}\times6{\cdot}1\times10^{-28}\times9\times10^{20}$ ergs, or, roughly, 3×10^{-7} ergs. Preserving his other datum unchanged, this gives a minimum number of (say) 60 electrons to an atom of radium. But the other datum is the energy liberated by a radium atom measured by its heating effect; this energy is supposed to be distributed amongst the electrons in the atom. Yet Rutherford has shown that something like 98 per cent. of the heating effect is due to the alpha particles. Until we know something more definite about the alpha particles no calculation on the author's lines can have any weight. Needless to say, we do not claim any greater validity for the estimate we have made above.

Our author regards the explosion theory of photo-electric action as unnecessary, and gives the alternative theory depending upon the accumulation of the effects of forced oscillations.

"The electron continues to take up energy from the light until a velocity is reached, depending only on the nature of the atom and not on the intensity of the light, when its kinetic energy is sufficient to carry it clear of the attraction of the positive atom."

We should have thought that on this explanation the velocity of the electron, when sensibly outside the metal, would have been about zero instead of nearly that of light.

We regret the choice of electrostatic units, while thoroughly approving the adoption of a single kind instead of the mixed electrostatic and electromagnetic units which are so often met with.

Many data employed are those relating to an atom or an electron. There is doubtless gain as well as loss in making use of these instead of the corresponding data for (say) unit volume or unit mass. We think, however, that there is preponderating gain in writing all formulæ so as definitely to indicate to what extent the value accepted for the number of particles in a cubic centimetre influences the numerical result. Thus in the expression for electrical conductivity,

$$\sigma = \frac{1}{4\alpha\Gamma} e^2 lu \mathrm{N},$$

α is the gas-constant referred to an electron. Now α/e is known with more certainty than either α or e, and there is gain in writing $e\mathrm{N}$ as a product, so that the formula would be written—

$$\sigma = \frac{e\mathrm{N}}{4\Gamma\alpha/e} \cdot lu.$$

Probably the most daring speculation in this book is in connection with the problem of aberration and æther drift. Our author desires to remove the difficulties in connection with this problem by denying the existence of the æther altogether. The scientific man, in accepting the æther, "has fallen into the most glaring errors of the crudest nominalism." Our author's explanation is based upon Faraday tubes. May we suggest that these Faraday tubes seem suspiciously like an æther, but with special properties attributed to it?

In many other respects we think that the author is too dogmatic in his assertions; his exposition would gain if the overbearing tone were modified. The reader also resents the too colloquial character of some sentences, such as, "My own vote is cast, for what it is worth, for the latter." Science does not advance by the mere casting of votes, whatever they may be worth.

Although we do not find ourselves in agreement with everything in this book, it is undeniably a very invigorating study of the subject. The publishers are to be congratulated on securing it, and also on the care taken in producing it. There are exceedingly few typographical errors; as proper names are important, we mention that Spender (p. 216) should be Spencer.

OCEANIC TIDES.

Scientific Papers. By Sir George Howard Darwin, K.C.B., F.R.S Vol. i., Oceanic Tides and Lunar Disturbance of Gravity. Pp. xv+463. (Cambridge: University Press, 1907.) Price 15*s.* net.

THE syndics of the Cambridge University Press are bringing out in four volumes the collected papers of Sir George Darwin. The first volume is before us, and contains a list of about sixty papers written between 1875 and 1906, that will be distributed over the four volumes.

Sir George Darwin's papers being easily separated into well-defined groups, the collected papers will not be in chronological order, but will be classified according to subject as follows:—Vol. i., Oceanic Tides and Lunar Disturbance of Gravity; vol. ii., Tidal Friction with Astronomical Speculations; vol. iii., Figures of Equilibrium of Rotating Liquid; vol. iv., Periodic Orbits.

The height of the tide at any point at a variable time t must be expressible as the sum of a number of periodic sine or cosine terms, the arguments moving uniformly with the time, and the coefficients being constant. The periods are mostly forced periods, and there is little difficulty in pointing out what they are. In addition there are the free periods. "A dynamical problem of this character," writes Sir George Darwin (p. 350), cannot be regarded as fully solved unless we are able not only to discuss the "forced" oscillations of the system, but also the "free." Hence we regard Mr. Hough's work as the most important contribution to the dynamical theory of the tides since the time of Laplace."

The coefficients of the forced oscillations are indicated by theory to some extent. We have first an equilibrium theory, and then a dynamical theory. ("The problem of the tidal oscillation of the sea is essentially dynamical," p. 349.) By laborious quadratures the effects of continents may be roughly taken into account. Finally we are driven back upon the empirical determination of coefficients from observation. This is dealt with in the sixth paper of the present volume. The work is theoretically easy, but most laborious in practice.

In the ninth paper the author concludes from tides of long period that the rigidity of the earth is about that of steel.

Tide prediction follows naturally, when the coefficients of the various superimposed tides have been obtained. An ingenious machine at the National Physical Laboratory, near Teddington, traces the combined effect of twenty-four different tides upon a chart. In two hours the curve that represents the tides of one year can be traced. It afterwards takes a computer a few days to measure the times of high and low water. The machine is used for forty different ports, and, it may be remarked, is therefore not overworked, as its services are required for eighty hours each year.

On p. 5 there is a schedule of notation of the principal tides, with the speed attached. The speeds are combinations of simple multiples, positive and negative, of the earth's rotation, and the mean motions of the sun, moon, and lunar perigee. The speeds are given numerically on pp. 20, 21, &c. On p. 139 we find tables of coefficients for Port Blair, which quickly and clearly indicate the relative importance of the various tides. On p. 116 we note that an attempt to detect the nineteen-yearly tide failed.

"The actual change of sea-level between 1870 and 1873 [at Karachi] was nearly 0·25 feet, and this is just about nine times the range of the nineteen-yearly

tide. It is thus obvious that this tide must be entirely masked by changes of sea-level arising from meteorological causes."

We cannot help thinking that the methods of harmonic analysis described on pp. 157–258 are a little unnecessarily cumbrous. One simplification we should like to suggest. Given the height of the tide at intervals of one solar hour, an approximate period exactly commensurable with a solar hour might always be taken for the tide under analysis. The difference between the true period and the assumed period will then appear as a progressive change of epoch in the successive periods of analysis; meanwhile the assumed period, involving exact repetition after an integral number of hours, immensely facilitates the harmonic analysis, as the present writer has found in an allied subject.

The second part of the volume deals with the lunar disturbance of gravity, and closes with a prediction :—

"I venture to predict that at some future time practical astronomers will no longer be content to eliminate variations of level merely by taking means of results, but will regard corrections derived from a special instrument as necessary to each astronomical observation."

GARDEN BOOKS.

(1) *Roses: Their History, Development and Cultivation.* By Rev. J. H. Pemberton. Pp. xxiv+336. (London: Longmans, Green and Co., 1908.) Price 10*s.* 6*d.* net.

(2) *Sir William Temple upon Gardens of Epicurus, with other Seventeenth-Century Garden Essays.* Pp. lxxii+272. (London: Chatto and Windus, 1908.) Price 1*s.* 6*d.* net.

(1) THE English literature of the rose ranks higher, and is more abundant, than that of any other florist's flower. By general consent the most popular book on the subject was the late Dean Hole's work, entitled "A Book about Roses," which is read with interest even now for the personal reminiscences it contains. "The Rose Garden," by the late William Paul, is a standard work with invaluable illustrations, and "The Book of the Rose," by the Rev. Foster Melliar, of which a new edition was published shortly before the author's death, is an eloquent expression of the views and ideas of an enthusiast in respect to the qualities of the exhibition rose, and the methods of cultivation by which the plants may be induced to produce the most perfect flowers.

There are many other published works, some newer, others older, than those mentioned, yet such is the interest in the queen of flowers that rose cultivators will gladly welcome the latest contribution by the Rev. J. H. Pemberton.

Rose-growers visit the exhibitions of the National Rose and other societies, and they are induced to emulate the efforts of the best exhibitors. But if ordinary rose-culture is simple enough to those who are willing to give their time and care to the subject, it is nevertheless true that the production of perfect blooms such as are capable of winning prizes at an important competitive exhibition is attended with all sorts of difficulties. The less experienced growers, therefore, are willing to learn from those who have already achieved success, and certainly no amateur has been more consistently successful over a long period of years than the author of the book under notice.

Mr. Pemberton tells us that his father was an ardent rose-grower, and Mr. Pemberton himself commenced to cultivate roses at the earliest opportunity, being tempted a short time afterwards to enter upon the more adventurous and exciting business of exhibiting his blooms at the competitive exhibitions.

The first portion of the book is devoted to explaining the botanical classification of roses, and to describing some of the more important of the wild species. Some of these are natives of Britain, but the larger number are exotic or foreign.

The author's request in the first chapter that readers will bear in mind that the rose is not an exotic loses much of its point when we remember that the Hybrid Perpetuals, Teas and Hybrid Teas have been obtained entirely from exotic species! These earlier chapters may be recommended to the study of hybridists, for they show clearly that very few species have yet been subjected to cross-breeding, and therefore there are good reasons for the belief that although the present variation in roses is very wide, even greater variation may be expected, and novelties that may establish types altogether distinct from those at present in cultivation.

The author has done well to exhort amateur cultivators to attempt the work of cross-breeding roses for themselves, and notwithstanding that the description given of the processes of fertilisation and fructification is not of scientific exactness, the chapter on raising seedlings will be likely to effect good.

In the second part of the volume Mr. Pemberton talks straight to the cultivator upon the details of cultivation, carefully and thoroughly explaining the systems of vegetative reproduction, such as budding, grafting, layering, and rooting of cuttings; the tilling and manuring of the soil, planting and pruning. In these pages the author's intimate and practical knowledge of his subject is plainly revealed, and the directions are given so lucidly and yet so tersely that to misunderstand them would appear impossible.

As the winner of hundreds of friendly battles Mr. Pemberton is able to afford most valuable hints and directions upon the subject of competitive exhibitions, and whilst his enthusiasm for these will be likely to beget also in his readers a desire to engage in the "Wars of the Roses," his helpful counsel will encourage them to do so with every prospect of obtaining some measure of success.

We are glad that in this book, written as it is by such an enthusiastic exhibitor, the case for the decorative value of roses in the garden is stated so fairly and sympathetically. Not all rose-growers wish to exhibit, but those who do not, equally with those who

do, desire to cultivate the best varieties of roses in the best manner, and the decorative gardener will find much in this book that will specially appeal to him.

The illustrations of rose species are reproductions from authentic works on the subject, and in addition to these there are useful designs which illustrate the practical details of budding, pruning, and other operations. We heartily commend this work to the notice of all who aspire to excel in the art of rose-culture.

(2) This volume is a contribution to the "King's Classics" under the general editorship of Prof. I. Gollancz. The first portion, consisting of forty-nine pages, is devoted to an introduction by Mr. Albert Sieveking, who states that the book contains in whole or abstract the Garden Essays of Sir William Temple, Abraham Cowley, Sir Thomas Browne, Andrew Marvell, and John Evelyn, who "in their lives cover the whole of the seventeenth century, and in their writing represent not only some of the best of garden, but of English literature." The introduction is a learned *critique* of the five writers mentioned, and the views contained therein are likely to commend themselves to the reader, for they are well founded, being evidently based on a conscientious study of each. Incidentally Mr. Sieveking gives considerable information upon the history of gardening in Britain, and we commend the reader to study the introduction before reading the selected contributions from the seventeenth-century writers. Of these we regard the prose of Temple as representing a style of literature that is at once pleasing and enlightening. His essay indicates such an appreciation of the art of gardening and intimate knowledge of the best gardens of his day as are certain to appeal to the practical horticulturist.

Notwithstanding our own advanced methods, we are impressed with the insight into cultural problems Temple displays, although some of his opinions were based upon inaccurate premises. His reasons for recommending contemporary gentlemen to possess gardens for themselves are unanswerable, but the lofty air in which they were advanced invests them with a certain amount of humour.

The selection from Cowley includes a letter addressed to Evelyn, and some entertaining verses appreciative of the garden. The extracts from Browne's "Garden of Cyrus" and "Plants Mentioned in Scripture" give the reader some idea of the style of the writer, but they are unsatisfying, and it may be regretted the editor was compelled to curtail them so severely. His observations on grafting prove that numerous experiments were made in this art at that early date. Marvell's verses show an inclination to criticise gardeners for straining after the unnatural and attempting the mixing of plants by purposeful cross-breeding.

Passing to Evelyn's letters to Dr. Browne and others, these are all interesting and informative, whilst the abstracts from his famous "Diary" are not only interesting, but they go to show Evelyn's great knowledge of gardening subjects, and his unusual powers of observation.

GERMAN SCIENCE MANUALS.

(1) *Bakterien, und ihre Bedeutung im praktischen Leben.* By Dr. H. Miehe. Pp. iv+141. (Leipzig: Quelle and Meyer, 1907.)

(2) *Lebensfragen; die Vorgänge des Stoffwechsels.* By Dr. F. B. Ahrens. Pp. vi+153. (Leipzig: Quelle and Meyer, 1907.)

(1) THIS is an excellent little book. In it Dr. Miehe expounds the story of the microorganisms so clearly that an ordinary, intelligent reader will easily and pleasantly acquire, so far as mere reading can supply it, a trustworthy knowledge of all the fundamental facts and theories of bacteriology. The author takes us from the *De re rustica* of M. Terentius Varro—who seems to have been in the matter of microbes much what Democritus was in respect to atoms—to the "denkwürdigen Brief" of van Leeuwenhoek to the Royal Society in 1683, wherein the famous observer expresses his naïve astonishment at certain frolicsome "animalcula" he had discovered in the human mouth; and our guide does not leave us until we have seen at least the outstanding features of the work of Jenner, Lister, Pasteur, Koch, Eberth, Winogradsky, and the many others whose labours have, each in its degree, helped to illuminate the dim but fascinating pathways which lead into the realms of the infinitely little. He shows us the microorganisms as helpers and as enemies, their modes of increase, and the methods of their destruction; their distribution on land and sea; and the problems of philosophy and of practical life to which the study of these "little fleas" leads.

The book strikes just the happy mean required in a work of this kind. It avoids the trivialities which often embellish expositions of "popular" science. It states the problems clearly, and discusses them soberly, yet withal is no dull and ponderous disquisition; in style it is rather Gallic than Teutonic.

There is a glossary of such terms as are unusual and not sufficiently explained in the text. Given on the part of the reader a very small modicum of scientific knowledge, no mystery of the microorganism dealt with in the book need remain a mystery for lack of simple and lucid exposition.

(2) The "Lebensfragen" contains a number of articles explaining the principles of nutrition and the origin and method of preparation of the chief foodstuffs. To persons who feel more than a passing curiosity about the production of sugar, butter, beer, wine, tea, and so forth, or about the chemical composition of these substances, the descriptions so far as they go may be recommended as trustworthy. But they do not go far enough for the technical reader, and are not intended for him. In each case a sketch of the source, manufacture, and chief chemical characters of the article is given, together with any salient facts of general or historical interest connected therewith. In the chapter on sugar, there is, for example, a description of how the beet-sugar industry was fostered in France by Napoleon. There are also chapters on enzyme action and on the production and application of artificial fertilisers.

The book is written for the general reader who wishes to know, without too much detail, something substantial about the chief things which go to nourish his kind—"the oil to make him a cheerful countenance, and bread to strengthen man's heart." To the English reader, however, there is hardly sufficient novelty, either in the substance of the essays or in their form, to make it worth his while to peruse the book, unless he wishes to give his German an airing.

C. SIMMONDS.

OUR BOOK SHELF.

Studies in Blood Pressure: Physiological and Clinical. Second edition, enlarged. By Dr. George Oliver. Pp. xii+255. (London: H. K. Lewis, 1908.) Price 4*s.* net.

IN this second edition Dr. Oliver has carried the subject of clinical pulse gauging a distinct step forward. Not only has he greatly improved his compressed-air manometer, but he has made further clinical observations on blood pressure, and he presents the subject in a series of generalisations which cannot fail to be of practical value. The alterations he has effected in his instrument concern each of the three portions constituting it—the glass tube, the armlet, and the apparatus for regulating the air pressure in the tube. This latter is now closed at the distal end, thereby doing away with the necessity for a tap, and effectually avoiding leakage. The armlet no longer consists of a gutta-percha bag which completely encircles the limb, but of a canvas bag, constructed to encircle the limb partially, and provided with three straps; this is a great improvement on the older contrivance, admitting, as it does, of ready adjustment to the limb. Finally, instead of regulating the air pressure by a ball-pump, which causes the index to move along the tube in a series of bounds, Dr. Oliver now employs a compressor fashioned concertina-wise, the size of the chamber being controlled by means of a screw passing between the two boards constituting respectively the top and the bottom, an arrangement which enables the air pressure to be regulated with great evenness and nicety.

Dr. Russell recently directed attention to the fact that a thickened, sclerosed artery may vitiate the findings obtained with the armlet method. In this Dr. Oliver agrees. He finds that the readings he obtains with the armlet method may be higher than those yielded by his earlier spring instrument (hæmodynamometer). In the slighter degrees of arterial sclerosis the difference in the readings obtained by the two methods is small—from 10 to 20 mm. Hg.—but in advanced sclerosis this difference may be much greater, reaching to 40, 50, 70, and even 100 mm. Hg. But, as the author points out, this very difference may be of advantage, affording, as it does, a means of estimating the degree of arterial sclerosis present. He has, moreover, shown that in old people very high armlet readings may be observed in conjunction with low hæmodynamometric readings, without any evidence of cardiac strain—the actual blood-pressure, *i.e.*, being low, though a high degree of sclerosis is present. Only when the arterial wall is normal are the readings furnished by the two methods identical.

One of the most interesting parts of the book is that which deals with the causes of excessive arterial blood pressure. The condition is attributed essentially to constriction of the arterioles as the result of chemical irritation, and the sources of the chemical agents capable of bringing this about are discussed. Dr. Oliver is to be congratulated on the production of these valuable studies.

Dairy Laboratory Guide. By Prof. C. W. Melick. Pp. v+129; illustrated. (London: Archibald Constable and Co., Ltd., 1907.) Price 5*s.* net.

IN some parts of Great Britain, and in most parts of Ireland, dairying is being gradually transferred from the farm to the factory, and an increasing demand for properly trained managers has to be met. Not only must such managers be experienced in the practical operations of butter- and cheese-making, but they must also be able to manipulate the machinery providing power to the dairy, be able to carry out the chemical analysis of milk and cream, possess a knowledge of dairy bacteriology, and be business men. At three of the dairy schools in Great Britain the equipment should be sufficient for providing the course of training required, but no courses specially intended for dairy managers seem yet to be given.

In the State agricultural colleges in the dairying parts of North America, short courses of training for dairy managers are regularly given, and it is for such courses that Prof. Melick has prepared this series of exercises. The book should be useful on this side of the Atlantic by indicating the general lines on which courses can be arranged. In detail, however, the exercises are not entirely suitable for use in this country. The use of the hand churn and butter worker is nowhere referred to, but, though skill in making butter by hand is unnecessary to the creamery manager, the process provides a training which cannot be obtained by more mechanical methods. The three exercises given in hard and soft cheese-making are totally insufficient, and if the plea is offered that there is no time for more, it would surely be better to omit the making of "dried milk cocktail," "buttermilk pop," and a dozen other dietetic delicacies and nostrums which are given as exercises to the students. Again, the economics of dairying should be dealt with far more thoroughly, and the bacteriological exercises should be extended beyond the bacteriology of impurities in milk to the bacteriology of the ripening of cheese and cream.

Nor on literary grounds can the book be recommended in this country as a students' text-book. Partly owing to numerous "printer's" errors, partly to clumsy phraseology, and partly to the use of American technicalities, the meanings of which are unknown to us, portions of the book become almost unintelligible. For example, the student is directed to "make nutrose by boiling together in any alkaline solution dried casein and caustic acid," and again to "make eulactol by dissolving proteic vegetable substance and adding hydrates of carbon, salts, such as phosphate of calcium, cooking salt, or carbonate of sodium, and allow to vaporize" (pp. 107–8). On the other hand, Gray's method for the determination of moisture in butter is admirably described.

Discoveries in Hebrew, Gaelic, Gothic, Anglo-Saxon, Latin, Basque, and other Caucasic Languages, showing Fundamental Kinship of the Aryan Tongues and of Basque with the Semitic Tongues. By Dr. A. E. Drake. (Denver: The Herrick Book and Stationery Company; London: Kegan Paul, Trench, Trübner and Co., Ltd., 1907.) Price 25*s.* net.

JUST as in the sphere of the natural sciences men from time to time arise who believe that they have discovered perpetual motion, or that the circle can be squared, or that one can demonstrate that the earth is flat, so, too, in comparative philology writers are

still occasionally found who, in defiance of all the rigidly scientific investigations of Brugmann, Osthoff, Henry, Sweet, Murray, and other philologists, persist, by disregarding phonetic and other ascertained linguistic principles, in connecting together utterly dissimilar tongues, such as the Indo-European languages, Hebrew, and Basque. The author of the above-named work is a writer of this type. His work bristles with philological impossibilities, and he appears to have no conception of the necessity of ascertaining, before comparison of one language with another, the laws which govern the sound changes of the languages compared and of the immediate groups to which they belong. The Hebrew word Satan he thinks is cognate with the Basque Tusuria "by transposition," and the work abounds in similar equations. The volume is unworthy of serious attention, and its only interest arises from its being one of those strange works that spring from the union of a certain kind of learned industry with misdirected ingenuity.

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.*]

Fellowship of the Royal Society.

IT is well known that under existing regulations the number of new fellows elected to the Royal Society every year is only fifteen. In this way the total number of fellows is kept at about 450. In the early days when this arrangement was made the limited annual number was doubtless sufficient to ensure the election of all the scientific men who really merited the honour, but since those days the scientific world has been growing larger and larger, and at the same time the general standard of work in all branches has become higher.

So long as the annual number of candidates was not more than forty or forty-five the selection of fifteen was not very difficult, and no man who had really done good work had to wait more than two or three years before election. Now, however, the annual number of candidates has increased to eighty or ninety, and this year it is said there were nearly 100 candidates.

Is it not high time, then, that the Royal Society took definite steps to make some change which would meet the requirements of the changed circumstances? Many of the older members of the society are well aware that the present state of affairs is unsatisfactory, and some have expressed their sentiments, but nothing has yet been done.

A simple plan would, of course, be to elect thirty new fellows every year instead of fifteen, but one can see objections to this plan. Has it ever been suggested that the Society should create an associateship and elect associates as well as fellows? The number of fellows might remain as it is, but if a limited body of associates was created, say fifty to begin with, and was increased by the election of twelve or fifteen every year, the pressure would be relieved, and I should think A.R.S. would be preferable to a long-deferred F.R.S. Subsequent elections of fellows could then be made from the associates, and this double election would give better assurance than now exists that none but the best men of the year were admitted to the fellowship.

ENQUIRER.

Earthquakes and Earthshakes.

SOME of the memoirs, professedly seismological, which have appeared during the last year or two indicate that confusion has arisen from the use of the word earthquake in two distinct and independent senses. As this confusion seems likely to increase unless a modification of our nomenclature is adopted, the introduction of a new term appears to be requisite, however much this may be deprecated on other grounds.

In the generality of cases, the phenomenon represented by the word earthquake consists of a vibratory motion of the ground, of the nature of a wave motion, propagated outwards from a more or less extensive origin or focus. In some cases this disturbance may lead to damage or destruction of buildings, or even to displacement of the surface layers of the earth; but these are secondary results of the molecular displacements involved in the propagation of the wave motion, and, apart from them, the earth, after the earthquake has passed, resumes the same position and condition as before.

Occasionally, however, the word is applied to a disturbance of a wholly different kind, resulting in the formation of fractures and displacements of the solid rock, displacements which are molar and permanent, in the sense that the masses affected by them do not return to their original position after the earthquake has passed.

As the first was the sense in which the word is invariably used in Robert Mallet's classical researches, as it is that which has been sanctioned by long-continued usage, and as the proportion of records and observations, which do not apply to this phenomenon, is probably less than one in a thousand, I suggest that the word *earthquake* should continue to be used in this sense, and that for the other sense, in which it is sometimes used, the word *earthshake* should be substituted. Using the words in this way, we may say that earthquakes, or at any rate severe earthquakes, are frequently, if not invariably, caused by rupture of the earth's crust and the formation of fractures or faults in the solid rock, but these fractures, which are the primary cause of the earthquake, are only the secondary result of the earthshake, the action of which arises at a greater depth, and the ultimate cause of which lies beyond our present ken. The distinction is an important one, and the importance may be greater than will be acknowledged immediately, for some recent studies made by me have indicated a possibility that the earthshake has sometimes a greater extent than the earthquake; in other words, that the area over which permanent displacements of the earth's surface have taken place may be greater than the seismic area, or the area over which the shock was felt.

Incidentally, it may be mentioned that the whole of Prof. See's recent publications on the cause of earthquakes, and the greater part of those by Prof. Hobbs, deal with earthshakes and not with earthquakes as here defined. This is natural, for only the permanent changes, resulting from the earthshake, are of importance to the cosmogonist or the geologist; the transient displacements produced by the earthquake concern them, directly, but little, if at all.

R. D. OLDHAM.

Classification and Mathematics.

IF mathematics is to be regarded as the science of classification, a view apparently taken in many recent works, it may be worth while to consider whether mathematical teaching should not begin with the use of models of classifications in general rather than with the special classifications in connection with which terms like straight line, rotation, product, power, &c., were originally introduced.

By a model of a classification is meant, for example, a set of things which can be classified by one respect as colour, and cross-classified by another as shape. Similarly, models can be made having three or four or more differentiations, in which any two differentiations have the relation of classification and cross-classification. If each differentiation is supposed to be ordered, we have then spaces of two, three, or four dimensions, of which the classified things form the points. By motion of a point in the space is meant its change in those properties which have been used in the classification. Consideration of the meaning of extension, rotation, and right angle shows the possibility of using the motion of extended bodies to construct a classification of the points of a space, even when we are unable to recognise the differentiations themselves of the space. This is the case met with in ordinary geometry.

As the foundation of geometry lies in the idea of ordered classification, so that of algebra lies in the conception of

correspondence between things. A function or one-to-one correspondence is a classification and cross-classification of the things which correspond. For example, a division of a number of models having different markings into two classes by colour and a cross-classification by shape gives a correspondence of the markings in one colour class to the markings in the other. If each marking in one class corresponds to the same marking in the other, we have the correspondence one. Similarly, various circular functions may be illustrated by models, beginning with transpositions. If things which correspond are called operands, and a correspondence of operands a function, then names seem to be needed to mean a correspondence of functions, and for the still higher correspondences which occur. In the usual school course we practically begin with the correspondences of functions, namely, of the numbers one, two, three, &c. It would seem more natural to begin with the correspondence, first, of operands to operands, and then of operands to functions, and define words as power, product, sum in reference to correspondences of operands illustrated by models. For example, a set of things the correspondence of which to another set is under discussion may be called a quantity. Two quantities which correspond to the same quantity correspond to each other; and their correspondence to each other is the product of the correspondence of one to the intermediate quantity and of the intermediate quantity to the other. In the case of vectors, since a vector is a correspondence of points, this would require the term product to be given to what is generally called the sum.

The properties of permutation, association, distribution should be considered in reference to tables of operands before considering tables of functions such as multiplication and addition tables. Space will not allow of discussing the illustration of addition, rule of signs, two-to-two correspondence, &c. The study of irrational numbers and continuous spaces should be postponed to a later stage.

Oundle. C. ELLIOTT.

An Emanation from Sodium.

DURING the course of some experiments upon the contact potential difference between the alkali metals and glass I noticed that a freshly cut piece of sodium rapidly discharged an electroscope.

Further examination showed that this action occurred only if the gold leaf was charged negatively. Little or no effect was produced if it was positively electrified. The action could be completely stopped by a membrane of celluloid sufficiently thin to give interference colours, and this fact alone points strongly to the discharging action being due to a vapour.

It was found, in fact, that a slight current of air directed so as to carry the supposed gas away from the charged plate of the electroscope enabled the leaf to retain its charge.

The effect is, however, unlike that met with in the case of phosphorus, since the vapour from that substance discharges both positive and negative electricity equally well. It does not, therefore, appear due to the air becoming ionised by a change occurring at the surface of the sodium, but more probably to the emission of an electrified gas. Experiment has shown that the rapid oxidation of the surface has little or nothing to do with the existence of the emanation, and it is very significant that all action ceases after prolonged heating (to melting point) of the metal. After some hours, however, the sodium shows signs of recovering its power to discharge a negatively electrified body.

Since all portions of the same block of sodium do not exhibit the action to the same extent, I am attempting to concentrate those parts which show it most strongly in order to determine whether some new radio-active body is present in the metal or whether there is a radio-active change occurring in the sodium itself.

A slight indication that the emanation is capable of depositing a radio-active layer of matter has been also noticed. The other alkali metals are now being examined and the whole matter fully investigated.

CHARLES E. S. PHILLIPS.

Castle House, Shooters Hill, Kent.

WIND PRESSURE.

THE importance of a correct knowledge of the pressure exerted by the wind, as affecting the stability of modern structures, was brought prominently before the public by the disaster to the Tay Bridge on the night of December 28, 1879. At that time observatories at which wind pressure was directly measured were rare, the usual observed characteristic of the wind being its velocity as given by the Robinson cup anemometer.

At some stations both the Robinson cup anemometer and the Osler recording pressure plate were installed, and it was for this reason that in the report of the Royal Commission which was appointed in 1881 to consider the question, an attempt was made to state the relation between the probable maximum pressure which would be recorded in a gale and the maximum hourly run of the Robinson cups during that period. Also from records of pressure plates which were considered by the Commission to be not due to instrumental error depending upon momentum, but which represented real phenomena, it was decided that, for structures in exposed situations in this country, a maximum wind pressure of 56 lb. per square foot of surface should be allowed for in the design.

It was, however, felt by engineers at the time that this value, assumed uniform over the whole surface of a large structure, was very excessive, for, as the late Sir Benjamin Baker remarked at a discussion on wind pressure at the Institution of Civil Engineers soon after the report of the Commission was published, if such pressure actually obtained there ought not to be a bridge standing in the country. It was on this occasion that Sir Benjamin Baker stated his conclusions as to the nature of the motion of the wind and the pressures resulting from it, which theory was based, not on elaborate experiments, but on close observation of the behaviour of natural objects in the wind. In his words,

"If leaves and other light objects floating in an apparently steady current were watched it would be found that certain leaves would shoot forward at an increased velocity of 25 per cent. and upwards as compared with the mean velocity. Over a width of 20 feet at the centre of a wide and steady current the mean velocity might thus be constant, whilst over some particular width of 1 foot it might be momentarily fully 25 per cent. higher, and in the case of wind pressure 25 per cent. increase of velocity meant more than 50 per cent. increase of pressure. It was quite possible, therefore, that the large pressure boards might register a notably less pressure than the small boards, and might afford a clue to the reason why railway carriages were not upset when traversing lofty and exposed viaducts."

This appears to have been the first recognition of what may be called the variable structure of the wind as a factor of safety in the stability of structures, and it may be mentioned that the variation predicted by Sir Benjamin Baker was found to exist at points distant 11 feet apart in the experiments of Mr. Dines in 1894.

To test the truth of his conclusions Sir Benjamin Baker erected some wind-pressure plates on the site of the Forth Bridge, each provided with an arrangement for measuring the maximum pressures experienced. One of these gauges was 300 square feet in area, and the others 1½ square feet. Taking the mean of the maximum daily readings for two years, the small-gauge indications were found to be 50 per cent. greater than the large-gauge indications, which was the result anticipated.

In experiments of this kind it is interesting to notice that there is one particular case in which with the

assumed structure of the wind the small plate might register a pressure lower than the large one. This is the somewhat rare event when in a gale there is one gust of considerably greater intensity than those which precede or follow it. If during this gust the small plate occupied a region of low velocity, its registered maximum pressure would be lower than that of the large plate. This appears to have happened in one of the gales at the Forth Bridge during the experiments, but its rarity supports the evidence of anemometers, which show that the average gale consists of a series of gusts of nearly equal intensity, so that the probability of the maximum velocity occurring in the region of the small plate is very great. It is important to realise that the above conclusions are in no respect applicable to the pressures which may obtain at any given instant on two plates during a gale, as a little consideration will show that the probability of the small plate occupying the region of lowest velocity at any instant is the same as that of its occupying the region of highest velocity, from which the conclusion follows that the small plate will also register the lowest pressure during the gale.

In the foregoing statements the difference in resistance of large and small surfaces in the wind has been treated as depending entirely on the structure of the wind, that is, it has been assumed that if the wind were a perfectly uniform current in which the velocity over any considerable area was the same, the pressures on the two surfaces would be identical.

This, of course, is not necessarily the case, as there may exist a purely dimensional effect in the resistance of appreciable magnitude, and in the opinion of some authorities the explanation of the Forth Bridge experiments was to be found in this, and not in the structure of the wind.

For this reason, when the wind-pressure experiments were commenced at the National Physical Laboratory in 1904, the determination of the existence or non-existence of this dimensional effect was made the chief feature of the research. These experiments were made on plates and models ranging up to 100 square feet in area, erected on the top of an observation tower 50 feet above the ground, which had a fairly clear space in front of it. After some preliminary work, the method which was finally adopted consisted in the determination of the constant k in what may be called the "equivalent" pressure velocity relation

$$p = kV^2,$$

that is the relation which would exist if the velocity of the wind were uniform.

The determination of this relation when a plate is moved at a known velocity in still air is fairly easy. It becomes more difficult when a plate is suspended in a uniform current of air on account of the trouble involved in forming a correct estimate of the velocity of the current, since, owing to the conditions of flow being disturbed in the region of the plate, it is necessary to place the velocity gauges at some distance from the plate. In the case of a plate exposed to the wind, there is the added complication of the varying structure of the current, and the problem at the National Physical Laboratory was to obtain the "equivalent" pressure velocity relation from observations of the resultant pressure on a plate and the corresponding pressure in a "Dines" tube, which was used as the velocity gauge, distant 10 feet from the edge of the plate. A solution was found in the observed fact that although the pressures at any instant in two tubes facing the wind, and distant 10 feet apart, might differ by as much as 50 per cent., yet if one hundred of these sets of readings were taken at successive intervals of time, the *mean* pressures for each tube were practically identical. From this it was assumed that if a large number of observations of the resultant pressure on the plate and the (simultaneously observed) pressure in the "Dines" tube were made, the means of these experiments would give the equivalent pressure-velocity relation sought. For this purpose 200 observations of this kind were made on each plate tested, two observers operating two sensitive water gauges at the foot of the tower. One of these water gauges was connected by two lead pipes attached to the legs of the tower to the "Dines" tubes, and the other by two similar pipes to an air cylinder in which the pressure varied with the fluctuations of resultant pressure on the plate. The arrangement of the 100-square-feet plate and the "Dines" tube is shown in the photograph (Fig. 1).

The results of experiments on three plates of areas of 25, 50 and 100 square feet gave identical values of the constant k in the "equivalent" pressure-velocity

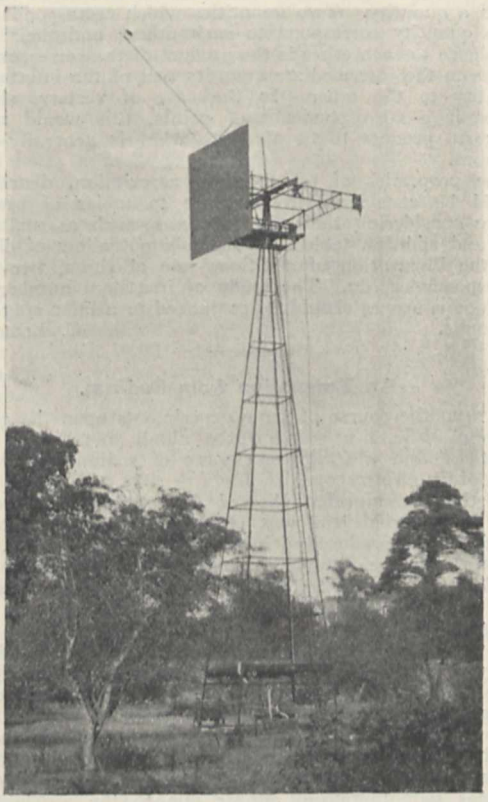


FIG. 1.—Wind Observation Tower with 100-square-feet plate in position.

relation, which in units of pounds per square foot and miles per hour was found to be 0·0032, indicating that for this range in dimensions the purely dimensional effect in the resistance was negligible. There were strong reasons, however, to suppose that it was not negligible for all ranges in dimensions, since the value of k determined at the National Physical Laboratory in 1903 for plates of 2 and 3 square inches in area in a uniform current was 0·0027, and that determined by Mr. Dines in 1890 for a plate of 1 square foot in a whirling machine was 0·0029. This view has been fully confirmed by the publication during the present year of the results of M. Eiffel's experiments on plates let fall from the second stage of the Eiffel Tower. Using square plates varying in area from 10 square feet to five-eighths of a square foot, M. Eiffel found a continuous change in the value of the

constant, ranging from 0·0032 for his largest plate to 0·00285 for his smallest plate. The plotted results of M. Eiffel's observations on square plates and those

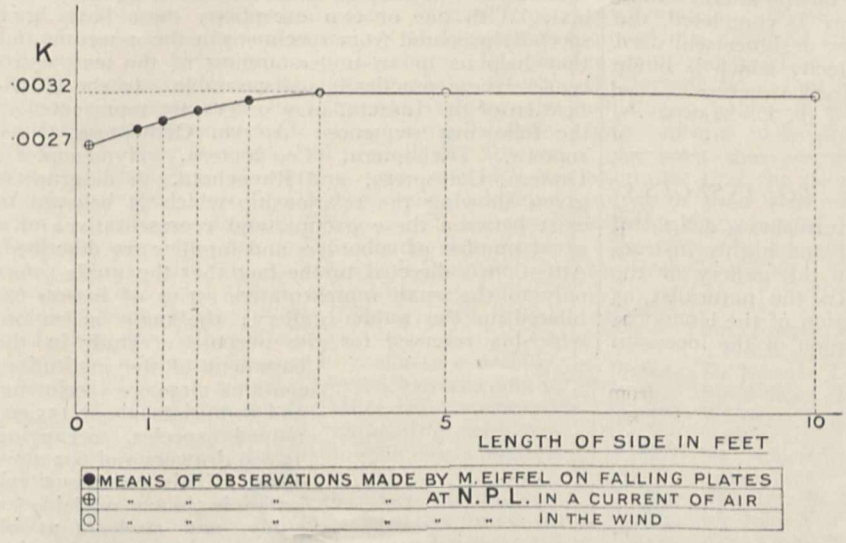


FIG. 2.—Curve showing the dimensional variation in the air-resistance of square plates.

made at the National Physical Laboratory are shown in Fig. 2. There appears, therefore, to be a purely dimensional factor in the resistance of plates, which for the case of square plates has the effect of increasing this resistance up to an area of approximately 10 square feet, when it becomes practically constant.

In the small-scale experiments made in a uniform current of air at the National Physical Laboratory, it was found that although the resistance per unit area of combinations of plates, such as lattice-work, differed considerably from that of square or circular plates, the resistances of similar combinations of plates were approximately the same. To test the possibility of predicting the resistance of a complex structure in the wind from observations on a small-scale model in a current, a model lattice girder was constructed of wood, with a span of 30 feet, and a depth of 3 feet 6 inches. This was placed on the tower (Fig. 3), and a set of observations made on it. A small-scale model of this was made in brass, the linear dimensions being reduced in the ratio of 1 to 42. The resistance of this was determined in the current. On comparing these resistances they were found to have precisely the same ratio as that of the resistances of the large square plates in the wind and the small square plates in the current, that is, the resistance of the large girder was 18 per cent. greater than that of the small one. The conclusion was that the resistance of any structure, however complicated, can be predicted with considerable accuracy from observations on a small model of it, as in the similar problem of the resistance of ships.

The important case of the resultant wind pressure on roofs is more difficult to treat experimentally, owing to the oblique impingement of the wind, which renders the position of the centre of pressure uncertain.

Until recent years it has been customary to treat the forces on a roof due to wind pressure as pressures affecting the windward side only, but from experiments on small models in a current of air, Mr. Irminger, of Copenhagen, has shown that there is a considerable suction effect on the leeward side of the roof, due to the eddies from the ridge. It does not necessarily follow from this that the resultant effect on the leeward side of a roof must be a suction, as this will depend on the pressure inside the building also.

In the National Physical Laboratory experiments a roof model was erected on the tower, having sides each of 56 square feet in area. The results of the observations of resultant pressure on the leeward side showed widely different values, according as the conditions were those of a roof supported on columns through which the wind could pass freely or on walls. In the former case it was found that the reduction of pressure inside the roof due to the eddy from the eaves of the windward side was approximately of the same magnitude as the reduction of pressure outside due to the eddy from the ridge, so that the resultant pressure on the leeward side was practically zero. When the conditions were those of a roof supported on walls, the maximum wind forces were found to exist (*a*) when the doors and windows on the windward side of the building were open and those on the leeward side closed, and (*b*) *vice versâ*. In case (*a*) the maximum wind force was on the leeward side of the roof outwards, and in case (*b*) it was on the windward side inwards. It follows, therefore, that in such a building the roof should be designed so as to be equally strong in each direction.

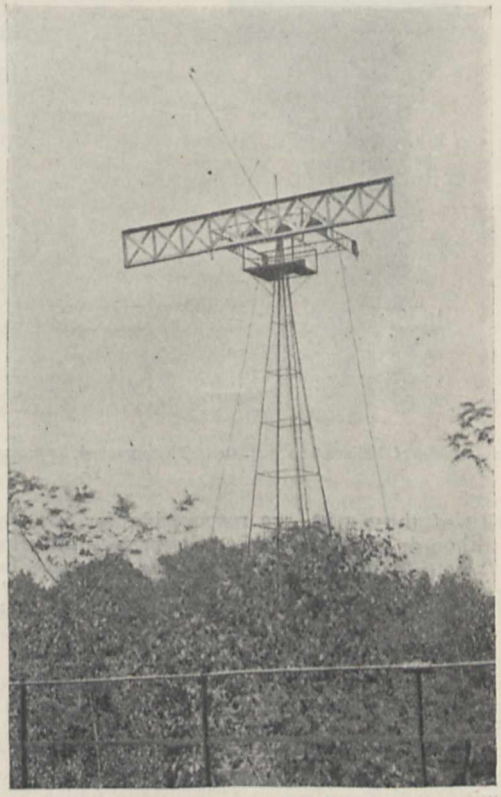


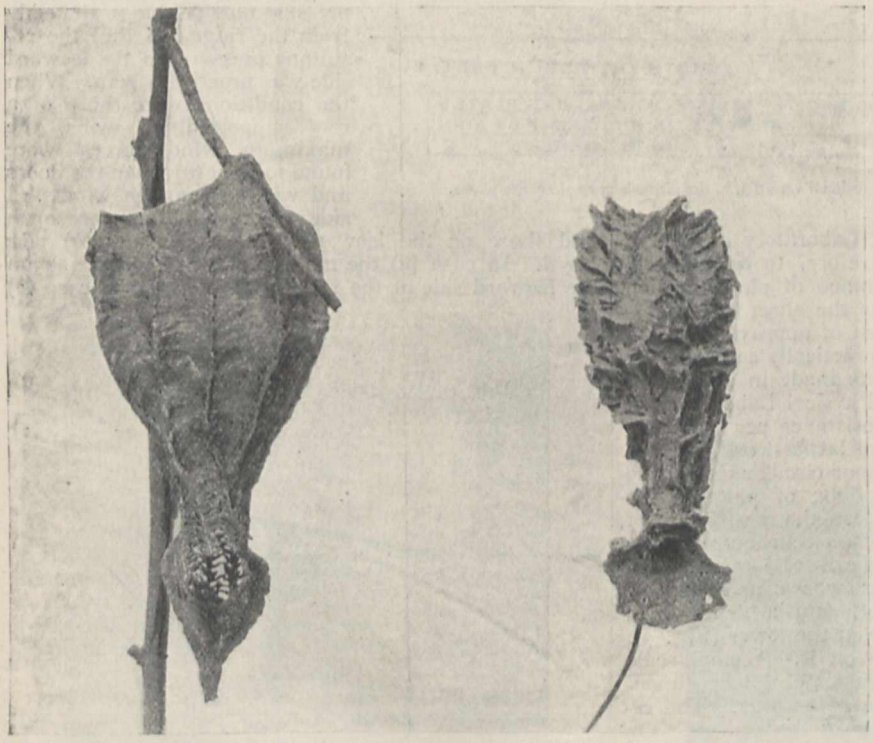
FIG. 3.—Wind Observation Tower with model girder 30 feet by 3·5 feet in position.

It will be seen from this brief sketch that although the difficult engineering problem of the distribution of the pressure of the wind on large structures is not solved, yet when the investigation on the lateral extent of gusts which is now in progress is completed, the only further information which the designer will need is that of the maximum wind velocity which is likely to obtain on the site of the proposed structure.

T. E. STANTON.

BRITISH MUSEUM GUIDE TO INSECTS.[1]

THE publication of this work furnishes a delightful companion to the charming and highly instructive series of insects exhibited in the gallery of the Museum of Natural History. To the naturalist as well as to the layman this exhibition of the bionomics of the Insecta is a living expression of the incessant activity of those who are responsible for its display, and although Mr. Charles O. Waterhouse informs us that "considerable time must necessarily elapse before the exhibited series of insects can be completed," and that the guide must be looked upon as a provisional one, yet in its present form it gives groups of properly organised facts which cannot fail to instruct and diffuse knowledge by making the study of these animals clearly interesting and accessible to the public.



Nests of species of Ischnogaster, nat. size. Photographed from specimens in the British Museum (Natural History).

A legible plan of the gallery is given, and bold reference numbers in the text will enable the visitor to find with facility any group of insects in which he may be specially interested. Where necessary models are given to illustrate the metamorphoses of various insects, and where possible species likely to be of interest from agricultural or horticultural points of view have been chosen.

The guide is embellished with a number of full-page illustrations, in addition to the numerous figures in the text. With one or two exceptions these have been specially prepared from specimens in the museum, and they help us to an understanding of the text which renders them practically indispensable. In the classification of the Insecta, nine orders are represented in the following sequence:—Aptera, Orthoptera, Neuroptera, Trichoptera, Lepidoptera, Hymenoptera, Diptera, Coleoptera, and Rhynchota. A diagram is given showing the relationship which is believed to exist between these groups, and representatives of a great number of suborders and families are described. Attention is directed to the fact that the guide refers only to the small representative series of insects exhibited in the public gallery; the main collection, which is reserved for the purpose of study in the basement of the institution, contains 1,150,000 specimens, and comprises about 155,000 named species, occupying 13,000 drawers and 602 store boxes. This enormous collection is always available for study, and students at all times receive every attention and assistance at the hands of those who are in charge of the various departments.

In revising this guide we would suggest that reference letters be given to Figs. 14 and 19; that the word *tibia* be added to the diagram in Fig. 18; and that the magnification of Figs. 40, 57, 58, 61, and 62 be indicated.

[1] "A Guide to the Exhibited Series of Insects in the Zoological Department (Insect Section), British Museum (Natural History), London." Pp. 59; with 62 illustrations. (Printed by Order of the Trustees, 1908.) Price 1s.

PROF. K. A. MÖBIUS.

PROF. KARL AUGUST MÖBIUS, for many years director of the Zoological Museum in Berlin, died on April 26 at the age of eighty-three. He was a notable naturalist, with a broad and cheerful outlook, greatly interested in the habits of creatures, and enthusiastic over their beauty. There are few zoologists who do not know "The Fauna of the Bay of Kiel" by Möbius and Meyer, the two volumes of which form a rich storehouse of observations on the bionomics of a shallow sea. Möbius was probably the first to establish a salt-water aquarium in Germany, and he helped to start the famous zoological garden at Hamburg. He had, indeed, a strong practical sense, and made many useful suggestions in connection with fisheries, oyster-culture, and the harvest of the sea in general.

Möbius was born in 1825 at Eilenburg, in the Prussian province of Saxony; he was trained as a school teacher, but his enthusiasm and ambition were roused by reading the works of Alexander von Humboldt, and he went to Berlin, with a light purse, to study natural history. By giving lessons to others he was able to afford a university training, and he sat at the feet of men like Ehrenberg and Johannes Müller. He became assistant to Lichtenstein, who helped him in 1853 to a congenial teaching post in

Hamburg, where he had time for faunistic studies. In 1868 he went to Kiel as professor of zoology, and it was there that he did what was probably his best work, which is embodied in great part in the book already referred to. He had his share of travel too, and made collections and observations of importance in Mauritius, the Seychelles, and elsewhere. In 1880 he had the pleasure of seeing the completion of the Zoological Museum and Institute at Kiel, to the organisation of which he had devoted himself wholeheartedly. In 1887 he was called to Berlin as director of the new Zoological Museum, a position which he held until the end of 1905. His first zoological paper was on "The Nests of Social Wasps." Of the many others, we may mention "Die Fauna der Kieler Bucht" (along with H. A. Meyer), "Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen," "Die Fische der Ostsee," "Die Bildung, Geltung und Bezeichnung der Artbegriffe." He was particularly interested in marine creatures, in molluscs especially, but he ranged over a wide field, from alcyonarians to fishes. It is but a few months since his "Aesthetik der Tierwelt" was published, expressing with unabated enthusiasm his delight in the sea's endless progeny.

The Festschrift to Möbius with which his students honoured him on his eightieth birthday was an eloquent testimony to his efficiency as a teacher; the list of his papers—faunistic, bionomical, practical, and theoretical—suggests a strenuous life; and his position as president of the fifth International Congress of Zoologists in Berlin in 1901 was an indication of the esteem in which he was so widely held.

THE BRITISH MEMBERS OF THE INSTITUTE OF FRANCE.

THE subjoined address was presented to Monsieur Fallières, the President of the French Republic, at St. James's Palace, on Wednesday, May 27, at 11 a.m.

In the absence of Sir Joseph Hooker, the *doyen* of the British members of the Institute, who was elected in 1866, the address was presented by Sir Norman Lockyer (elected in 1873), with the following words:—

"En l'absence du doyen des membres de l'Institut de France dans ce pays, j'ai l'honneur de vous présenter cette adresse avec le plus profond respect.

"Les sentiments de fraternité ont été maintenus depuis plusieurs siècles entre les littérateurs, les savants et les artistes de la France et de l'Angleterre.

"Nous nous réjouissons qu'à présent tout le monde va suivre notre exemple."

The President made a sympathetic reply, fully acknowledging the importance of science and culture in bringing nations together and cementing their friendship.

The members of the various academies were then presented to the President, who cordially addressed a few words to each.

To the President of the French Republic.

SIR,—On the auspicious occasion of your visit to England we, the undersigned Associates and Correspondents of the Institute of France, desire to be permitted to offer to you an expression of our sincere respect. The intellectual pursuits to which that illustrious Institute is consecrated form some of the most potent and enduring bonds that link the nations together in peace and goodwill. As representatives of these pursuits in this country we are proud of our connection with the Institute of France, which has for so long been one of the great centres of culture in the world. We rejoice that the feelings of sympathy and brotherhood which have for centuries been maintained between the cultivators of Literature, Science, and Art in France and Great Britain are now daily spreading more widely and deeply among the peoples of the two countries, and we are sure that your visit cannot but give a powerful stimulus to the progress of this peaceful and beneficent alliance. We desire to express the fervent hope that your tenure of the high office which you hold with such lustre and distinction may long continue to be prosperous.

We trust that you may be pleased to receive the assurance that the people of this country are heartily united in their sentiment of admiration and friendship for the people of France.

We have the honour to subscribe ourselves, with the deepest respect,

Your obedient servants,

1866. Sir Joseph Hooker, G.C.S.I., O.M., C.B. F.R.S. 1900, A.
1873. Sir Norman Lockyer, K.C.B., F.R.S.
1874. Sir William Huggins, K.C.B., O.M., F.R.S.
1878. Whitley Stokes, C.S.I., C.I.E., F.B.A. 1891, A.
1881. Sir Lawrence Alma-Tadema, O.M., R.A. 1891, A.
1883. The Rev. R. Flint, D.D., LL.D.
1887. Sir John Evans, K.C.B., F.R.S.
1890. The Right Hon. Lord Rayleigh, P.C., O.M., Nobel Laureate, P.R.S.
1890. Sir Hubert von Herkomer, C.V.O., R.A. 1896, A.
1890. Sir E. Maunde Thompson, K.C.B., I.S.O. P.B.A.
1891. Sir Archibald Geikie, K.C.B., F.R.S.
1891. The Right Hon. James Bryce, P.C., F.R.S., F.B.A. 1904, A.
1893. A The Right Hon. Lord Lister, P.C., O.M., F.R.S.
1903. Sir Frederick Pollock, Bart., F.B.A.
1903. Sir Henry Roscoe, F.R.S.
1894. R. W. Macbeth, R.A.
1895. Sir William Ramsay, K.C.B., Nobel Laureate, F.R.S.
1896. Sir William M. Christie, K.C.B., F.R.S.
1896. Sir David Gill, K.C.B., F.R.S.
1898. Sir Edward Poynter, Bart., P.R.A.
1899. Sir Edwin Ray Lankester, K.C.B., F.R.S.
1901. A Sir William Q. Orchardson, R.A.
1901. J. S. Sargent, R.A. 1905, A.
1902. J. E. C. Bodley.
1902. The Right Hon. Lord Reay, P.C., G.C.S.I., G.C.I.E., F.B.A. 1906, A.
1903. John H. Lorimer, R.S.A.
1903. W. G. John, A.R.A.
1903. Edward Caird, LL.D., D.C.L.
1904. Stanhope A. Forbes, A.R.A.
1905. Arthur J. Evans, F.R.S., F.B.A.
1905. Sir Francis Seymour Haden, P.R.S.P.E.
1905. Barclay Vincent Head, D.Litt., D.C.L., Ph.D.
1905. Richard Phené Spiers, F.R.I.B.A., F.S.A.
1906. Sir William Crookes, F.R.S.
1907. Sir George Darwin, K.C.B., F.R.S.
1907. The Right Hon. Lord Brassey, G.C.B.
1908. The Right Hon. A. J. Balfour, M.P., F.R.S.
1908. E. A. Abbey, R.A.

The following is a French translation of the Address:—

A son Excellence, Monsieur Fallières, Président de la République Française.

MONSIEUR LE PRÉSIDENT,—Nous saisissons avec empressement l'occasion de votre visite officielle à Londres pour vous prier, en notre qualité de Membres associés et correspondants de l'Institut de France, de vouloir bien accepter l'expression de nos plus respectueux hommages.

Les Arts et les Sciences au progrès desquels se

dévoue l'illustre Institut de France constituent des liens à la fois parmi les plus puissants et les plus durables qui unissent les nations dans le maintien de la paix et de la cordialité. Comme représentants de ces différentes branches de culture intellectuelle en Angleterre, nous sommes heureux et fiers d'être en rapports intimes avec l'Institut de France, depuis si longtemps l'un des grands foyers de lumière du monde entier.

Nous nous réjouissons à la pensée que les sentiments de sympathie et de fraternité qui se sont maintenus depuis plusieurs siècles entre les littérateurs, les savants et les artistes de la France et de la Grande Bretagne s'étendent et se fortifient journellement entre nos deux nations, et nous sommes persuadés que votre visite ne peut manquer de stimuler puissamment le progrès de cette alliance pacifique et bienfaisante.

Nous vous prions, Monsieur le Président, de vouloir bien nous permettre d'ajouter l'expression de notre ferme espoir que votre occupation du poste élevé dont vous remplissez les fonctions avec tant de lustre et de distinction continuera longtemps à être heureuse et prospère; et nous esperons qu'il vous sera agréable de recevoir l'assurance que la nation Britannique est unanime dans ses sentiments d'admiration et d'amitié pour la nation Française.

Nous avons l'honneur d'être avec le plus profond respect,

Monsieur le Président,
Vos très obéissants serviteurs.

The Address, which was beautifully illuminated, had been approved by the President and officers of the Royal Society and the President of the Royal Academy. The organisation of the deputation and the correspondence connected with it were undertaken by the British Science Guild.

NOTES.

THE local secretaries for the Dublin meeting of the British Association desire to direct the attention of officers of the association and members who intend to be present to the urgent necessity of filling up and returning forthwith the post-card sent out with the invitation circular. Many have already done so, but the work of the hospitality subcommittee, which has to be completed months beforehand, and, as everyone knows, is of a delicate and difficult nature, is now at a standstill owing to the fact that information has not been received from a large number of the chief members of the association as to whether they will be accompanied by lady members of their families or not. This information is asked for on the card referred to, which is the only source at the command of the local committee.

A STATUE of Liebig is to be erected in Darmstadt, where he was born in 1803. The corporation of Darmstadt has contributed 150*l.* towards the expenses.

THE death is announced of Dr. R. Chalmers, of the Canadian Geological Survey, at the age of seventy-four years. Dr. Chalmers, says *Science*, joined the survey about twenty-three years ago, and conducted work in Pleistocene geology, especially in his native province of New Brunswick.

AT the anniversary meeting of the Linnean Society on Monday the King of Sweden was elected an honorary member of the society. Dr. Dukinfield H. Scott, F.R.S., was elected president in succession to Prof. W. A. Herdman, F.R.S., and Dr. Otto Stapf, F.R.S., was chosen to fill the office of botanical secretary thus vacated by Dr. Scott. The gold medal of the society was presented to the Rev. T. R. R. Stebbing, F.R.S.

A REUTER message states that an International Association for Cancer Research was inaugurated in Berlin on May 23 to promote the investigation of cancer and the care of cancer patients, the collection and publication of international cancer statistics, and the establishment of an international centre of information on all matters concerning cancer research. The association proposes to publish an international technical organ, and to organise international cancer conferences. So far, thirteen States, including all the great Powers except Great Britain, have joined the association, the seat of which will be at Berlin.

THE inauguration of the International Institute of Agriculture took place in Rome on May 23 in the presence of the King of Italy, who formally opened the new building for the use of the permanent delegates. The *Times* correspondent reports that the Italian Government was represented by seven ministers and the chief State officers. Thirty foreign delegates, including Sir Thomas Eliot, representing Great Britain, attended, and were entertained at dinner by the King. The new building is the gift of the King of Italy, who also has endowed the institute with an income of 12,000*l.* a year, bringing the total annual income up to 40,000*l.* The international character of the institute is assured by the fact that it is receiving the support of every nation, and nearly all have appointed delegates. It was only in June, 1905, that the conference assembled in Rome at the invitation of the King of Italy to consider the project, and the excellent progress which has been made already augurs well for the permanent success of the institute.

THE Royal medals and other awards given annually by the Royal Geographical Society for the encouragement of geographical science and discovery were distributed at the anniversary meeting of the society on Monday. The founder's medal was presented to Lieut. Boyd Alexander, for his African explorations and careful trigonometrical survey of the region between the Benue and Lake Chad. Lieut. Boyd Alexander devoted a considerable time to the exploration of Lake Chad, and added materially to our knowledge of that constantly shifting lake. A careful study was made of the hydrography of the various river systems, the Niger, the Congo, and the Nile, through which the expedition passed. Detailed maps were made of the more unknown parts of the region, such as the Bamingi, Kibali, and the Yei rivers. Much information was gathered concerning the physical features of the region passed through; careful studies were made of several of the types of natives, and important additions were made to our knowledge of the natural history of the extensive region. The patron's medal was awarded to H.S.H. the Prince of Monaco, for his work in oceanography. Among the notable additions to scientific knowledge made on board the *Princess Alice* are:—(1) the results of using the deep-sea traps invented by the Prince, which threw a new light on the life on the floor of the deepest parts of the ocean; (2) successive seasons' exploration on the coast of Spitsbergen and in the adjacent seas; and (3) studies of the conditions of the upper air by means of meteorological kites in mid-Atlantic. Other awards were as follows:—Murchison award to Colonel Delmé-Radcliffe, for his work when as resident in the Nile province of Uganda he mapped the whole province, and for the work which he did afterwards when in charge of the English section of

the Anglo-German Boundary Commission, between Victoria Nyanza and Mount Ruwenzori. The Gill memorial to Dr. T. G. Longstaff, for his exploring work in the western Himalayas and Tibet, and especially on his last expedition in the Garhwal Himalayas, when he ascended the summit of Trisul. The Back bequest to Lieut. George Mulock, for his long-continued work, mostly during his own time, in preparing the six sheets of the Antarctic charts, showing the results of the *Discovery* expedition. The Cuthbert Peek grant to Rai Sahib Ram Singh, a native Indian surveyor, who has done excellent surveying work on the expeditions of Captain Deasy, Dr. Stein, Captain Rawling, and Major Ryder.

AT the conclusion of a description in part iv. of vol. lxxxix. of the *Zeitschrift für wissenschaftliche Zoologie* of the remarkable land-planarians of the genus Rhynchodemus, Dr. W. E. Bendl, of the University of Gratz, points out that certain curious variations in the secondary genital structures of the members of this and the allied genera appear to be correlated with geographical distribution. In one group the male copulatory organs are found to be of much simpler structure than in a second assemblage, and it appears that while the former type is in the main characteristic of the Oriental and Australasian species, the latter is dominant in the eastern Holarctic and Ethiopian forms.

WE have received a copy of an excellent little biographical pamphlet, by Prof. W. May, of Karlsruhe, entitled "Auf Darwin-Spuren," and forming part xiv. of "Gemeinverständliche Darwinistische Vorträge und Abhandlungen," published at Braekwede-i-W. by Dr. W. Breitenbach, the editor. The part before us is illustrated with portraits of Darwin's father and grandfather, and with reproductions of photographs of the Darwin statue at South Kensington, and of the house at Shrewsbury where the great evolutionist was born. Whether by intent or by accident, the fasciculus appears very opportunely in relation to the impending "jubilee" of the reading of the "origin-of-species papers" by Darwin and Wallace at the Linnean Society.

WE have been favoured with a copy of a pamphlet (without printer's or publisher's name) describing the laboratory established in 1901 at Sutton Broad, Norfolk, by Messrs. Eustace and Robert Gurney for the study of fresh-water biology, in which it is announced that the gentleman last named will be pleased to arrange for the accommodation of naturalists desirous of working on this branch of research, no charge being made for the use of the laboratory. A considerable amount of work has already been accomplished in connection with the tidal system of the district, and its past and present effects on the fauna of the Broad. The crustaceans, beetles, and dragon-flies, and to a certain extent the rotifers and hydrachnids of the district, have formed the subjects of investigation, but much remains to be done in connection with the molluscs, turbellarians, and protozoans.

FROM the Entomological Bureau of the U.S. Department of Agriculture we have received Circular No. 99, dealing with nut-weevils, and from the West Virginia University Agricultural Experiment Station Bulletin No. 110, devoted to the grape-vine root-borer. Two species of weevil do considerable damage to chestnuts, of which large quantities are now grown in the States, and various methods of checking the multiplication of these pests are suggested. Hazel-nuts are attacked by an allied, but shorter-bodied and shorter-beaked, weevil. The grape-vine root-borer is one of the clear-winged moths, and a species indigenous to North America, where it doubtless originally infested wild vines. The caterpillars burrow long tunnels in the roots of vines, to which they do very serious damage, for the most part quite unknown to the cultivators. The cultivation of races of vine immune to the attack of root-borers is recommended.

IN a recent number of Records of the Indian Museum (vol. i., part iv., No. 23, December, 1907), Captain R. E. Lloyd describes and figures, under the name *Nudiclava monocanthi*, a remarkable new genus and species of hydroids, which has been found parasitic on a fish, *Monocanthus tomentosus*. The hydroid consists of a basal cœnosarcal plate attached to the skin of the fish, and from the basal plates arise the hydranths and the gonophores. The hydranths are entirely devoid of tentacles, and have a peculiar histological structure; thus Nudiclava resembles greatly *Hydrichthys mirus*, described by Fewkes, but differs in the gonophores being sporosacs, while Hydrichthys produces free medusæ. In the Memoirs of the Indian Museum (vol. i., No. 2) Captain Lloyd describes the anatomy of the gigantic marine isopod *Bathynomus giganteus*.

THE April number of the *Emu* is illustrated by a reproduction from a photograph of a nest of the brown flycatcher (*Micraeca fascinans*) containing two eggs laid by

Nest and Eggs of Brown Flycatcher, with Egg of Square-tailed Cuckoo. (Nearly natural size.)

the rightful owner, and a third deposited by the square-tailed cuckoo (*Cacomantis variolosus*). The size of the nest admits of only three eggs; and it is stated in the same issue by Mr. E. M. Cornwall that in the case of an allied flycatcher (or "flyeater") and the bronze-cuckoo, the former bird normally lays a clutch of three eggs, but only two of them are found in a nest containing a cuckoo's egg. What becomes of the third egg is not stated. In the case of the nest photographed, the difference between the colour of the cuckoo's and the flycatcher's eggs, as shown in the accompanying reproduction, is very marked, while the small size of both is very noticeable.

THE third volume of Notes from the Royal Botanic Garden, Edinburgh, is devoted to a history of the garden and biographies of the principal gardeners from the year

1756. The concluding portion now issued is mainly concerned with William M'Nab, who was deservedly esteemed both for his capabilities as a gardener and for his personality. He was a noted authority on heaths and hard-wooded plants. The papers he published on the planting of hardy evergreens and the cultivation of Cape heaths are printed as an appendix to his biography.

THE list of new garden plants introduced during the past year has been issued in the usual form of an appendix (No. 3) to the *Kew Bulletin* for 1908. The record includes new species of Bulbophyllum and Eria from Malaya and India; species of Lewisia are products of the United States, and a large number of cactus specimens under the genera Echinopsis, Echinocactus, Mamillaria, and Phyllocactus have been introduced from Mexico, Argentina, Paraguay, and other States of South America. Among the small quota from China there occur species of Rhododendron, Viburnum, and Berberis.

WITH the view of making known the results of investigations upon tropical American ferns as they are undertaken in the National Herbarium at Washington, it is proposed to issue a series of studies similar to the series "Studies of Mexican and Central American Plants." The work is being entrusted to Mr. W. R. Maxon, and the first part is published as vol. x., part vii., of Contributions from the United States National Herbarium. The part contains critical notes on uncertain genera and species. The limits of *Asplenium salicifolium* and the identity of *Asplenium rhizophyllum* are discussed. A number of new species are diagnosed, and the new generic name Ananthacorus is suggested for *Pteris angustifolia*.

AN article contributed by Mr. F. Ramaley to the University of Colorado Studies, vol. v., No. 2, describes the plant distribution in the north-east of Latimer County, in Colorado. The altitude varies from five to six thousand feet; the soil of the district is derived from sedimentary rocks, largely Red Sandstone, except in parts where granite rocks occur. The prevailing formation is a scrub of *Cercocarpus latifolius*, dotted in parts with *Pinus scopulorum*; grasses and species of Artemisia clothe the valleys, but along the streams bushes and trees, such as species of Pseudotsuga and Salix, find a congenial habitat. The Cercocarpus scrub grows densely on the sandstone soil, but is almost absent on the granite; lichens and Selaginella, on the contrary, prefer the granite areas.

IN *Man* for May Mr. D. I. Bushnell describes an ancient site at Kimmswick, Missouri, with curious remains of an ancient salt factory. The vessels used are remarkable as having an impression of cloth on the outer surface. It is supposed that a depression was first made in the earth or sand of the size and form of the vessel desired. The hollow was then lined with cloth, over which was spread a thin layer of clay previously mixed with pulverised shell and sufficient water to make it of the proper consistency. When the vessel became dry and was taken from the mould the cloth would be removed, the impression of which, however, would remain on the outer surface. The extensive cemetery adjoining the factory seems to belong to a branch of the Shawnee tribe, who probably made salt on this site.

THE March number of *Buddhism*, the organ of the International Buddhist Society, which advocates the propagation of the faith in the West, contains a remarkable article by Mrs. Rhys Davids on "The Value of Life in Buddhism." The more advanced school of Buddhists have come to see that the current conception of Nirvána as the cessation of sentient existence is a fatal obstacle to the acceptance of the Dharma in Europe. As the writer observes:—"It is hardly conceivable that the West will call such a creed anything but pessimistic, so long as the West retains its peculiar view of life, and its conception of the essential immortality of the self." Hence she proposes to define Nirvána as "the perfected state of the individual mind and heart, emancipation from all taint of lust, ill-will and illusion." She endeavours to show that Buddha, "in judging human individuals capable of realising, now and again, a perfected humanity independently of any transcendental outlook, raised life, or the possibilities of life, to a very high value." The editor, in a very cautious criticism of this theory, seems to prefer to believe that "Buddha and his advanced hearers beheld an interminable series of lives, with Nibbána as the goal." It seems unlikely that this attempt to put new wine into old bottles will be accepted by the orthodox thinkers of the East. But in view of the current belief in the immobility of eastern faiths, the new development is certainly interesting.

MR. F. COHEN, of Bonn, has published a beautiful contoured map of the Eifel, including Aix-la-Chapelle, Coblentz, and Trèves, on the scale of 1 : 200,000, prepared from the Government Survey by Dr. H. Rauff. The height-zones are shown in clear shades of colour, the contours being drawn at every fifty metres. For geographers and cyclists, who may often be happily combined, this large sheet, published at 3 marks, is a really notable achievement.

PROF. H. POTONIÉ has issued a fourth and enlarged edition of his brochure entitled "Die Entstehung der Steinkohle" (Borntraeger, 1907, price 4 marks). This is illustrated in the best sense by a number of landscape views of actual vegetation in swamps, bogs, and forests, with examples of stems found *in situ* in Coal-measures. A strong case is made out for the theory of the production of coal-seams in place and not by flotation, and stress is laid on deposits of "sapropelite," from the decay of various water-loving organisms and their excrement. A form of carbonaceous rock results which in turn provides petroleum. All who have to do with coal may read this little book with pleasure, and they will be especially grateful for the care with which the illustrations have been brought together and reproduced.

THE results of the meteorological observations made at Mount Tsukuba (Japan) during 1903 have recently been received; at the peak station (869·5 metres) and at the base hourly observations are given, at the middle station (240 metres) for every two hours. The volume contains an interesting discussion by Mr. T. Okada of a typhoon that swept over the eastern part of Japan on September 28, 1902, with a violence that had not been experienced for many years. An interesting fact is that the storm centre passed very near Mount Tsukuba (lat. 36° 12′ N., long. 140° 5′ E., approximately), so that the atmospheric condition at the summit and base stations could be determined. On the same day another violent cyclone appeared over the western part of the islands.

THE *Denkschriften* of the Vienna Academy of Sciences, vol. lxxxi., contain a very valuable contribution to the meteorology of west Turkestan, compiled (at the suggestion of Dr. J. Hann) by Heinz v. Ficker from the Russian meteorological year-books and other sources, and based on observations between 1894 and 1903 at seventeen stations. The area, which embraces 8½° of latitude and

17½° of longitude, and differences of altitude amounting to 3600 metres, is subject to great contrasts of climate, *e.g.* at Pamirski Post, in the south-east, the mean yearly temperature is 29°·8 F., and at Termez, in the south, 63°·9; the mean yearly variation (difference of warmest and coldest months) is 68°·2, at Kasalinsk, in the north-west, and 40°·9, at Prschewalsk, in the north-east. The whole country has a very small rainfall, averaging from about 5 inches on the Steppes to 14½ inches in the districts of the Naryn and Lake Issykul. The author states, with reference to the cultivation of the land, that the small rainfall and rapid evaporation give rise to the gravest fears for the future of the country.

DR. A. STOCK announces in part ii. of the *Verhandlungen der deutschen physikalischen Gesellschaft* for 1908 that he has succeeded in producing a material which, while porous to air and other gases, will not allow mercury to pass through it at pressures less than 1 atmosphere. It is composed mainly of clay, water-glass, and gum burnt together, and can be substituted for the taps and other appliances used in the manipulation of gases. The material withstands acids and boiling water, can be fused directly to glass, and is about five times as porous as that used by Dr. K. Pritz for the same purpose two years ago.

IN France the Société d'Encouragement granted a subvention for a research on the gases occluded in steels, and the results of the work, by Dr. G. Belloc, of the University of Caen, are published in the current issue of the Bulletin (vol. cx., No. 4) of the society. The gases, he finds, consist of mixtures of carbon dioxide, carbonic oxide, hydrogen, and nitrogen, and the liberation of the gases is in intimate relation with the critical points of iron. Carbon dioxide is liberated first at about 550° C., and forms the great bulk of the volume present. Nitrogen begins to appear at 550°. More gases are given off by the steel taken from the centre of an ingot than from samples nearer the surface.

THE *Physical Review* for April contains a study of the changes of the electrical resistance of selenium cells by Messrs. F. C. Brown and J. Stebbins, of the University of Illinois. They find that pressure diminishes the resistance at a rate nearly constant up to about 400 kilos. per sq. cm., and that the cells are somewhat less sensitive to light at high than at low pressures. Increase of temperature in the neighbourhood of 20° C. produces a rapid decrease of resistance, which becomes less marked as the temperature gets higher. The sensitiveness to light decreases as the temperature rises, and appears to be a function of the resistance of the cell, whether that resistance is determined by the temperature, pressure, or illumination of the cell. Radium and hydrogen peroxide both decrease the resistance of a cell to a remarkable extent.

MESSRS. MACMILLAN AND CO., LTD., have published the forty-fifth annual issue of "The Statesman's Year-book," that for 1908. Its character is described excellently by its subtitle—"Statistical and Historical Annual of the States of the World for the Year." The volume has been enlarged again; more space is devoted to the British Empire and the United States. An account of the changes in the organisation of the British Army has been included, and the returns of the recent French census of 1906 are given. Some thirty pages of additions and corrections contain the most recent available statistics, among others those of public education in England and Wales. The maps and diagrams are, as usual, a very attractive feature. Three diagrams deal in a luminous manner with important matters in connection with the British Navy, and some interesting comparisons with the naval strength of other countries are shown graphically. It would be valuable and instructive if next year the editor, Dr. J. Scott Keltie, could provide similar diagrams comparing the United Kingdom with Germany, the United States, and other great countries, so far as the provision of higher education is concerned. We know of no subject in which statesmen stand more in need of instruction; and we are sure that a graphical comparison of the expenditure on higher education and scientific research, of the percentage of the population receiving higher technical instruction, and similar matters would show that while we apply the two-power standard to the arts of war, we are behind other progressive nations in the provision made for the arts of peace through higher education and science.

A FOURTH edition of Prof. E. Hammer's "Der logarithmische Rechenschieber und sein Gebrauch" has been published by Mr. Konrad Wittwer, of Stuttgart. The volume deals with methods of using logarithms and the slide rule, and their application to various forms of calculation. No tables are provided. The price of the book is one mark.

WE are glad to see a column devoted to science of the week in the *Standard of Empire*, the first number of which appeared on Saturday last. The new periodical, which is published at the *Standard* office, will appear as a gratis supplement every Thursday in that newspaper, and will also be issued separately as a weekly journal devoted to Imperial affairs.

WE have received from Mr. Robert Sutton, 43 The Exchange, Southwark, S.E., the fourth part of the first volume of Dr. E. Howard Adye's "Studies in Micropetrography." This fasciculus contains pages 29–36 of the first volume, and two full-page plates. The rocks dealt with are ophitic diabase, andesitic dolerite, fine olivine-basalt, and ophitic olivine-dolerite.

MESSRS. A. AND C. BLACK are publishing a second edition of "Studies in Fossil Botany," by Dr. D. H. Scott, F.R.S. The work, the first edition of which was reviewed in NATURE of November 15, 1900 (vol. lxiii., p. 53), will in future appear in two volumes. The first, dealing with the Pteridophyta, is now ready, and its price is 6*s.* net; the second volume will be published, it is expected, next autumn, when we propose to review the complete work.

MESSRS. CASSELL AND CO., LTD., have commenced the publication, in twenty-four fortnightly parts, price 7*d.* net each, of "The Nature Book." The work is to be a popular description by pen and camera of the beauties of outdoor nature. Among numerous contributors we notice the names of Messrs. Walter Crane, Richard and Cherry Kearton, and Dr. W. J. S. Lockyer. The first part reaches a high standard of excellence. The letterpress is interesting and accurate, while the illustrations are abundant and beautiful. The publication should secure a wide popularity, and prove of real service to teachers of nature-study.

THE first volume of the fifth edition of Prof. Wundt's "Grundzüge der physiologischen Psychologie" appeared in 1902, and was noticed in NATURE of November 6, 1902 (vol. lxvii., p. 2). The second and third volumes of the same edition were reviewed in 1905, with Prof. Titchener's translation of the work (vol. lxxi., p. 529). The first volume of the sixth revised edition of this elaborate work has now been received from the publisher, Mr. W. Engelmann, Leipzig. Nearly two hundred pages have been

added, the increase being necessitated by the rapid growth of experimental or physiological psychology during the past few years. The character of the work remains the same, and has been sufficiently described in reviews of earlier editions. The price of the present volume is thirteen marks.

OUR ASTRONOMICAL COLUMN.

DANIEL'S COMET, 1907*d*.—A continuation of Herr H. H. Kritzinger's ephemeris for Daniel's comet appears in No. 4245 of the *Astronomische Nachrichten* (p. 345, April 29). From this ephemeris we see that the comet is now apparently travelling very slowly through the constellation Virgo, nearly parallel to, and some 15′ south of, the equator. Its positions on June 1 and 13 will be $\alpha = 13h.\ 52{\cdot}1m.$, $\delta = -0°\ 14'{\cdot}3$, and $\alpha = 13h.\ 48{\cdot}1m.$, $\delta = -0°\ 20'{\cdot}2$, respectively. The comet is now a little brighter than the twelfth magnitude, and crosses the meridian about 9.30 p.m.

SPECTROSCOPIC BINARIES.—For some time past the observers at the Dominion Observatory, Ottawa, have been endeavouring to complete their set of observations of the spectroscopic binary ι Orionis by obtaining spectrograms at a critical part of the velocity curve where it changes its form rapidly. According to a note in No. 2, vol. ii., of the Journal of the Royal Astronomical Society of Canada (p. 106, March-April), the necessary spectrograms were secured at the end of January. The following principal elements have been calculated from measurements of 107 plates :—period = 29·136 days, eccentricity = 0·75, longitude of the apse 110°, projected length of semi-major axis = 29,680,000 km., and velocity of the system = +20·7 km.

Elements for ψ Orionis, of which the radial velocity has a remarkably short period, have also been obtained; they are :—period = 2·5259 days, $e = 0{\cdot}063$, $\omega = 186°$, and $a \sin i = 5{,}103{,}000$ km.

Mr. Harper has recently discovered that the star δ Herculis has a variable radial velocity with a fairly wide range; this star has therefore been added to the observing list at Ottawa.

RECENT OBSERVATIONS OF JUPITER.—Some interesting observations of Jupiter were reported to the March meeting of the British Astronomical Association by the Rev. T. E. R. Phillips, who directed attention to the fact that the great south tropical disturbance was once more passing the great Red Spot. The dark material of the disturbance was observed to be passing round the south side of the Red Spot by the south temperate belt, leaving a sharply defined oval in which the Red Spot lay; the latter feature was very difficult to see, and appeared at times to be distorted and irregular in form, as though clouds were passing over it. Since the beginning of the apparition the disturbance has increased considerably in length, from about 60° in September to 115° at the end of January. The rotation period of the Red Spot was less during the earlier part of the apparition, but the diminution was not so marked as it was during the conjunction of 1906, when it amounted to 14° between April and August. At each conjunction of these two features, since the first appearance of the south tropical disturbance in 1901, the Red Spot has, for the time being, appeared to be pushed forward (the *Observatory*, May, No. 396, p. 196).

DOUBLE-STAR OBSERVERS.—In continuing his series of articles on double-star observers in the May *Observatory* (No. 396, p. 205), Mr. Lewis gives a very interesting account of the work performed by Baron Dembowski between 1852 and 1878. With a telescope of 5 inches aperture, and fitted with neither position circle nor driving clock, Dembowski commenced a revision of the brighter pairs given in the "Mensuræ Micrometricæ," and did most excellent work. After mentioning the double-star work of Schiaparelli and other observers, Mr. Lewis proceeds to the consideration of what he calls the third period of double-star astronomy, which began when Burnham submitted a catalogue of eighty-one new double stars to the Royal Astronomical Society in 1873; all these doubles had been observed with a 6-inch refractor mounted in Burnham's back yard. In 1900 this same observer published a catalogue of 1290 doubles discovered by himself between 1871 and 1899. Mr. Lewis also gives a long list of observers of this third period, and the sizes of the instruments with which they worked.

In the note on the relative accuracy of various double-star workers, which appeared in these columns last week, the mean value given in the last line should, obviously, be $0''{\cdot}0698$, and not $0''{\cdot}698$ as printed.

THE COLOUR FILTER AND ISOCHROMATIC PLATE IN ASTRONOMICAL PHOTOGRAPHY.—An important paper by Mr. R. J. Wallace, on the function of a colour filter and "isochromatic" plate in astronomical photography, appears as a reprint from the *Astrophysical Journal* for March. Mr. Wallace discusses at length the use of various filters and stained plates, and shows, by reproductions of some of his photographs taken at the Yerkes Observatory, the immense gain in definition resulting from such use.

In the course of his discussion Mr. Wallace also refers to the results recently published by Prof. Lowell in his paper on the sharpening of celestial photographic images, and states a number of points whereon he disagrees with the conclusions arrived at by Prof. Lowell.

A NEW ASTRONOMICAL JOURNAL.—The first number of a new journal, printed in Japanese characters, has just appeared under the title of the *Astronomical Herald*, and is published by the Astronomical Society of Japan. This first number is dated April, and contains, among other articles, a note on sun-spots by Mr. S. Hirayama, and one on ancient astronomy.

ALTERNATE CURRENT MEASUREMENT.

THE ordinary dynamometer is as well adapted for direct as for alternate current measurements; but while it is generally regarded as the best available instrument for alternate currents, its use with direct currents is almost restricted to standard instruments of the ampere balance type. This is due to the immensely greater sensitiveness obtainable with direct current instruments constructed on the heterostatic principle, as exemplified in galvanometers with permanently magnetised needles or magnets. The latter instruments, due originally to Kelvin and Maxwell, and first developed commercially by Ayrton and Perry, have been brought to a high state of perfection in recent years, with the result that ordinary measurements on direct current circuits are much more precise and satisfactory than those on alternate current circuits.

The only likely way at present of improving alternate current instruments is to use iron-cored electromagnets to increase the strength of the field acting on the moving system. The well-known difficulties due to the varying permeability, hysteresis, &c., of the iron cannot be overcome, but may be entirely avoided by exciting the electromagnet in shunt.

The excitation of an electromagnet can be governed either by controlling the current through the exciting coil or by controlling the voltage applied to the winding. On direct current circuits the two methods are identical owing to the operation of Ohm's law, but with alternate currents the two modes of control lead to widely different results if the resistance of the winding is made small compared with the impedance. With current control, the magnetism produced depends on the properties of the core, but is independent of the resistance of the winding. The reverse is true of the voltage controlled magnet, for, if this is suitably designed, the magnetic flux is connected with the applied voltage by a strict mathematical law not dependent on the physical properties of the core, except for a small correction term due to the resistance of the winding. The shunt magnet in another way contrasts sharply with the series magnet. In each case the strength of the magnet is increased by diminishing the air gap, but the smaller this is made the more accurate the shunt magnet becomes and the less accurate the series magnet. The field due to the shunt magnet is not in phase with the applied voltage, so that special means must be used to supply the moving coil of the instrument with a suitable current if the deflection is to indicate truly the quantity to be tested. But

this difficulty, it is found, can readily be overcome. All measurements with alternate currents relate to mean values. It is not necessary to make the instantaneous value of the torque exerted on the moving system of the instrument a measure of the simultaneous value of the quantity tested, as, for instance, is the case with ordinary dynamometers. All that is needed is proportionality between the mean values. With the aid of this principle it can be shown that the shunt magnet offers for instrument purposes great advantages, one of these being that the density of the air-gap flux, without loss of accuracy, can be increased to a value far exceeding that obtainable in permanent magnet instruments.

The ordinary modes of analysis used for the solution of alternate current problems rest upon several convenient but inaccurate assumptions, such as sine law wave form, proportionality of magnetic flux to magnetising current, &c. Such methods can be used to give an approximate explanation of known results, but are not adapted to predict precisely the action of a new type of instrument in terms of measured data relating to its parts. In a paper read before the Royal Society[1] on January 16, a simple form of analysis, previously pointed out by the present writer, is further developed. This method is free from

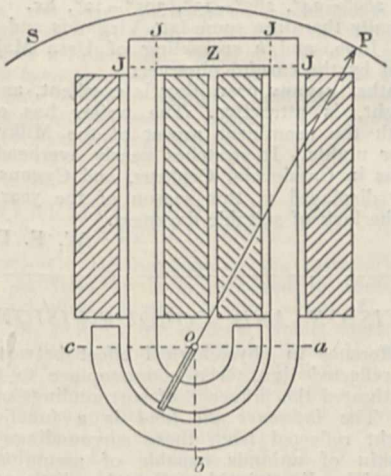


FIG. 1.

assumptions such as those mentioned. It rests upon the theorem that each one of a number of known cyclic quantities, however different these may be in wave form, can be expressed as a linear function of an equal number of other cyclic quantities, the latter being such that the mean square of each is unity, and the mean product of any two is zero. This theorem leads naturally to a vector method of representation, which in many cases closely approximates to that usually adopted for alternate current investigations, but there is the important difference that when the results obtained are independent of assumptions such as sine law wave form this fact can be proved, while if such independence does not hold good a superior limit can be found to the error involved in results obtained by the ordinary method.

One of the instruments of which the behaviour has been investigated theoretically and fully confirmed experimentally is illustrated in Fig. 1. The magnetic circuit consists of a block of thin iron stampings shaped so as to have only one narrow air gap, the section of which is increased by suitably extending the poles. The field windings are shown in section, and are liberally supplied with copper. By this construction the ratio of resistance to impedance is made small. The moving coil is rectangular, one side turning in the air gap, the opposite side acting as an axis perpendicular to the figure, and shown at *o*. The instrument becomes a voltmeter if the moving coil is placed in series with a condenser across the voltage applied to the field coil. It becomes a wattmeter if the main current is passed through an induction coil the secondary of which contains a large resistance and the moving coil. If the resistance of the field coil were zero, the flux through the core would simply depend on the applied voltage, whatever the magnetic properties of the core; and if this coil were short-circuited the core flux could not be varied. The chief points to be investigated were the effect of the actual resistance of the field coil, the influence of the E.M.F. induced by the field in the moving coil circuit, and the precise meaning and influence of the self-inductance of the moving coil. Exact formulæ have been established and verified for all these effects, some of which may be illustrated by the following tests. If the field coil be open-circuited and a current be passed through the moving coil, this will turn so as to enclose the greatest flux, but this position will not be *oc* because of the portion of the flux crossing the air gap twice, this part being greatest for the position *ob*. For feeble currents the resulting position will be near *ob*, but will tend to approach *oc* for larger currents, owing to the corresponding increase in the permeability of the core. If, however, the field coil be short-circuited, an alternating current through the moving coil will invariably turn it to the position *ob*, because such current cannot produce a flux through the long limbs of the magnet. If the field coil be excited by an alternating voltage and the moving coil circuit be closed through a small resistance, this coil, owing to its self-inductance, will turn to *oa* so as to enclose the minimum flux, while if under the same conditions the moving coil circuit be closed through a condenser, the coil will turn to *oc* so as to enclose the maximum flux.

A thorough analysis of these effects, confirmed by actual tests, shows that the instrument can be so constructed that for most purposes its errors are negligibly small, and also that it is possible to eliminate precisely these errors for any specified frequency by using a special winding round the magnet with its ends joined up to a condenser the capacity of which is determined by the frequency and the winding. None of the errors arise from the variable magnetic properties of the core. In connection with alternating current work, the voltage-controlled magnetic field thus offers great advantages for investigating purposes.

W. E. SUMPNER.

[1] "Alternate Current Measurement." By Dr. W. E. Sumpner. (Communicated by Prof. Perry, F.R.S.)

NEW LIGHTS ON THE ANTHROPOLOGY OF CALIFORNIA.

THE anthropological department of the University of California, thanks to Mrs. Hearst's munificent endowment, is able to issue a further series of studies on the native races of that State. The most voluminous contribution is that of Mr. S. A. Barrett on the "Ethnogeography of the Pomo and Neighbouring Indians," a group of tribes numbering at present about 1000 souls, and occupying the region known to geographers as the Coast Range Mountains immediately north of San Francisco Bay, and running eastward to the Sacramento River. These people are now partially civilised, and support themselves by farming and labour. But sufficient is known of their primitive condition to show that they had no totemic clans or groups, and that their tribal organisation was weak, there being no chief in the commonly accepted sense of the term. There was a sort of council of minor chiefs presided over by a chief captain, whose authority was strictly limited, and who was elected by the community. The inferior chiefs, on the other hand, held their offices by hereditary right, and the succession passed from one incumbent to the family of that sister who was nearest to him in age, kinship and descent being in the female line.

In regard to culture, these people fall into three divisions:—the ocean tribes, who depended for food upon the fish and molluscs which abounded in the sea, and derived the material for their food and clothing from the redwood forests of the coastal districts; secondly, the valley tribes, who occupied in severe weather round grass-thatched houses, while during the summer they wandered along the streams and lived in temporary brush shelters, but used no canoes, as the rivers are of inconsiderable volume; lastly, the tribes of the inner lake region, who built elliptical huts thatched with the tule rush, which

also supplied them with materials for nets, mats, and slings with which they killed water-fowl, using for the purpose of fishing canoe-shaped rafts of the tule. The materials for the study of this civilisation now extinct are found in the ancient village sites which have been carefully examined by Mr. Barrett. The greater part of his elaborate report is occupied by a survey of the tribal dialects, which adds largely to the information recorded by Schoolcraft, Powell, Bancroft, and others. In another and less elaborate report Messrs. S. A. Barrett and A. L. Kroeber give an account of the Miwok tribe.

Of more general interest and importance is the investigation conducted by Mr. W. J. Sinclair into the question of the existence of relics of prehistoric man in the auriferous gravels of the Sierra Nevada. The evidence of the early existence of man in California has been hitherto almost entirely based on the well-known report issued in 1880 by Prof. J. D. Whitney in the course of the geological survey of the State. The present inquiry has been devoted to a further investigation of the sites from which the human remains and objects alleged to be the work of man are said to have been derived. The result is seriously disconcerting to those who have relied on the evidence collected by Whitney. Mr. Sinclair points out that, though these gravels and the intercalated volcanic outflows are admittedly of various geological periods, Whitney made no attempt to indicate from which series of gravels the relics were obtained. In the case of the discoveries made in mines worked by hydraulic machinery the provenance of the vast majority of objects can no longer be verified, and there is good reason to suspect that many, if not all, the specimens have been washed down from modern Indian village sites situated on bluffs overhanging the pits, which were disintegrated by the powerful water currents. Mr. Sinclair reviews in detail all the more remarkable "finds" in this region. One large mortar is said to have been found in association with "a small oval tablet of dark coloured slate with a melon and leaf carved in bas-relief." But it exhibits no signs of wear from gravel friction; the scratches are all recent defacements, and the carving is said to show very evident traces of a steel knife-blade.

Special attention is naturally given to the Calaveras skull immortalised by Bret Harte, which is now a cherished possession of the Harvard Museum. Mr. Sinclair asserts that the substance adhering to it is not a gravel, but a cave breccia, and that the skull was not obtained in the gravels beneath the rhyolite, or from any other gravel of the rhyolitic epoch, none of which exhibits any trace of the stalagmitic cementation which has been recognised in the skull matrix. He suggests that the skull was derived from a comparatively modern Indian cave interment. If, he adds, man of a fairly high developed type was in existence during the deposition of these gravels, he must have been "a contemporary of the three-toed horse and other primitive forms of the late Miocene and early Pliocene, a thesis to which all geological and biological evidence is opposed." His conclusion is that the evidence is insufficient to prove the presence of the remains of men in the auriferous gravels; that there have been abundant opportunities for such relics to be accidentally mixed with these gravels; and that the local geological conditions render it improbable that such implements and bones have been found in the assumed sites.

It would be premature to attempt to criticise this important report in detail. Doubtless those authorities who assert the genuineness of these relics will not allow the case to go by default. English anthropologists have always adopted an attitude of reserve in relation to the Calaveras skull. If the question of the antiquity of the human race depended on the authenticity of these Californian discoveries, the position would perhaps be serious. But even if Mr. Sinclair's indictment survives the criticism to which it is inevitable that it must be exposed, the abundant evidence from other unquestioned sources which now exists renders a challenge of one set of relics a matter of little importance. Whatever may be the result of the controversy, the necessity of caution in dealing with evidence which has been collected without rigid scientific supervision is sufficiently obvious.

METEORIC PHENOMENA IN JUNE.

IN June there are few meteors seen which leave streaks. Possibly the twilight is responsible for this; it must partially be so, but I do not think that it will wholly account for the seeming rarity of meteors of the same type as the August Perseids or November Leonids.

Yet there are a few noticed by vigilant observers, and especially in the morning hours. These are directed from radiants in Pisces, Andromeda, Aries, Perseus, and other constellations in the same general region of the sky. There are the α–β Perseids, δ Cassiopeids, π, μ, and γ Andromedids, β Triangulids, α Arietids, β and ϵ Piscids, and many others. In 1887 I saw several fine streak-leaving meteors from a radiant near the position of the August Perseids at about η Persei. All the centres referred to, however, stand in need of corroboration, as they are supported on very slender evidence indeed.

Fireballs are not uncommon to June, though few real paths appear to have been hitherto determined in this month.

When we have such excellent atmospheric conditions as prevailed in June, 1887, it is possible to discern a large number of showers. Some of these are directed from places south of the equator; for instance, there are radiants at 252°−21°, 269°−24°, 283°−13°, 305°−12°, &c.

Occasionally there are some late Virginids and Serpentids noticed in June, and a sprinkling of Ursa Majorids will be recorded by the careful observer.

The weather usually prevailing is excellent, and the sky, though light, is attractive. The writer has often been struck with the prominent aspect of the Milky Way on midsummer nights. It stretches nearly overhead, and the rich regions in Cassiopeia, Cepheus, and Cygnus are often beautifully displayed at this season of the year, notwithstanding the lack of suitable darkness.

W. F. DENNING.

VISION AND COLOUR-VISION.

THE difference in physiological effect between incident and reflected light is a commonplace to those who have investigated the influence of surroundings on sensitive animals. The *influence du fond* is a function of the altered light reflected from these surroundings upon the eyes or skin of animals capable of assuming variable coloration. The direct incident light has little or no effect in producing the result.

In a series of papers (*Zeit. f. Augenheilkunde*, Bd. xvi., pp. 448–463; *Wiener medezinische Wochenschrift*, No. 46, 1906, No. 48, 1907) Prof. Raehlmann asserts that the light perceived by vertebrates is reflected from the plane separating the outer laminated limb of the rods and cones into the inner homogeneous limb of the same. He now claims that colour-vision is due to the reflected light setting up "stationary waves" in the inner limb of these retinal elements. To support this view he proceeds to show from recent work that if a Lippmann gelatin film (placed between a mirror and a source of light) be exposed to different parts of the spectrum, and then cut into microscopic sections and examined under a high power, the substance of the film is seen to be traversed by zones of black granules separated by colourless intervals, the interspaces equalling the wave-length of the light used, and, therefore, whilst perceptible in the case of red and yellow light, are so crowded together in green and blue light as to be almost continuous. This result is claimed by Prof. Raehlmann as confirmatory evidence of the truth of his hypothesis. The sensitive film is represented by the morphologically inner portion of the rod or cone, the mirror by the membrane separating this from the outer refractive portion, and the case would be complete if any arrangement of black and colourless zones comparable to that set up in the film could be discovered in the inner portion of the cone, but though Prof. Raehlmann has used the ultra-microscope after a given monochromatic exposure, he can discover nothing in the inner cone-limb but a perfectly uniform granulation, and though the length of the cone is known to vary with that of the light-waves used, yet he has not been able to correlate the somewhat

different appearance of the granulation in the case of cones exposed to red and blue light with the qualities of the light. This argument from Lippmann's direct colour photography, therefore, is at present unconvincing in its most essential feature.

The second argument in support of the view that colour arises from "stationary waves" set up in the inner segments of the rods and cones is the ready explanation it affords of colour-blindness. On the usual theory that light traverses the outer dioptric limb of the rods and cones and is arrested by the retinal pigment, the origin, and especially the variations of the colour-sense, are difficult to explain, even with the aid of the retinal purple. Prof. Raehlmann, however, has no difficulty in pointing out that disturbance of the reflecting power of the outer rod-limb, such as might readily ensue without causing loss of sharpness of sight, would cause variation and even loss of colour-vision, whilst the much commoner reverse condition would be due to dislocation of the rods by choroidal or pigmentary disturbances from a vertical into an oblique position such as is found normally at the weak-sighted periphery of the eye. Other phenomena of vision—adaptation, the dazzling effect of contrast, after-images, and the interesting structural variations shown in the rods of animal retinas (for example, the coloured globules of many birds, the retina of deep-sea cephalopods)—are also touched upon, and an attempt is made to show that on this hypothesis a fuller explanation may now be given than has hitherto been possible. Direct proof of this view, however, has not yet been obtained, and the analogical or indirect evidence advanced in support of it cannot yet be said to be of a convincing nature.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—On the occasion of the installation of the Chancellor on June 17 it is proposed to confer degrees upon the following, among others:—Hon. C. Algernon Parsons, C.B., F.R.S., Sir Andrew Noble, Bart., K.C.B., F.R.S., Sir William Crookes, F.R.S., Prof. Horace Lamb, F.R.S., and Prof. G. D. Liveing, F.R.S. It is understood that, according to precedent, the new Chancellor has nominated the recipients of the honorary degrees which will be conferred at his installation.

Dr. Guillemard, Dr. Haddon, and Mr. H. Y. Oldham, of King's College, have been nominated to represent the University at the International Congress of Geography to be held at Geneva next July.

The special board for mathematics has nominated Mr. H. F. Newall, of Trinity College, as a member of the board of electors to the Plumian professorship of astronomy, and the special board for physics and chemistry has nominated Dr. W. N. Shaw as a member of the board of electors to the professorship of mechanism and applied sciences.

The Vice-Chancellor announces that he has received from Prof. Liveing an intimation of his intention to resign the professorship of chemistry an Saturday, June 20.

EDINBURGH.—Prof. Crum Brown will resign the chair of chemistry on July 25. Applications for the chair, the patronage of which is vested in the curators, should be sent, with relative testimonials, on or before July 4, to Mr. R. Herbert Johnston, 4 Albyn Place, Edinburgh.

LEEDS.—Prof. W. H. Bragg, F.R.S., professor of mathematics and physics in the University of Adelaide since 1886, has been appointed to succeed Prof. Stroud in the Cavendish chair of physics. Prof. Bragg will enter upon his duties at Leeds next February.

OXFORD.—Mr. C. F. Jenkin has been elected to the newly constituted professorship of engineering science.

Mr. Benjamin Kidd will deliver the Herbert Spencer lecture on Friday, May 29, at 4 p.m., in the Sheldonian Theatre, the subject being "Individualism and After."

Dr. Joseph F. Payne, hon. fellow of Magdalen College, has been appointed by the delegates of the common university fund to deliver a course of six lectures in the next academic year on the history of medicine, dealing specially with Greek medicine.

Prof. E. B. Poulton and Mr. A. H. Church have been appointed to represent the University on the occasion of the Linnean Society's celebration of the fiftieth anniversary of the reading of the Darwin-Wallace memoir on the origin of species.

MR. J. P. GRIFFITH, Rathmines Castle, Dublin, has just contributed 100*l*. towards the new buildings of the North Wales University College.

THE Association of Technical Institutions has awarded the prize of 25*l*. for the best essay on "The Bearing of Technical Education on Industrial Progress" to Dr. John Ryan, Milltown, co. Dublin, and the prize of the same amount for the best essay on "The Bearing of Technical Education on Agriculture and Industries of a Rural Character" to Mr. Edgar Chamberlain, Municipal Technical School, Lincoln.

MESSRS. SWAN SONNENSCHEIN AND CO., LTD., have now published "The Girls' School Year-book" for the year April, 1908, to April, 1909. This is the third year of publication of a very useful work of reference. A hundred and thirty public secondary schools for girls in different parts of England and Wales are described in some detail, and a fairly complete list of similar schools in the United Kingdom is provided. It is not always easy to see the reasons for the choice of schools receiving extended treatment, but the year-book is still young, and the editors will probably extend their selection in future issues. The second part of the volume deals chiefly with careers for girls, but provides other useful information also. The book is certainly gratifying evidence of the improvement which has been accomplished in the education of girls during recent years, and it is satisfactory to notice that it is proposed in next year's issue to deal with instruction in domestic science and housecraft, for it is in this direction that there is real need of experiment and observation if our girls' schools are to be successful in preparing their pupils for one of the most important parts of a woman's life.

WE learn from the *Pioneer Mail* that a letter has been sent by the secretary of the Government Education Department to the registrar of the University of Bombay stating that the Governor in Council has had under consideration the nature of the provision at present made in Government colleges affiliated to the Bombay University for the teaching of science. The committee appointed by the syndicate of the University in 1906 to inspect these colleges indicated many points in which the instruction in chemistry, physics, and biology could be improved. The letter points out that it is necessary to meet the requirements of two distinct classes of students—those who specialise in science with the view of making it their life work, and those who take an elementary course to qualify them in part for a degree in arts, or for admission to the medical profession. It is proposed to concentrate the higher teaching of science in the College of Science at Poona, which will be equipped thoroughly for the purpose. Steps have been taken to obtain a full staff of highly qualified professors, and when the college is in full working order it will afford facilities for the study of science such as have hitherto been unattainable in Bombay. For the second class of students it is proposed to provide a laboratory in Bombay at which students from different colleges may pass through a course of elementary science. A similar course would be provided at the College of Science for Poona students, and for the present the science departments of Gujarat and Sind Arts Colleges would be retained. This elementary course will consist almost entirely of practical work, and it is hoped in this way to supply a deficiency in the ordinary course of study of Indian students by providing a training in observation and the accurate recording of facts.

THE Scotch Education Department is publishing at short intervals memoranda on the teaching of various school subjects. The teaching of English, arithmetic, languages, drawing, history, and, most recently, nature-study and science, have been dealt with in this way. The sixth memorandum (Cd. 4024) is divided into two sections, concerned with nature-study and science respectively. Nature-study as here described is a very comprehensive branch of knowledge, related in its various aspects with many other

subjects, designed primarily, as the introduction to the Blue-book points out, to overcome the divorce between school and home life, which is nowadays a serious defect of education. Nature-study justifies its place in the curriculum only when it brings the pupils into direct contact with natural objects and phenomena, and develops in their minds habits of correct observation and intelligent discrimination. The guidance provided in the memorandum is practical, and preeminently designed to assist teachers, so that the pupils may derive from these lessons the advantages the study can ensure when rightly pursued. School gardens, excursions, collections, calendars, weather observations, and the care of animals, are some of the subjects selected for treatment, and the teachers who work in the spirit of the hints and suggestions which enrich these pages will have no reason to fear failure to develop in their pupils open-eyed interest in nature. An appendix by Prof. J. Arthur Thomson shows teachers in detail how the subject may be studied seasonally, and the difficulty of obtaining material obviated. The second section of the memorandum explains how the work in nature-study should develop later in the curriculum into a more formal study of experimental science, with the object of encouraging the habit and spirit of accurate investigation. Individual work on the part of the pupil is insisted upon, and the importance is pointed out of truthful and clear records of results. Outlines of work are put forward as indicating suitable courses of study for an intermediate school devoting three hours a week, in two equal periods, to the subject, as well as for higher schools. It is satisfactory to find it laid down that the value of the work will depend upon its spirit and method, and upon the power of initiative and self-reliance developed in the pupils, rather than upon the amount of examinable knowledge acquired.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 20.—"On the Osmotic Pressure of Compressible Solutions of any Degree of Concentration. Part ii. Cases in which both Solvent and Solute are Volatile." By Prof. A. W. **Porter**. Communicated by Prof. F. T. Trouton, F.R.S.

In a former paper (see NATURE, September 5, 1907, vol. lxxvi., p. 487) the author found an exact relation between vapour pressures and osmotic pressure in the usual case in which the solute may be taken as involatile. The case now considered is the more general one, in which both solvent and solute are volatile.

The author has considered several cases in which the vapour pressure is changed, and found that in each case it is only necessary to know the partial pressure of the pure solvent the vapour of which is referred to in order to calculate what the change in the vapour pressure amounts to. The same method might presumably be applied to other cases also, such as magnetisation, &c.

March 19.—"On Vapour Pressure and Osmotic Pressure of Strong Solutions." By Prof. H. L. **Callendar**, F.R.S.

The foundation of the vapour-pressure theory of solutions laid down in this paper is the assumption of a simple relation between the vapour pressure and the molecular constitution of the solution. That there should be a simple relation of this kind appears extremely probable when we consider that the concentration of the vapour phase in the solutions here examined is very small, and that such relations generally take a very simple form at extreme dilution. That such a relation should serve as a key to many of the phenomena occurring in solutions is not surprising in view of the fact that equality of vapour pressure is one of the most general conditions of equilibrium in physical chemistry. The relation of this assumption to the gas-pressure theory, or the hydrate theory, or the capillary pressure theory, as already indicated, is that it involves them all, since they may be regarded as merely different aspects of the same phenomena. An equivalent assumption may be formulated, at least approximately, in terms of partial pressure, or capillary pressure, or chemical attraction, but it would merely be putting the same thing in different words. The vapour-pressure method appears to be the most direct line of attacking the problem. If, for instance, we regard the changes of capillary pressure in relation to vapour pressure as defined by the relation $UdP = vdp$, we should arrive at nearly the same result by similar approximations. But this method does not appear to be so convenient, because it involves the volume U, which is generally unknown and variable in an uncertain manner, whereas the volume of the vapour v at low pressures may be regarded as conforming very closely with the laws of gases.

There is no doubt that further experimental work may be required to establish the vapour-pressure theory generally, since accurate data for strong solutions are comparatively scarce. The interpretation of the ionisation factor, and its relation to the heat of dilution, requires further elucidation. Analysis of nearly all the data at present available, in addition to the examples above cited, fails to show any serious disagreement with the vapour-pressure theory. The theory cannot pretend to be exact for all ranges of temperature and concentration, but it seems likely to serve, at least as a second approximation, for coordinating results which have hitherto appeared discordant.

March 26.—"Comparison of the Board of Trade Ampere-standard Balance with the Ayrton-Jones Current Weigher; with an Appendix on the Electromotive Force of Standard Cells." By T. **Mather**, F.R.S., and F. E. **Smith**.

The paper describes experiments by which the relation between the Board of Trade ampere and one-tenth C.G.S. unit of current, as realised by the Ayrton-Jones instrument (Ayrton, Mather, and Smith, Phil. Trans., A, vol. ccvii., p. 463), was determined.

The comparison was carried out by aid of a combination of standard cells and resistances used as a secondary standard of current. This combination was evaluated by the Ayrton-Jones current weigher at the National Physical Laboratory on each of the three days during which experiments were made at the Board of Trade Laboratory, so that if any change occurred in the secondary standard it would be detected.

Two methods of comparison were employed, both giving concordant results, viz. one Ayrton-Jones ampere $= 1{\cdot}0003_3$ Board of Trade ampere, the latter ampere being, therefore, smaller than the former by about 1/30 per cent.

A difference of this order was anticipated, for a recent determination of the electrochemical equivalent of silver (Smith, Mather, and Lowry, Phil. Trans., A, vol. ccvii., p. 579) by the Ayrton-Jones instrument gave 1·11827 milligrams per coulomb, whereas the Board of Trade balance was adjusted to correspond with 1·118 milligrams.

According to these experiments, the Board of Trade ampere will deposit silver at the rate of 1·1179 milligrams per second, so that *the Board of Trade ampere is equal to the international ampere, as defined by silver deposit, to within 1/100 per cent.*

The above experiments, combined with figures given by Prof. Ayrton and the authors (Phil. Trans., A, ccvii., p. 536), enable the E.M.F.'s of standard cells to be expressed in terms of the Board of Trade volt, this being defined as the P.D. between the terminals of a resistance of one Board of Trade ohm when one Board of Trade ampere is passing. The results are:—

E.M.F. of normal Weston cadmium cell $= 1{\cdot}0186_8$ Board of Trade volts at 20° C.

E.M.F. of normal Clark cell $= 1{\cdot}433_0$ Board of Trade volts at 15° C.

The Reichsanstalt value for the cadmium cell is 1·0186 at 20° C., and that for the Clark cell, determined directly by Mr. Trotter, 1·4329 at 15° C.

April 30.—"On Scandium." By Sir William **Crookes**, F.R.S.

Scandia is one of the rarest and least known of the recognised rare earths. It was discovered in 1879 by Nilson, who separated it, together with ytterbia, from erbia extracted from euxenite and gadolinite. Later in the same year Cleve extracted scandia from gadolinite, yttrotitanite, and keilhauite, and described the scandium sulphate, double sulphates, nitrate, oxalate, double oxalates,

selenate, acetate, formate, oxide, and hydrate, and gave some of the chief reactions of the new body.

In the course of the author's twenty years' work on the fractionation of the rare earths, he has repeatedly tested his products by examining their photographed spectra, using the dominant lines of the various elements as tests for their presence. Scandium has an extremely characteristic group of lines in its spectrum, situated between wave-lengths 3535·864 and 3651·983, the strongest being at 3613·984, midway between two strong iron lines. By using a part of the spectrum in which this occupies the centre of the photograph, it is easy to see if scandium is present. Detecting the dominant line, the presence of scandium can be verified by reference to the other lines of the group.

The author found scandium in some of the fractions, but only in small quantities. A few years ago he commenced an examination of all the obtainable rare earth minerals in order to see if any of them showed more than a trace of scandium. The minerals examined were :—æschynite, allanite, alvite, auerlite, baddeleite (Ceylon), bastnasite, bröggerite, cerite, cleveite, columbite, cryptolite, eudialite, euxenite, fergusonite (Ceylon), fergusonite (Ytterby), fluocerite, gadolinite, hielmite, homolite, keilhauite, knopite, koppite, lanthanite, monazite, mosandrite, orangite, orthite, polycrase, pyrochlore, rhabdophane, samarskite, scheelite (Bohemia), scheelite (New Zealand), schorlomite, sipylite, tantalite, thalenite, thorianite, thorite, thorogummite, tscheffkinite, tysonite, urdite, wiikite, xenotime, yttergarnet, yttrialite, yttrocerite, yttrogummite, yttrotantalite, yttrotitanite, zirkelite (Ceylon, sp. gr. 5·0), zirkelite (Ceylon, sp. gr. 4·42).

Of the minerals examined, scandium was detected in auerlite, cerite, keilhauite, mosandrite, orangite, orthite, pyrochlore, thorianite, thorite, and wiikite.

Wiikite is a black amorphous mineral of specific gravity 4·85. Its hardness is 6. It is infusible before the blowpipe. It is imperfectly attacked by strong mineral acids, and breaks up easily when fused with potassium bisulphate. Heated to full redness in a silica tube, it gives off helium, water, and a distinct amount of sulphuretted hydrogen, followed by a white sublimate. The mineral begins to crack at a temperature a little below redness, and at the approach of redness gas is evolved with almost explosive violence, the mineral breaking up and flying about the tube. A fragment so treated examined under the microscope shows the surface covered with glistening points. With a high power these points are resolved into a mass of minute cubes, curiously regular in form and appearance. Heating drives off 5·83 per cent. of its weight; 5·82 of the loss is water and acid vapour, the difference, 0·01 per cent., consisting chiefly of helium, with a little hydrogen, carbon dioxide, and a mere trace of neon.

After the crude earths, chiefly yttria, ytterbia, and scandia, have been separated from the mineral, they are "fractionated" by methods described in the paper. Towards the end of the fractionation the chief impurity is ytterbium. Fortunately, the very strong dominant line of the ytterbium spectrum, wave-length 3694·344, occurs at a vacant part of the scandium spectrum, and near the characteristic group of scandium. A sample of scandia is not taken as satisfactory if the least trace of this line is seen on an over-exposed spectrum of scandium, and if the atomic weight is higher than 44·1. The atomic weight of ytterbium being 173, a very little of it as an impurity raises the atomic weight of scandium.

The author has prepared and analysed the following compounds of scandium :—scandium hydroxide, scandium carbonate, hydrated scandium chlorides, hydrated scandium bromides, scandium chlorate, scandium perchlorate, scandium bromate, scandium sulphates, anhydrous scandium sulphate, basic scandium sulphate, scandium and potassium double sulphate, scandium selenates, scandium nitrates, scandium formate, scandium acetate, scandium propionate, scandium butyrate, scandium iso-butyrate, scandium iso-valerate, scandium oxalates, scandium picrates, scandium pyromellitate, scandium camphorate.

Royal Anthropological Institute. May 5.—Prof. W. Ridgewav, president, in the chair.—Report on the Hythe crania: F. G. **Parsons.** An account was given of nearly 4000 measurements which the author made on 575 of the skulls under Hythe Church, Kent. The author reviewed the various historical facts in connection with them, as well as the numerous traditions and explanations which had from time to time been put forward to account for the presence of the crania. He declined to believe any of the numerous battle theories, and pointed out that skulls of women and children were plentiful, that earth was present in many of the crania, and that the injuries which have so often been referred to battle-axe and spear wounds were certainly inflicted many years after death, and were made probably by spades and pickaxes in digging up the skulls. From numerous details of collateral evidence the author argued that the bones probably must have come to their present place before the Reformation, and, as there were femurs of about 4000 people in the stack, must have represented the burials of more than a century. Mr. Parsons believed that the bones were of the thirteenth, fourteenth, and fifteenth centuries. The chief point of interest in the measurements was the shortness of the skulls, which averaged 17·9 cm. for the males. This is 1 cm. shorter than the two large London series lately recorded by Dr. Macdonnell, and goes far to disprove that observer's suggestion that the English head is gradually growing shorter and broader. The teeth were remarkable for their freedom from caries and for the wearing down of the crowns, pointing to hard, coarse fare. Many pathological specimens of bones were exhibited showing that osteo-arthritis and syphilis were very rife. The various abnormalities in the skull bones and sutures were classified, and their frequency recorded for future anatomical comparison.

Chemical Society, May 7.—Prof. E. Divers, F.R.S., in the chair.—The refraction and dispersion of triazo-compounds: J. C. **Philip.** A study of these constants shows that the contribution which the N_3-group normally makes to the molecular refraction is 8·91 units, and that to the molecular dispersion 0·36–0·37, but ethyl triazoformate, phenylazoimide, and α-naphthylazoimide show refractive and dispersive powers above the normal values. The bearing of these results on the formulation of the N_3-group is discussed.—The dissociation constants of triazoacetic and α-triazopropionic acids: J. C. **Philip.** The values found show that the introduction of the N_3-group into the molecule of acetic or propionic acid increases the strength of the acid nearly as much as the introduction of a bromine atom.—The fermentation of mannose and lævulose by yeast-juice (preliminary note): A. **Harden** and W. J. **Young.** Mannose is fermented by yeast-juice at almost the same rate as dextrose, whilst lævulose is fermented somewhat more rapidly. The peculiar influence of phosphates on the fermentation of these sugars by yeast-juice is described in detail.—The constituents of olive leaves: F. B. **Power** and F. **Tutin.** The following substances were isolated :—(1) a new monocarboxylic acid, $C_{22}H_{45}.CO_2H$; (2) a mixture of fatty acids containing oleic acid; (3) hentriacontane, $C_{31}H_{64}$; (4) pentatriacontane, $C_{35}H_{72}$; (5) oleasterol, $C_{26}H_{34}O$, a new crystalline alcohol related to the phytosterols; (6) a new crystalline alcohol, olestranol, $C_{25}H_{42}O_2$, which appears to be a hydroxyphytosterol; (7) homo-olestranol, $C_{27}H_{46}O_2$, a compound similar to olestranol; (8) *d*-mannitol; (9) a sugar which yields *d*-phenylglucosazone; (10) a trace of an essential oil; (11) oleanol, $C_{31}H_{48}O(OH)_2N_2O$, which contains one alcoholic and one phenolic hydroxyl group.—The constituents of olive bark: F. B. **Power** and F. **Tutin.** The following crystalline compounds were obtained, together with some amorphous products :—(1) a new monocarboxylic acid, $C_{31}H_{67}.CO_2H$; (2) a new monocarboxylic acid, $C_{24}H_{45}.CO_2H$; (3) a new monocarboxylic acid,

$$C_{34}H_{69}.CO_2H;$$

(4) a new monocarboxylic acid, $C_{29}H_{57}.CO_2H$; (5) a substance, probably a tertiary alcohol, $C_{35}H_{68}O$; (6) pentatriacontane, $C_{35}H_{72}$; (7) a phytosterol, $C_{27}H_{46}O$; (8) a substance identical with ipuranol, recently isolated by Power and Rogerson from *Ipomoea purpurea*; (9) a new phenolic substance, olenitol, $C_{14}H_{16}O_6$; (10) *d*-mannitol; (11) a sugar which yields *d*-phenylglucosazone.—The reaction of diazonium salts with mono- and di-hydric phenols and with naphthols: K. J. P. **Orton** and R. W. **Everatt.** All diazonium salts couple quantitatively with

α- and β-naphthols in alcoholic media, but under similar conditions these salts do not combine with monohydric phenols. The dihydric phenols, resorcinol and orcinol, behave like the naphthols in alcoholic solution, but in aqueous solution only diazonium salts, with a preponderance of halogen atoms in the benzene nucleus, couple with the two dihydric phenols.—The condensation of benzoin with methyl alcohol: J. C. **Irvine** and D. **McNicoll.**—The mutual solubility of 2-methylpiperidine and water: O. **Flaschner** and B. **MacEwen.**—The melting points of the anilides, *p*-toluidides, and α-naphthalides of the normal fatty acids: P. W. **Robertson.** The irregularities in melting points in the series of anilides and *p*-toluidides seem to tend always in the reverse direction to those observed in the case of the amides. The disturbing factor appears to be a function of the lack of symmetry of the molecule, and is to a great extent eliminated on taking the mean melting points of the amides and anilides and of the amides and *p*-toluidides. In the fatty α-naphthalides, where the substituent group is heavier, irregularities tend to disappear.—The absorption spectrum of camphor: W. N. **Hartley.** The author confirms Baly, Marsden, and Stewart's statement that strong solutions of camphor in alcohol show a band in the spectrum due to the CO and CH_2 groups, but otherwise the substance is remarkably diactinic.—The viscosity of solutions: C. E. **Fawsitt.** A continuation of work on colloidal and alcoholic solutions.—The action of fused potassium hydroxide and of hydrogen peroxide on cholesterol (preliminary note): R. H. **Pickard** and J. **Yates.**—The volumetric estimation of silver: W. R. **Lang** and J. C. **Woodhouse.**—A criticism of Werner's theory, and the constitution of complex salts: J. A. N. **Friend.**—The action between potassium sulphite and potassium pentathionate: E. **Divers.** The author points out that the accuracy of Debus's investigation of the action between a sulphite and a pentathionate (Trans. Chem. Soc., liii., 278) is not affected by Colefax's quite recent work (*ibid.*, 1908, xciii., 798).—Note on phenolic thetines and their action with benzoyl chloride: E. de B. **Barnett** and S. **Smiles.**—The relation between dielectric constant and chemical constitution, part i., stereoisomeric compounds: A. W. **Stewart.** Examination of active and racemic compounds, and also of geometrical isomerides, shows that the influence of the spacial arrangement of atoms on the dielectric constants of isomeric substances is not clearly marked. In one case the active isomeride had a stronger absorptive power than the racemic form.—An apparatus for determining the specific inductive capacity of organic liquids: A. W. **Stewart.**—The influence of solvents on the rotation of optically active compounds, part xii., ethyl tartrate in aromatic halogen derivatives: T. S. **Patterson** and D. P. **McDonald.**—A new test for silver: A. W. **Gregory.** A solution of a silver salt to which has been added a mixture of aqueous ammonium salicylate with ammonium hydroxide furnishes on further addition of ammonium persulphate an intense brown colour. Lead does not give this reaction.—The spontaneous crystallisation of substances which form a continuous series of mixed crystals; mixtures of naphthalene and β-naphthol: H. A. **Miers** and F. **Isaac.**

Linnean Society, May 7.—Prof. W. A. Herdman, F.R.S., president, in the chair.—*Exhibits.*—Fruits of the "Buddha's Claw" variety of *Citrus medica* obtained at Easter from the gardens at La Mortola, formerly belonging to the late Sir Thomas Hanbury, also a normal fruit for comparison: Prof. F. E. **Weiss.**—Representation of the movements of Peripatus and other invertebrate animals by means of the Newman fire-proof kinematograph: F. Martin **Duncan.** The special feature of the apparatus used was that it enabled one to analyse all movement, picture by picture, instead of having to run the whole film through from end to end without a stop, as in ordinary kinematograph projectors. The effect of concentrated light upon different species of invertebrate animals had proved of interest and frequently a difficulty, so that colour filters and isochromatised negative film had in some cases to be used to obtain a satisfactory record.—*Papers.*—Colony-formation as a factor in organic evolution: H. M. **Bernard.**—Antipatharia from the voyage of H.M.S. *Sea-lark*: C. F. **Cooper.**—Fresh-water fishes, batrachians, and reptiles obtained by Mr. J. Stanley Gardiner's expedition to the Indian Ocean: G. A. **Boulenger.**—The madreporarian corals, part i., the family Fungidæ, with a revision of its genera and species and an account of their geographical distribution: J. S. **Gardiner.**

Faraday Society, May 12.—Mr. L. Gaster in the chair.—Apparatus for determining the boiling points of very small quantities of liquids: L. **O'Dowd** and Dr. F. Mollwo **Perkin.** This consists of a capillary tube which is placed in about 1/5 c.c. of the liquid the boiling point of which is to be determined. The liquid is contained in a small test-tube, which passes through a hole in the cork in such a way that the end containing the liquid comes in close contact with the thermometer also passed through the same cork. A stirrer is also provided. The heating liquid is contained in a flask capable of holding from 100 c.c. to 120 c.c., and may be either sulphuric acid, glycerin, or other suitable liquid. One end of the capillary tube is sealed, and the open end is so arranged as to be at the bottom of the liquid. On raising the temperature bubbles commence to give off from the end of the capillary tube, and when a constant stream of bubbles comes off the source of heat is removed. The thermometer is read at the moment the bubbles cease to be given off, that is, the temperature at which the temperature of the vapour in the capillary is equal to the atmospheric pressure and is the boiling point of the liquid. Numbers were given, showing for high boiling substances, and also for low boiling substances, that accurate results can be obtained.—Ozone, particularly in connection with water purification: Dr. F. Mollwo **Perkin.** After a historical introduction, the apparatus of Messrs. Siemens and Halske was described in detail. It consists of two concentric electrodes, the inside one of aluminium and the outside one of glass. The inner electrode is hollow, and is kept cool by a circulation of water. The outer one is also surrounded by water in order to prevent heating. The aluminium electrode is connected with one pole of the high-tension current (8000 volts). The containing vessel, which is filled with water, is of iron, and is earthed. This is thus the negative pole, and as water surrounds the glass pole it becomes electrified. Dried air is passed up an annular space between the two electrodes, and by means of the silent electric discharge becomes ozonised. From the ozoniser the air passes up towers filled with pebbles, over which water trickles. By this means a large surface of water is exposed to the action of the ozone; it thus becomes sterilised, and from here passes over cascades in order to remove any dissolved ozone. Messrs. Siemens and Halske have large installations dealing with the purification of water supply at Wiesbaden and at Paderborn. Other uses of ozone, such as the preparation of vanilla, the bleaching of flour, and other purposes of oxidation, were also mentioned. As apparatus for laboratory use was exhibited in working.—Dr. **Veley** showed an apparatus for the determination of dielectric constants of non-conducting liquids.

Royal Meteorological Society, May 20.—Dr. H. R. Mill, president, in the chair.—Upper air observations in Egypt: B. F. E. **Keeling.** The whole prosperity of Egypt is connected with the weather of the neighbouring country of Abyssinia. As the summer rainfall is greater or less in Abyssinia, so is the Nile flood, and in consequence the area of land cultivated and the general prosperity is greater or less. In years when a bad, low stage of the river is to be expected, following on a bad flood, the early spring showers in Abyssinia are then of very great importance. As, unfortunately, there is no meteorological service in Abyssinia, it is not possible to obtain information about the rainfall over that region, so steps have recently been taken to obtain observations on the upper air over Egypt by means of pilot balloons and kites. Mr. Keeling gave an account of the methods employed, and of the directions in which it was hoped in the near future to develop the work. He also stated that the observations of the anti-trade winds made by M. Teisserenc de Bort and Mr. A. L. Rotch have been confirmed. At Helwan the anti-trade wind is reached at a height of about 6500 feet above sea-level. The greatest height so far reached by a balloon

was 54,000 feet, and on that occasion the south-west anti-trade wind was apparently penetrated and a north-west upper current encountered.—Balloon experiments in Barbados, November 6–8, 1907: Prof. J. P. **d'Albuquerque.**—Observations on the colour of lightning made at Epsom, 1903–7: S. C. **Russell.** The author had for the past five years kept a record of the colours or series of colours noted during each thunderstorm or display of sheet lightning, and tabulated them under their respective colour. He had thus results of observations of fork lightning made during fifty-seven thunderstorms, and seventy-eight observations of sheet lightning. It appears that in fork lightning red is the colour of the most frequent occurrence, and this is followed closely by blue, the least frequent colours being orange and green. White is of the greatest frequence in sheet lightning, red and yellow being next. It seems that the presence of hail, when occurring in association with a thunderstorm, is intimately connected with blue lightning.

Institution of Mining and Metallurgy, May 21.—Mr. Alfred James, president, in the chair.—The electrical equipment of gold mines: H. J. S. **Heather.** Continued discussion on this paper.—The behaviour of tellurium in assaying: Sydney W. **Smith.** An examination of the behaviour of this substance during pot-fusion, scorification, and cupellation in order that some reasons may be offered for taking the precautions which are generally regarded as necessary to ensure successful work. The paper describes a number of careful observations made with this end in view, and a summary of the conclusions arrived at is given.—The average rate of accumulation and absorption of gold amalgam by copper plates: Edward **Halse.** The absorption and accumulation of gold on copper plates: W. F. A. **Thomae.** These two papers deal with the same subject, the general conclusion of the two authors being that the absorption of gold by copper plates may be ignored by the mill-man in view of its small importance. In no case does the average rate appear to exceed a fraction of a grain per ton milled, and in the case of ore containing coarse gold it is practically nil. The authors look at this matter from somewhat different points of view, Mr. Thomae especially thinking that further data might be worth placing on record.—A journey to Central Asia: A. **Adiassewich.** This paper records the results of travels in Central Asia, with special reference to the position and prospects of the mining industry there. After a general description of the conditions of mining, the author passes in review the leading districts, Orenburg, the Khirgiz Steppes, &c., and gives details of the occurrence of gold, silver, copper, iron and other ores, coal, and petroleum.

PARIS.

Academy of Sciences, May 18.—M. H. Becquerel in the chair.—The hovering flight of birds: Marcel **Deprez.**—The turning of aëroplanes: Paul **Renard.** To turn an aëroplane requires that the apparatus should incline transversely a given amount; it will, in addition, usually have the effect of lowering the trajectory. Before making a turn it will therefore be necessary to rise if the original height is to be maintained at the end of the turn.—The profile of the polar masses of dynamos: Paul **Girault.**—The ultramicroscopic examination of charged centres in suspension in gases: M. **de Broglie.**—The re-combination of the ions in dielectrics: P. **Langevin.** On the supposition that in gases the re-combination of the ions with contrary signs is due to the attraction of their electric charges, the author has shown in an earlier paper that relation $\frac{\alpha}{4\pi(k_1+k_2)}=1=\epsilon$ holds, in which α is the coefficient of re-combination, k_1 and k_2 the mobilities of the positive and negative ions. In the present paper the application of this formula to the case of solid dielectrics is considered, and a simple method described of determining ϵ.—The influence of the surrounding atmosphere on the friction between solid bodies: F. **Charron.** The presence of moisture, benzene vapour, or alcohol vapour in the air reduces the friction, but no variation could be observed when the air round the moving parts was replaced by dry hydrogen, carbon dioxide, or ethylene.—The auto-excitation of a tri-phase alternator by means of electric valves: C. **Limb.**—The differences of contact potential between metals and liquids: L. **Bloch.** The apparent difference of contact potential between metal and liquid is smaller for alkaline solutions than for water, and smaller for water than for acid solutions. Salts give effects differing only slightly from water. The method is sensitive enough to detect traces of acid and alkali beyond the reach of detection by colour reagents.—The radiography of the lungs and stomach of the fœtus and still-born infants: M. **Bouchacourt.** In infants whose lungs have been filled with air, the lungs show definitely in the radiograph, but the usual practice of artificial inspiration in the case of infants apparently still-born may lead to the erroneous conclusion that the child has lived. The causes of the visibility of the stomach in the radiograph are also discussed.—Observation on the time required for the solution of substances: Gaston **Gaillard.** The substances studied were sodium thiosulphate, sugar, and sodium sulphate. The effect of the size of the crystal and rate of agitation have a great influence on the results, and it is only when these two factors are kept as constant as possible that comparative measurements can be obtained.—A photographic action of infra-red light: A. Gargam **de Moncetz.** The gelatinobromide plates were fogged by the X-rays previous to the exposure to the red rays, the light being filtered through a solution of iodine in carbon bisulphide capable of cutting off all rays between 800 λ and 4 λ. The plate showed clear effects of the exposure for wave-lengths between 920 λ and 1350 λ. The preliminary fogging of the plates by ordinary light instead of by the X-rays did not give these results.—The kinematographic study of the Brownian movements: Victor **Henri.** The path described by a particle, as shown by these experiments, was very complex; it varies from one particle to another, and is absolutely independent for each particle even when two particles only 2 μ apart are compared. The trajectory often shows abrupt changes of direction. The displacements measured for 0·05 second were compared with those deduced by Einstein's formula, and were found to be about four times greater than the latter.—The iodomercurates of thorium and aluminium: A. **Duboin.** The preparation and properties of $ThI_4,5HgI_2,18H_2O$ and $AlI_3,HgI_2,8H_2O$ are described.—The definite compounds of silicon and palladium: Paul **Lebeau** and Pierre **Jolibois.** Silicon and palladium unite directly with evolution of heat, giving rise to two definite silicates, Pd_2Si and PdSi, the first of which has been separated and analysed. The existence of the other silicide has been deduced from the determination of the fusibility curve and the metallographic study of the ingots obtained. These silicides are analogous to the platinum silicides already known.—A method for the volumetric estimation of tartaric acid in argol and cream of tartar: Em. **Pozzi-Escot.** The method is based on the insolubility of barium tartrate in alcohol, and the solubility of barium bromide in the same solvent. The excess of barium used is converted into the oxalate, and the latter determined with potassium permanganate.—The elimination of carbon monoxide from coal gas: Léo **Vignon.** Details of laboratory experiments on three methods are given: the conversion into methane by reduced nickel, the transformation into carbon dioxide by heating with oxide of iron at definite temperatures, and the direct absorption with cuprous chloride. The question of the cost of treatment or the value of the gas after such treatment is not dealt with by the author.—Propargylcarbinol: MM. **Lespieau** and **Pariselle.** Starting with the ester $CH_2Br—CHBr—CH_2—CH_2.OCH_3$, this is successively converted into 1 : 2 : 4-tribromobutane by the action of hydrobromic acid, 2 : 4-dibromobutene, from the preceding by the action of potash, the alcohol, $CH_2=CBr—CH_2.CH_2OH$, and the sought for acetylenic alcohol,

$$CH\equiv C—CH_2.CH_2OH.$$

—The mixed trihalogen derivatives of methane: V. **Auger.** A description of the preparation and properties of $CHCl_2I$, $CHClI_2$, $CHBr_2I$, and $CHBrI_2$.—The constitution of the combinations of tetramethyl-diamino-benzhydrol with some methylenic derivatives: R. **Fosse.**—Some orthobenzylated colouring matters from triphenylmethane:

A. **Guyot** and P. **Pignet.**—The cytology of the renal labyrinth of the Thysanoura: L. **Bruntz.**—The biology of a parasitic Rhabdocœle of *Cardium edule*: Paul **Hallez.**—The action of the X-rays on the evolution of the mammary gland during pregnancy in the rabbit: MM. **Cluzet** and **Bassal.** The evolution of the mammary gland may be hindered at all stages by the application of the X-rays, the maximum effect being produced when it is made in the course of the first fortnight.—The arrest and prolonged detention of radium sulphate in the living tissues: H. **Dominici** and **Faure-Beaulieu.**—The theory of electrical stimulation: Louis **Lapicque.**—An attempt to separate hypertensive substances from the urine: J. E. **Abelous** and E. **Bardier.**—Epithelioma and the parasitic nature of cancer: F. J. **Bosc.**—Acute tuberculous septicæmia of the guinea-pig: André **Jousset.**—Tubercles and fossil stems of Equisetum: P. H. **Fritel** and René **Viguer.**—The utilisation of faults for the determination of the mean density of the earth: A. **Berget.**—The study of the sea floor in the bay of the Seine: J. **Thoulet.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part i. for 1908, contains the following memoirs contributed to the society:—

December 21, 1907.—The Pyrenomycetes and Tuberaceæ of the Göttingen flora: A. **Peter.**—The fundamental equations for the electromagnetic processes in moving bodies: H. **Minkowski.**

February 8, 1908.—Researches from the Göttingen University chemical laboratory (xix.) (1) Dissociation by the addition of water in terpene compounds; (2) synthesis of α-phellandrene; (3) synthesis of isofenchone ($C_{10}H_{16}O$) from nopinone ($C_9H_{14}O$): O. **Wallach.**—The differential equations of binary semi-invariants and invariants in independent substitutions: W. Fr. **Meyer.**

February 22.—The uniformisation of algebraic curves (imaginary substitution-groups): P. **Koebe.**

DIARY OF SOCIETIES.

THURSDAY, MAY 28.

ROYAL SOCIETY, at 4.30.—On the Theory of Capillarity: Prof. E. T. Whittaker, F.R.S.—Effect of a Cross Wind on Rifled Projectiles: A. Mallock, F.R.S.—Transparent Silver and other Metallic Films: Prof. T. Turner.—Mrs. Ayrton will give Demonstrations of Wave-Motion in Water. (Paper read January 30, 1908.)

ROYAL INSTITUTION, at 3.—The Chemistry of Photography: Dr. Alexander Scott, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, MAY 29.

ROYAL INSTITUTION, at 9.—Ancient and Mediæval Projectile Weapons other than Firearms: Sir Ralph Payne-Gallwey, Bart.

MONDAY, JUNE 1.

ARISTOTELIAN SOCIETY, at 8.—Person and Thing: Prof. G. Dawes Hicks.

INSTITUTE OF ACTUARIES, at 5.—Annual General Meeting.

TUESDAY, JUNE 2.

ROYAL INSTITUTION, at 3.—Animal Heat and Allied Phenomena: Prof. William Stirling.

WEDNESDAY, JUNE 3.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Studies in Steam Distillation. Part iii., The Fatty Acids: H. Droop Richmond.—The Detection of Poisonous Metals: Dr. G. D. Lander and Mr. H. W. Winter.—The Estimation of Cocoanut Oil in Butter: Raymond Ross.—Ochoco Fat: Dr. Julius Lewkowitsch.—The Detection of Small Quantities of Methyl Alcohol in the Presence of Ethyl Alchohol: I. E. Hinkel.—The Separation of Certain Volatile Fatty Acids by Extraction with Benzene or Toluene: T. R. Hodgson.

ENTOMOLOGICAL SOCIETY, at 8.—On certain Nycteribiidæ, with Descriptions of Two New Species from Formosa: Hugh Scott.—Descriptions of some new Hesperidæ from Central and South America: Hamilton H. Druce.—Mimicry in Tropical American Butterflies: J. C. Moulton.—Heredity in the South-east African Form (*cenea*) of *Papilio dardanus* (*meropé*): G. F. Leigh.

GEOLOGICAL SOCIETY, at 8.—On the Fossiliferous Rocks of the Southern Half of the Tortworth Inlier: F. R. C. Reed and Prof. S. H. Reynolds.

THURSDAY, JUNE 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Aberration of Sloped Lenses and on their Adaptation to Telescopes of Unequal Magnifying Power in Perpendicular Directions: Lord Rayleigh, O.M., Pres. R.S.—On the Viscosity of Ice: R. M. Deeley.—The Effect of Temperature on the Neutralisation-Volume Change for Different Salts at Different Concentrations: Miss Ida Freund.—Note on a New Sounding Machine for Use on Lakes and Rivers without a Boat: Prof. E. J. Garwood.

ROYAL INSTITUTION, at 3.—The Chemistry of Photography: Dr. Alexander Scott, F.R.S.

LINNEAN SOCIETY, at 8.—Note on the Spicules of *Chirodota gemmifera* Dendy Hindle: Prof. A. Dendy, F.R.S.—Two New Fungus Diseases: E. S. Salmon.—The Caryophyllaceæ of Tibet: F. N. Williams.—Polychæta of the Indian Ocean: F. A. Potts.—The Stylasteria of the Indian Ocean: Dr. S. J. Hickson, F.R.S., and Miss Helen M. England.—A Contribution to the Mycology of South Africa: W. N. Cheesman and T. Gibbs.—*Exhibits*: Drawings prepared to illustrate Descourtly's "Ornithologie brésilienne.": C. E. Salmon.—Lantern-slides of the Life-history of a Wood-boring Wasp: F. Enoch.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Presidential Address by C. E. Rhodes.—The Mineral Resources of Trinidad: J. Cadman.—The Occurrence of Fluorspar in Derbyshire: C. B. Wedd and G. C. Drabble.—Calcining-kilns: G. Jones.—Cobalt and Northern Ontario: J. B. Tyrrell.

CHEMICAL SOCIETY, at 8.30.—Condensation Products from Pinene Aminodicarboxylic Acid: W. Godden.—A Delicate Test for Bromides alone, or in Solution with Chlorides: J. S. Jamieson.—Experiments on the Synthesis of 1-Methylcyclohexylidene-4-acetic Acid: W. H. Perkin and W. J. Pope.—The Triazo-group. Part iv., Allyl Azoimide: M. O. Forster and H. E. Fierz.

FRIDAY, JUNE 5.

ROYAL INSTITUTION, at 9.—The Nadir of Temperature and Allied Problems: Sir James Dewar, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Winding-engine Tests, with Notes and Suggestions on the Design and Testing of Plant: S. L. Thacker.—The Utilisation of Sewage for the Production of Crude Oil and Ammonia: M. F. Purcell.—The Oil Prospects of Central British South Africa: Dr. C. Sandberg.—Oil-mining: D. M. Chambers.—Mining in the Boundary District of British Columbia: F. Keffer.

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