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The Origin and Progress of Mankind.

SCIENCE would be writing its own epitaph did it not as occasion arises review old and apparently established hypotheses with a readiness to relinquish them in favour of newcomers, but equally it is the duty of science to walk warily and with circumspection lest it leave the solid track. The origin and progress of mankind have been the subject of two recent speculations which invite and demand close scrutiny.

According as they have laid stress upon one or other special character common to man and the primates, various investigators have placed the origin of humanity at different points in the evolution of the primate stock, but the drift of opinion has been to associate him closely with the great anthropoid apes. This close association is now contested by Prof. Henry Fairfield Osborn, who has recently stated that "no existing form of anthropoid ape is even remotely related to the stock which gave rise to man" and that these animals "constitute a separate branch of the great division of primates, not only inferior to the Hominidæ but totally disconnected from the human family from its earliest infancy." As Dr. W. K. Gregory has put it,

"Professor Osborn holds that the existing apes have ape brains and ape minds, adapted for life in the forest; that they walk on all fours; that the human foot shows no evidence of derivation from an arboreal type; that when men climb they do so in an awkward un-ape-like fashion; that the Neanderthal race had descended from thousands of generations of upright-walking men; and finally, that man was already a tool-making, intelligent being in the Pliocene epoch, certainly more than one million years ago."

Pithecanthropus of Java is no longer to be regarded as an 'ape-man' link, but as a true 'pro-man,' walking erect and capable of human speech and thought.

Prof. Osborn's throwing back of the origin of the human stem to a far distant past, before the anthropoid stock had diverged, has been stoutly combated by Dr. W. K. Gregory, who considers that the line of man's distinctive evolution struck off from the primitive chimpanzee-gorilla group, and that its origin can reasonably be looked for "somewhere within the known range of the anthropoid group in the Miocene and Pliocene, that is, somewhere between Western Europe and Eastern Asia." In his more recent writings Prof. Osborn has definitely accepted the remote arboreal

ancestry of man, and traces the common characters of man and modern apes to inheritance from a 'neutral' stock which existed in Oligocene and Eocene times; so that the differences between the protagonists are reduced to two matters of interpretation: the age of the origin of the human stock, and the distinctive characters of the common stem from which have branched men and the great anthropoids.

It is clear that every scrap of evidence must be brought to bear on the problem. In his Romanes lecture on "Palæontology and the Evolution of Man,"¹ delivered on May 4, Prof. D. M. S. Watson, without dealing in any way with the discussion which has been proceeding in the United States, analyses the significance of the fossil evidence of man's origin. Founding upon the palæontological evidence of evolution, he deduces certain generalisations, and two of these in particular he applies to the interpretation of man's origin, namely, that "the evolution of an organ follows the same course in closely related but independent stocks," and that evolutionary changes in structure "may be, and perhaps generally are, such as to produce greater mechanical fitness for the special mode of life of the animals considered."

In the result Prof. Watson finds that modern anthropoid apes have specialised in arboreal life, while *man* has also become modified in a direction of his own, as his lower limbs have assumed the whole functions of progression and his arms have been freed for handling food and tools. But each group bears in its broad chest and far-flung arms, as well as in other bodily structures, evidence of descent from "an ancestral great ape, differing from modern forms in his less intense brachiating specialisations."

Curiously enough, Prof. Watson's palæontological generalisations have some bearing upon the second speculation which scientific investigators have recently been invited to consider; this deals not with the origin but with the progress of mankind. In his Huxley Memorial Lecture, "Conversion in Science,"² delivered on the same day as the Romanes Lecture, Prof. G. Elliot Smith stands forth as the champion of the principle of diffusion of culture in ethnological science and the relentless opponent of any speculation which would seek to interpret resemblance in manners and beliefs as an outcome of similarity of circumstances. He

regards the hesitancy of scientific men to adopt a new generalisation as a function of old age and traditional obsession, and looks with hope to young men ready to embark on new adventures which seem hazardous to their elders. But neither the hazard nor the novelty of an adventure is a measure of its merit, and to most the test of an hypothesis will be its fitness to explain all the facts, balanced with its probability relative to knowledge already regarded as secure.

That diffusion of culture is as likely to be widely significant in ethnological science as is dispersal of species in biology, can scarcely be gainsaid, and Prof. Elliot Smith does well to emphasise its importance. To argue his case for dispersal, the biologist must show that the characters upon which he founds are significant of heredity, and can have arisen in no other way. So the proof of diffusion of culture must lie in combinations of symbols or beliefs or in detailed agreements which point unhesitatingly to an ancestral source and can have no other origin.

Prof. Elliot Smith is unwilling to admit the possibility of any other origin. He regards as a "reckless travesty of logic and consistency" the idea that in similar circumstances similar customs and inventions may arise. But on this matter biology has something to say. Prof. Watson finds it to be a general principle of palæontological evolution that "the evolution of an organ follows the same course in closely related but independent stocks," and it is one of the striking discoveries of modern zoology that 'convergent evolution' is a more general phenomenon than had been suspected; that, indeed, similar circumstances do often call forth similar structural reactions, even in unrelated animals. Surely it would be irrational to ignore in mental processes or in social development a biological principle which applies so widely to structural development.

With the merits of Prof. Elliot Smith's immediate application of the principle of diffusion of culture, the thesis that "the civilisation of the whole world was inspired by Egypt," that "not only Crete and Syria, but Mesopotamia and India, Africa and Europe, and indirectly the rest of Asia, Oceania and America derived their cultural capital from the same source," we are not here concerned, but in ignoring a broad biological principle there is a danger that dogma may replace dogma. The final scientific criterion must be "Prove all things; hold fast that which is good."

J. R.

¹ "Palæontology and the Evolution of Man: the Romanes Lecture delivered in the Sheldonian Theatre, 4 May 1928." By Prof. D. M. S. Watson. Pp. 28. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 2s. net.

² "Conversion in Science: Huxley Memorial Lecture, 1928." By Prof. G. Elliot Smith. Pp. 38. (London: Macmillan and Co., Ltd., 1928.) 1s. net.

Homogeneous Reactions of Organic Compounds.

The Mechanism of Homogeneous Organic Reactions from the Physical-Chemical Standpoint. By Prof. F. O. Rice. (American Chemical Society Monograph Series.) Pp. 217. (New York: The Chemical Catalog Co., Inc.; London: Arthur F. Bird, 1928.) 5 dollars.

IN recent years much attention has been given to the study of heterogeneous catalysis, and great advances have been made in our knowledge of the influence of surfaces in promoting chemical change. Prof. Rice's present work provides a welcome reminder of the importance of the complementary problem of homogeneous catalysis, since, as he points out in his introduction, organic compounds are often non-reactive when freed from catalysts, but undergo rapid change when the necessary catalyst is supplied. As illustrations of this non-reactivity he cites the case of ethylene and bromine, which "practically cease to react when dry and enclosed by 'non-polar' walls of paraffin wax," and the analogous phenomena whereby "the conversion of nitrocamphor to the pseudo form and the tautomerism of keto-enol isomers" are arrested when these substances are "free from catalysts and enclosed in a vessel with non-polar walls." A few exceptional cases, such as the racemisation of pinene and the thermal decomposition of acetone, in which chemical changes appear to take place in the vapour phase at elevated temperatures in the absence of a catalyst, are, however, described in the final paragraph of the book. In general, therefore, it is admitted that organic reactions, which normally proceed only under the influence of a catalyst, may also take place in the absence of a catalyst when collisions of exceptional violence occur.

The commonest catalysts for homogeneous organic reactions are acids and bases. Prof. Rice prefers to describe these transformations as taking place "under the influence of hydrogen and hydroxyl ions"; but this paraphrase (which is a legacy from the period when the study of dilute aqueous solutions threatened to monopolise the interest of physical chemists) introduces limitations which are now generally admitted to be both unjustified and unnecessary. Indeed, many of the most dramatic illustrations of catalysis, such as the catalysis of the mutarotation of nitrocamphor by the addition of 1 part of piperidine to 100 million parts of benzene, which Prof. Rice cites in his chapter on isomeric change, have been observed in anhydrous solvents and with nitrogenous bases,

under conditions which do not encourage the view that the active catalyst is the hydroxyl ion. Again, it is theory rather than experiment which limits the catalytic activity of an acid to the hydrogen ions produced from it, when the molecules of a strong acid may be even better catalysts than its ions, for example, for those transformations in which the migration of a proton is the essential feature.

From this point of view, definite progress was made when Brönsted pointed out that the modern definition of an acid as a substance which is able to give a proton to a base, leads logically to the conclusion that the anion of a weak acid must be classed as a base, and the kation of a weak nitrogenous base must be classed as an acid, since one can accept and the other can give a proton. When, therefore, ammonia and acetic acid interact to form ammonium acetate, the functions of the two radicals are reversed, the basic molecule of ammonia becoming acidic in the ammonium ion, and the acidic molecule of acetic acid becoming basic in the acetate ion. Experimental justification for this view has been found in Dawson's recent studies of catalysis by acids in the presence of their salts, and in the work done in Copenhagen and in Cambridge on the catalysis of the isomeric changes which give rise to the mutarotation of glucose.

These studies are of value mainly because they have provided numerical data for the catalytic power of the various molecules and ions which can give or accept a proton. Prof. Rice, however, is not yet prepared to give up the idea that the 'hydrogen ion' is the unique catalyst for these transformations, and has therefore put forward a modification of Lapworth's earlier theory that a minute trace of anhydrous hydrogen ions is solely responsible for the catalysis. Rice's 'dry hydrogen ions,' however, are no longer the naked protons or stripped atoms of the earlier theory (which have a heat of hydration of 260,000 calories, according to the calculations of Fajans), but are defined as "having a heat of hydration of 20,000 calories per molecule." They are, therefore, purely thermodynamic conceptions, to which no precise chemical composition can be assigned, and in this form their utility is not likely to be great.

Prof. Rice is, however, such a believer in the potency of hydrogen and hydroxyl ions that in his opening paragraph he expresses the opinion that it "seems to be not altogether outside the bounds of possibility that all slow reactions, which are really homogeneous, will fall into this class." Thus, in a subsequent chapter he suggests that the reversible

chlorination which gives rise to isomeric change in *N*-chloroacetanilide depends on a "simultaneous collision of a hydrogen ion at the amino group and a chloride ion at the *para* position," and, when referring to the Beckmann inversion, he expresses the view that "the action may then be regarded as simple hydrogen-ion catalysis." There is, however, no real justification, either theoretical or experimental, for supposing that all homogeneous catalysis can be reduced to a single type, since the mutarotation of beryllium benzoylcamphor, which is catalysed by acetone and chloroform, clearly depends on the ability of these substances to form co-ordination compounds with the metal, and is in a totally different category from the mutarotation of benzoylcamphor, which is a typical prototropic change, for which acids and bases provide the necessary catalysis. The fact that, in general, it is necessary to provide *both an acid and a base*, in terms of Brönsted's definition, in order to bring about changes of the latter type, is a recent discovery, which may perhaps find a place in later editions of the present volume.

In addition to the problems of homogeneous catalysis, which are so conspicuous in the chapters on isomeric change and on hydrolysis, an account is given under appropriate headings of the reactions of aliphatic and aromatic hydrocarbons, and of the various 'condensations' and 'transformations' which play such an important part in organic chemistry. Thus, a valuable summary is given of the work of Holleman and the more recent work of Francis, Hill, and Johnston on benzene substitution; and, although very little physico-chemical work has yet been done on substitution and condensation in organic compounds, it is useful to have these processes reviewed in the light of raw material for future research.

The author has not attempted to discuss in detail the influence on organic chemistry of the discovery of the electronic structure of matter; but this omission has made it easier to concentrate attention on the fundamental problems which form the main subject of the book, and the author may be congratulated on the success which he has obtained in presenting these in an attractive and useful form to the readers of his monograph. The appearance of this work is particularly opportune, in view of the fact that Prof. Rice has promised to take part in a general discussion on homogeneous catalysis, which it is proposed to hold at Cambridge at the end of September, under the auspices of the Faraday Society.

T. M. LOWRY.

Cleaning Coal for the Market.

Modern Coal-Washing Practice. By R. C. R. Minikin. Pp. 310 + 36 plates. (London: Ernest Benn, Ltd., 1928.) 45s. net.

IF it can be said of any machine or process that there is money in it, there follows the certainty that it will attract the attention of the commercial man, and he is sure to bring to his aid the engineer. The two acting together form a very strong combination, whose efforts more often than not bestow some benefit on the ordinary public. Books such as that under review are commonly records of the achievements of such combinations, although they are written in technical language so difficult to understand by the average reader.

It has been known for a long time that it pays to clean coal for the market, and at practically every colliery in Great Britain some effort has been made in the past to clean all the larger sizes of coal; but never before has so much attention been given to the treatment of the smaller sizes, that is, all the coal produced at the mine less than two inch cubes, than is being done at the present time. The sizing, sorting, and cleaning of coal might be all grouped under one title and called 'coal dressing,' but this term would be far too wide to apply in the present instance, for the author deals only with the smaller sizes; and although he has called his book "*Modern Coal-Washing Practice*," he gives some idea of the newer processes which do not involve the use of water. In addition to the results of the author's own experience, there is information collected from many different sources, such as the transactions of the scientific societies, the technical press, portions of text-books, and advertising literature, and the whole of these sources of information is rarely available except to the privileged few who may have a well-equipped technical library at hand.

One of the sources of information mentioned above is of comparatively recent growth. It arises from the modern tendency by firms who manufacture machinery, to employ men on the staffs who have received a sound technical training. Many of the more progressive firms have their own research departments, wherein university trained men strive to improve old machines, or to devise new ones, for special branches of industry. Whenever a new machine, or an old model improved, appears on the market, it is accompanied by well-written descriptions, usually well illustrated, which explain in a lucid way the principles underlying its operation, and, after making due allowance for possible commercial bias, it is surprising how much

information is available to anyone interested, from the source called advertising literature.

The early chapters deal successively with general considerations, the building construction involved, the assembly of material to be treated in feed-hoppers; and the first mechanical elements of the plant necessary, in the shape of waggon-tippers, bucket elevators, conveyors, and dust extractors. Whilst this is mainly descriptive, the author includes many practical hints on the selection of plant. Chapter x. dismisses the subject of the sizing of coal with great brevity, a fact which is rather surprising in view of the importance it has in connexion with coal-washing. It is, of course, true that a far larger range of sizes below 2-inch cubes are made in the United States than in Great Britain, but the smaller sizes are bound to receive more attention in Britain as time goes on. The following chapter deals with the crushing of coal, and reasons are given for this practice, but it might have been made more clear that the primary reason for crushing in Great Britain is to help separate coal from adherent shale. In the United States, crushing is done to assist in the substitution of the machine for the man, and perhaps more important still, to satisfy the demands of a market created and cultivated by far-sighted engineers at the mines, in addition to the separation of coal and shale. The theory of coal-washing is next discussed, but the theory of minerals separation in water is quite an old subject and is to be found in all books on mineral dressing. This portion adds nothing to the theory of the subject, nor did the author intend it to do so; he, rightly, includes it as an introduction to the most important part of the book.

The main theme of the book is to be found under the sub-title "Modern Plants and Systems." Taking individual examples of descriptions of coal-washing, they are well done, complete with much detail, line drawings, and photographs; but the order in which they are placed leaves something to be desired. It is the sequence of the descriptions that will be found confusing. It may not seem to matter what is the order in which the descriptions are placed, and yet the arrangement may have quite a disturbing effect on the mind of a person trying to obtain a comprehensive view of coal-washing. For this reason it would appear that it was not written for students of mining schools. This portion covers about 100 pages, or about one-third of the whole work, which in itself forms an argument that a classification of the systems ought to have been attempted, based on the general

principles underlying the most important operation in each system; an arrangement such as that suggested would surely have increased the value of the book to the student and to the general reader.

The usefulness of the book might have been further increased by the inclusion of a far greater number of flow sheet diagrams, which are, after all, the most comprehensive and intensive means of conveying a clear idea of a complete method of treatment, in any form of mineral dressing. There is something to be said for the line diagrams, which, although small, are very helpful; probably much more so than if they had been made larger and included in folder form. Following this is an account of the use of concentrating tables, a comparatively recent addition to the list of coal-dressing appliances, though very well known in other forms of mineral dressing; but it is surprising to find this section placed in the same chapter as froth flotation, a subject of such outstanding difference in principle as to deserve isolated and rather more extensive treatment.

There are chapters on the drainage of washed coal, with hints on the use of conveyors and elevators as de-watering devices, and descriptions of special machines designed for this purpose as well as notes on drainage bunkers. The defilement of the washing water by the constantly increasing percentage of fine coaly dirt, known as slurry troubles, is dealt with, and there is an elementary account of the testing of the washability of coal by the sink and float test. Results are given to show how the test is applied, but they suffer from faulty tabulation. This is a subject on which an account of the complete scientific control of a washery might have been based, for although this testing seems to be something adapted to the needs of teachers in the instruction of students, it is a highly desirable method not only useful in the designing of a plant to treat a peculiar kind of coal, but should also be used constantly throughout the working life of the washery to make sure that there is no alteration in the washability of the material.

The various stages of the treatment might well be checked by assay, for the whole assay office, together with the necessary apparatus and simple reagents, need not be a costly affair; and there is little doubt that in capable hands such an office would pay for its capital cost, upkeep, and depreciation many times over. Later on, costs and other commercial matters are considered. It is on this matter of costs that so much may be done to assist the management of collieries, a point which has been sadly neglected since the year 1914, probably

on account of the great instability of the costs of labour and materials. But surely a time has now been reached at which some stability in these matters has been attained, and costs of operations may be discussed once more with pre-War freedom, to the advantage of the coal industry as a whole.

The final chapter of the book deals with pneumatic separation, added as an afterthought as it were, and lending assurance to the view formed, that the subject matter had been drawn together in a hurry to the detriment of the treatment.

To summarise: considering how much matter has been written on mineral dressing, it is obvious that a student of coal dressing would do well to revert to the field of metalliferous mineral dressing, and work forward steadily to the narrower field of coal dressing, when the book might be very useful. The outstanding useful features are the descriptions of machines and processes, and all other considerations are subordinate to this.

C. HABBERJAM.

The Zeeman Effect.

Magnetische Zerlegung der Spektrallinien. Von Prof. Dr. P. Zeeman und Dr. T. L. de Bruin. (Sonderdruck aus Handbuch der physikalischen Optik, herausgegeben von Prof. Dr. E. Gehrcke, Band 2, Hälfte 2, Teil 1.) Pp. 595-682 + 1 Tafel. (Leipzig: Johann Ambrosius Barth, 1927.) n.p.

THERE is perhaps no name that has been more frequently mentioned in physical writings in the last ten years than that of Prof. Zeeman, and we welcome the authoritative account of the magnetic splitting of spectral lines which he has written with the collaboration of Dr. de Bruin.

The Zeeman effect has so dominated the theory of spectra in recent years that its theoretical aspect is fully discussed in all modern books on atomic structure, with but meagre accounts of the experiments on which the theory is based. It is therefore very interesting to have the experimental processes described in some detail, for it is easy to forget how difficult they are. Thus theory takes for granted that a certain component is displaced to a distance of say 17/15 of that of the normal effect, and forgets that the line itself has a finite breadth, that the magnetic field is not always precisely known, and that the distinction between 17/15 and 16/14 will anyhow only amount to a very small fraction of an Ångström unit. So, too, theory has built a vast edifice on measures of intensity, and it is easy to forget that the analysing grating itself alters the relative intensities of

differently polarised components, so that only the most thorough investigation of these disturbances brings out the right result.

The work under notice begins with a historical account of the discovery, recording the fact that Prof. Zeeman was partly incited to look for it by reading that Faraday had attempted to do so, though without success. No mention is made of the fact, perhaps quite legendary, that when the circular polarisation was first observed, the electron was determined to have a positive sign through a blunder, with which everyone will have the sincerest sympathy who has ever had to decide the sign of any gyroscopic effect. The history is followed by a description of the apparatus necessary to observe the effect, and recounts the improvements introduced by various experimenters in magnetic field, grating, source of light, etc.

The authors then proceed to develop the theory according to the dynamical principles on which it was worked out. But nothing could better illustrate the great rate at which the theory has advanced than the fact that though their account contains everything known up to about the end of 1926, a great deal of it is now unnecessary. The wave theory has tidied up all the quasi-dynamical analogies by which the formulæ were originally suggested. For example, the interrelationship of the Zeeman patterns in weak and strong fields was worked out by a semi-empirical rule "the permanence of g -sums," but it is now possible to trace the connexion in detail, and the permanence of g -sums appears merely as an elementary property of the coefficients of an algebraic equation. In fact, between 1926 and 1928 the building has arrived at the stage when most of the scaffolding can be taken down.

Though this main part of the theory has attracted most attention in recent years, and is therefore most fully discussed, other aspects of the Zeeman effect are also reviewed. Thus there is a short account of the effect in the more complicated spectra of the 'second grade' and in bands, in which both theory and experiment are still very defective, and an account of the inverse effect in solids and liquids. There is also an account of the resonance phenomena of Wood and Ellett. Furthermore, the Zeeman effect has achieved the dignity of having an 'applied' branch as well as a 'pure,' and a section is devoted to the remarkable discoveries of Hale concerning the alternating rotation of sunspots. Altogether, there is no other place where so full and trustworthy an account can be found of the various aspects of the Zeeman effect.

Index Biologorum.

Index Biologorum: Investigatores, Laboratoria, Periodica. Edidit G. Chr. Hirsch. Editio Prima. Pp. iv + 545. (Berlin: Julius Springer, 1928.) 27 gold marks.

THE "Zoologisches Adressbuch" issued by Friedländer for the Zoological Society of Germany was an invaluable work, but even its second edition, issued in 1911, has long been out-of-date. The present work, compiled by Dr. Hirsch of Utrecht, would be welcome if it did no more than take the place of that. It does more: it comprehends all biologists, "omnes investigatores, qui vitæ naturam ab omni parte indagant." The lines of investigation are now so many and so diverse that there is danger of hedges growing up between them. Many workers fortunately insist on breaking through the hedges, and it is to help them to clasp hands with their fellow-workers on the other side that this directory has been produced. It is not a guide only to some 14,000 individuals and their subjects of study, but refers also under the heading "Laboratoria" to more than 6000 institutions where biological studies are carried on. At the end is a list of periodicals, but since these number only 357, it is so manifestly incomplete that it is scarcely worth while to notice such omissions as *NATURE* and the *Annals and Magazine of Natural History*.

Dr. Hirsch tells us that the preparation of this work has taken him a year and a half, and that 14,000 hours have been spent on it by himself and his assistants; 30,000 letters have been dispatched to all parts of the globe. When one examines the work itself one can only marvel that it did not take longer. If the work is not complete the fault probably lies less with the compiler than with those who failed to answer his inquiries. A remarkable confirmation of this supposition is furnished by the entries relating to individual members of the staff of the Natural History Museum. While all the scientific workers of the Botanical and Geological Departments (including Mr. "Rams Bottom") find a place, there are numerous omissions from the zoologists, and the Entomological Department appears to be represented only by its past and present keepers. The same applies to the workers of the Imperial Bureau of Entomology. The names are more completely given in the entries under "Laboratoria." We decline to blame Dr. Hirsch for these omissions. Some people, it is well known, from a feeling of either superiority or modesty, or probably out of mere laziness, will not send the details that are asked for by compilers of works like

this. They should not allow their own self-importance to have any say in the matter. The book is to be of use to their colleagues if not to themselves, and their refusal to take the small amount of trouble concerned will in the end react to their own disadvantage.

Fortunately, omissions of the kind just mentioned seem to be rare. Such errors as we have noticed, apart from occasional misprints, are due to the changes that have occurred since the information was collected. They will doubtless be corrected in the new editions that are promised; but we must all help by sending such corrections to Dr. Hirsch. Thus can we best show our gratitude to him and to his publisher.

Our Bookshelf.

A Guide to the Literature of Chemistry. By E. J. Crane and Prof. Austin M. Patterson. Pp. ix + 438. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 25s. net.

ANY means of simplifying the essential and ever-recurrent business of "finding it in the literature" is certain to receive a warm welcome from chemists, more particularly if the simplification is accompanied by assistance in ensuring the exhaustiveness of the process. Useful introductory monographs on such lines have, of course, been published—those, for example, by Dr. F. A. Mason, and by Marion E. Sparks—but it has been left to the present and a former editor of the American abstract journal *Chemical Abstracts* to discuss and analyse the sources of chemical information in a really detailed manner.

Those who have had experience in securing exact and complete information on any chemical subject, whether academic or industrial, will be the first to utter a word of gratitude to the authors for having produced so informative a volume; by those it will be constantly referred to as an *aide-mémoire*. The reviewer would recommend that any chemist who for the first time proposes to conduct a careful literature search should commence with an equally careful study of this book. It is, somewhat naturally, American in its features. Since the authors' claim to speak with authority is based—very securely based—on their experience in presenting the cream of the world's chemical literature in a form acceptable to American chemists, it would be strange indeed if their own journal and their own resources were not made to supply paint for their picture. Nevertheless, they insist that the literature of chemistry is international, and they have clearly endeavoured to present a well-ordered view of the whole landscape.

There are eight chapters, in which are discussed the problem and its objectives, books, periodicals, patents, other sources of information, indexes, libraries, and procedure; in addition, the eight appendices (which occupy nearly half of the book)

provide lists of articles on chemical literature, of abbreviations, American libraries, periodical-lists, organisations, periodicals, dealers and publishers, and books.

A. A. E.

Von den Follatères zur Dent de Morcles: Vegetationsmonographie aus dem Wallis. Von Dr. Helmut Gams. (Pflanzengeographische Kommission der Schweizerischen Naturforschenden Gesellschaft: Beiträge zur geobotanischen Landesaufnahme, Heft 15.) Pp. xii+760+26 Tafeln. (Bern: Verlag Hans Huber, 1927.) 39 gold marks; 48 francs.

DR. GAMS is a well-known ecologist, or perhaps one should say geobotanist, of the Zurich school, and the present volume has resulted from an intensive study of a small portion of the Rhone valley and a mountain massif overtopping it. The district dealt with in detail is only 76 square kilometres in area. The account is divided into three parts, of which the first deals fairly fully with the environmental factors. Since the country investigated has altitudes ranging from 465 m. to 2980 m., and has had a complicated geological history, these are very diverse. The second part gives a list of the woody plants with the limits of their altitudinal zonation, common names, and soil preferences, and lists of several special groups of species.

The third part, occupying nearly three-quarters of the book, deals with the vegetation. The free-living and adnate communities of Cryptogams are classified and described, the forks of a dichotomous key being interpolated among the longer descriptive paragraphs. A similar method, of keying and describing the plant communities in one sequence, is employed in the very detailed account of the rooted vegetation. The life-forms of Raunkiaer are used as a basis for the classification of the types of vegetation, though the Geophytia include therophytic and cultivated communities. The six main headings are: Hydrophytia, Helophytia, Geophytia, Hemikryptophytia, Chamäphytia, and Phanerophytia. Under each of these the floristic composition and biological conditions of many communities are described with the aid of tables, figures, and diagrams. These communities have narrow limits and correspond rather to the 'associations' of the Upsala school than to any of the vegetational groups used by those working on the successional lines initiated by Clements. The work is prefixed by a full list of the contents and is accompanied by a loose coloured vegetation map, but it has no index.

W. B. T.

A British Garden Flora: a Classification and Description of the Genera of Plants, Trees, and Shrubs represented in the Gardens of Great Britain, with Keys for their Identification. By Lieut.-Colonel J. W. C. Kirk. Pp. xi+584. (London: Edward Arnold and Co., 1927.) 42s. net.

THE object of this book is to provide a means of the generic identification of hardy and half-hardy plants grown in gardens. Although thus restricted, the volume occupies 584 pages, since no less than 1050 genera are included. After an introductory

chapter dealing with floral morphology, the principles of classification, and other subjects, a key to the 138 families concerned is provided. Then follows the main portion of the book which treats of the separate families, the Dicotyledons being arranged according to Bentham and Hooker, except that the Monochlamydeæ are split up and inserted in groups amongst the Polypetaleæ. The families are furnished with a key to the genera. Each genus is briefly described and accompanied by notes on distribution, culture, and frequently on the species of interest. The analyses and keys are original, as are also the numerous and very useful illustrations. Indications are given of the derivation and correct pronunciation of names.

The volume is the outcome of the enthusiasm of a non-professional botanist and horticulturist. It is well got up, and although a few inaccuracies may be detected, it has evidently been prepared with care. The elaboration of a key to include a selection of families from all parts of the world is somewhat of a feat, though the author's grouping of families may in certain cases appear strange; for example, the placing of the Amentiferae at the end of the Polypetalæ. Colonel Kirk's book, however, can be as warmly recommended to botanically minded horticulturists, and should also be useful to university students and others who desire information as to genera which are extra British, but are in cultivation and thus readily accessible.

A. D. C.

L'aviation actuelle: étude aérodynamique et essais des avions; l'aviation actuelle et la sécurité. Par A. Toussaint. (Nouvelle Collection scientifique.) Pp. vi+315. (Paris: Félix Alcan, 1928.) 15 francs.

THIS paper-bound volume constitutes a notable addition to the general scientific series in which it is included. The author is Director of the Aero-technical Institute of St. Cyr and chairman of the French National Committee charged with the examination of all new inventions relating to aviation. The book is comparatively small, while the subject is, of course, of considerable magnitude; but the author presents a very broad and logical treatment of aviation at the present time.

The first chapter, occupying more than half of the total space, deals in fair detail with the aerodynamics of the several elements of the aeroplane. The two succeeding chapters, of relatively short extent, are respectively concerned with studies of the complete aeroplane and with laboratory tests and air trials. The last two chapters are probably of most general interest, in that they comprise essays on the state of military, naval, and civil aviation, tabulate air records, and discuss the special problems of security in flight as dependent on construction, propulsion, and personnel. The diagrams leave something to be desired, but the treatment is adequate and interesting, although several of the more general sections are limited to the French point of view.

Molecular Physics and the Electrical Theory of Matter. By Prof. J. A. Crowther. (Text-Books of Chemical Research and Engineering.) Fourth edition. Pp. viii + 202. (London: J. and A. Churchill, 1927.) 7s. 6d.

PROF. CROWTHER has performed a great service to elementary students in producing this new edition. It has been necessary to displace part of the account of earlier atomic theories to make room for sections on the important advances of the last few years, but the greater part of the classical groundwork has been left intact. The chapter on quanta is particularly valuable, and one cannot but admire the apt metaphors with which Prof. Crowther has enlivened his subject, even if at times his statements on controversial points are unduly dogmatic. One might have expected that more space would have been devoted to the artificial disintegration of atomic nuclei by α -particles, and that more illustrations of the cloud trails of ionising particles would have been inserted; we believe also that it remains to be proved that one of the disintegration products of the nitrogen atom is helium. Prof. Crowther's task, however, has been far from easy, and altogether the result of his labours is an adequate introduction to more advanced treatises of the type of Prof. Sommerfeld's "Atombau," and to current physical literature.

Algebraic Arithmetic. By Prof. Eric T. Bell. (American Mathematical Society Colloquium Publications, Vol. 7.) Pp. iv + 180. (New York: American Mathematical Society, 1927.) n.p.

THE practice of holding summer Colloquia, at which courses of lectures on specialised branches of science are given, is worthy of consideration by some learned societies in Great Britain. Seven such summer gatherings have been held by the American Mathematical Society, and the lectures given by Prof. E. T. Bell at a recent one form the basis of the volume before us. The subject matter is intermediate between the modern analytical theory of numbers and the classical arithmetic developed by Gauss and his school. It is mainly concerned with the somewhat abstract arithmetical theories in which a few American mathematicians have found a rich field for investigation during recent years. What is given in the book is but a narrow cross-section of an extensive tract of only partially explored territory. Prof. Bell outlines a few promising directions in which progress may be made towards extending the known results of algebraic arithmetic. Many readers would be illuminated by seeing a few concrete illustrations of the theories to which these investigations lead.

W. E. H. B.

Socrates among his Peers: Three Dialogues. By Owen Grazebrook. Pp. x + 172. (London: Kegan Paul and Co., Ltd., 1927.) 6s. net.

THIS book is of special interest to the general reader in its presentation of the background of Greek social life with reference to the intellectual

contemporaries of Socrates and Plato. The author carries us back to those more leisurely times in Athens when men were able to discuss at length such problems as those of immortality, justice, and the City of God.

There are three dialogues, the first taking place after a supper-party at which Socrates is ultimately induced to give his views on death. In the hereafter, time and space lose their importance and reality, nor can they fetter the soul as they had once appeared to limit or control the body. The second conversation takes place on the evening of the verdict against Socrates, and a stranger from Eos suggests that the evidence produced by the prosecution was insufficient. The last dialogue takes place at the Academy, the supper-party consisting of four visitors, and Plato's intended departure for Sicily introduces the discussion which centres round the City of God. The treatment of the themes and the local colouring are well executed.

H. D. A.

Food and Health: an Introduction to the Study of Diet. By Mrs. A. Barbara Callow. (The World's Manuals.) Pp. 96 + 4 plates. (London: Oxford University Press, 1928.) 2s. 6d. net.

IN these days, when importunate writers in the newspaper world urge us to eat this and avoid that, and conjure up needless uncertainties, this little book, comprising 96 pages of compact trustworthy information and advice, is calculated to preserve a steady view and balance in matters of food and health, and what may be reasonably expected to follow should prudent counsel prevail. "May not a reasonable man think that a cup of tea is not food?" asked the judge. "Not a medical man, my lord," said the witness. "I said a reasonable man," the judge replied (*Times*, Law Reports, April 1, 1927). It is, of course, arguable that if the beverage contains milk and sugar, here is a food, yet scarcely nourishment in the true sense. Mrs. Callow supplies an informing well-written chapter on the discovery of vitamins; another on their restraining influence in that widely prevalent disease, rickets, is a feature. The task outlined in the introduction, "to show how a complex problem can be simplified by the application of scientific knowledge," is certainly sustained.

The Land of To-morrow: a Mule-back Trek through the Swamps and Forests of Eastern Bolivia. By Henry M. Grey. Pp. 224 + 6 plates. (London: H. F. and G. Witherby, 1927.) 12s. 6d. net.

MR. GREY does not give the date of his journey through Bolivia, but apparently it took place some two or three years before the War. He went out to inspect a rubber estate owned by an English company. The local manager and agents did not welcome Mr. Grey; in fact, he found their attitude so menacing that he thought himself fortunate to leave the country unharmed. He was travelling the whole of the time, and the book contains little more than descriptions of the difficulties and discomforts of a journey through the Bolivian forest.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Mirage: Natural and Artificial.

NATURAL mirage is due to the passage of rays of light through strata of air in which the refractive index is a function of the height of the ray above the ground. In these strata the air, though not homogenous, is isotropic, that is, its optical properties at every point are the same in all directions but vary from point to point. In natural mirage the non-homogeneous strata generally form horizontal layers, and in different conditions the air above or below the stratum may be the denser. The refractive index of a gas depend almost entirely on its density, and, hence, if the pressure is constant (which may be assumed for the thin mirage producing layers) light will travel faster as the height of the ray increases if the warm air is uppermost, and vice versa.

Mirage is seldom absent on sunny days, but the conditions which make it conspicuous, namely, a large flat area, and sufficiently rapid variation of density in the refracting strata, are comparatively rare. All the phenomena of mirage, however, can be reproduced in a space of very moderate dimensions by substituting layers of fluid of varying densities for the corresponding strata of air, and I give here a short account of some experiments I have recently made in this way, using a glass tank with parallel faces. This was half filled with water. Sugarsyrup was then carefully introduced below the water until the tank was full, and allowed to stand for some days until diffusion had produced a layer of suitable thickness, with the refractive index of water at its upper limit increasing to that of syrup below.

FIG. 1.—Hollow prism, containing layers of syrup and water (side elevation). AB, image of a vertical slit, showing by its curvature the variation of refractive index.

and allowed to stand for some days until diffusion had produced a layer of suitable thickness, with the refractive index of water at its upper limit increasing to that of syrup below.

To examine the progress of diffusion, a diagonal was drawn across one of the glass faces of the tank, and this was photographed at intervals through the fluid from the opposite end. At first the diagonal is distorted only quite close to the surface of separation of the syrup and water. After a few days the distortion, though still large, is diminishing, and the form changes very slowly. The refractive index at each level could be determined from these curves, but a more direct measure was made by photographing the image of a vertical slit through a prism containing syrup and water which had been allowed to diffuse to the same extent as the fluid in the tank.

A tracing from one of these photographs is given in Fig. 1, from which it will be seen that a very fair representation of the distribution of the refractive index can be expressed¹ by $\mu_y = \frac{\mu_1 + \mu_2}{2} \sin p_y$, where μ_y is the refractive index at level y , and $y=0$ is the plane of the original surface of separation of the fluids, p being $= 2\pi/\text{thickness of the layer of diffusion}$.

¹ This is not the curve which would be obtained from the ordinary laws of diffusion, but is quite sufficiently correct for purposes of explanation.

A plane wave surface entering the tank parallel to the face at one end, assumes during its passage through the fluid a form such as is shown at BC (Fig. 2), and rays of light proceeding from a distant object in a horizontal plane become normals to this curved surface.

The fact that the wave surface closely approaches a half length of an harmonic curve and that the rays from the distant object are tangent to its evolute,

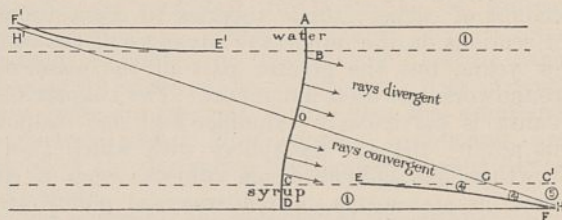


FIG. 2.—The course of rays of light passing through the fluid in the tank. AD, total depth of fluid. BC, thickness of layer in which the refractive index is variable, the curved line being the form taken by the originally plane wave surface entering the fluid at one of the faces. EF, E'F', branches of the evolute of this curve; H'OH, asymptote of the evolute.

makes it easy to describe the appearance which will be presented to the eye in any position in their subsequent course. In Fig. 2, EF and E'F' are branches of the evolute, and BC and HOH' their asymptote. The horizontal lines through B and C are the boundaries of the layer of diffusion.

Whether one or more images of the distant object are visible depends on the number of paths by which a ray can reach the position of observation.

The positions may be grouped as follows:

Position bounded by the lines.	Visible.
(1) AA' and BB' CC' and DD'	Single image; erect, un-distorted.
(2) B'BOG'	" erect, vertical scale contracted.
(3) GOC	" erect, vertical scale expanded.
(4) HGEF	Two images; one inverted, vertical scale expanded.
(5) C'GH	Three images; one inverted.

The alteration in the vertical scale depends on the convergency or divergency of the rays, e.g. of the normal to the wave front. In Fig. 2 the conditions are analogous to 'cold' mirage where the coldest air is near the ground. In physical atlases, one used to see pictures of "mirage in polar latitude," in which three ships appear one above the other, the middle one

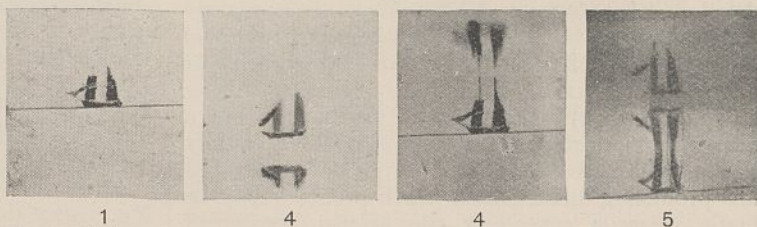


FIG. 3.—Photographs taken from positions corresponding to the points marked 1, 4, 5 in Fig. 2.

being inverted, and to reproduce this artificially a tracing-paper sketch of a ship was fixed to a window-pane and photographed through the tank. Fig. 3 gives examples of these pictures, the numbers under each referring to the position of the camera and indicated by the same numbers in Fig. 2. Some of the features of 'cold' mirage might probably be recognised in Great Britain on clear frosty mornings wherever there is a fairly large expanse of level ground.

The features of 'hot' mirage would be similar to those of cold taken in reverse order, but though 'hot'

mirage is very prevalent in desert and sandy places, I have never seen or heard of inverted images being recognised. The conditions where hot air underlies cold are much more unstable, and the occurrence of a sufficiently regular change of refractive index to produce two or three images must be rare.

The first noticeable effect of either 'hot' or 'cold' mirage is on the appearance of small objects near the horizon. 'Cold' mirage elevates the apparent horizon, while 'hot' mirage depresses it. In the former, if the base of the variable layer is above the eye of the observer, small bushes will look like trees or masts, and in the latter level ground will appear like a sea or lake.

As has been shown, a single layer of fluid of variable refractive index, increasing or decreasing regularly with the height, may give rise to three distinct images of the same object, and were it possible to have two separate layers arranged in the order, cold-warm-cold or warm-cold-warm, six images might be seen, though not all at the same time. Such a distribution would be very unstable, and probably has never been met with in Nature, but the conditions can be produced artificially by the use of thin hot plates.

I have made many experiments with hot plates and wires, some of the interference effects which can be produced by air heated in this way being very remarkable. The two described below have some bearing on the subject of mirage.

(1) *Hot Wire*.—In this experiment a beam of light parallel to the axis of a wire falls on a screen, eye-piece, or photographic plate. A heating current can be passed through the wire from its thin supports. When the wire is cold, the field of view in the eye-piece is uniformly lit by the source, except for the shadow of the supports which keep the wire in place, and show the usual interference bands visible outside and inside the geometrical contour of the shadows of small objects. If, however, the wire is heated (by a current introduced through the support) a large and intensely black area spreads round the point previously occupied by the shadow of the wire, as shown in the photograph reproduced in Fig. 4.

The dark area is bordered by brightly coloured interference bands (twelve or more can be distinguished by the eye), but these are difficult to photograph, because it is necessary



FIG. 4.—Photograph showing dark space round shadow of hot wire. The white cross marks the axis of the wire.

to use a very small source of light, which necessitates a long exposure, and the air currents set up by the heated wire cause the bands to shift irregularly.

When the wave front first meets the wire it is a plane, but on leaving, the effect of the temperature has been to produce a sort of pointed boss on the surface, not unlike that seen on some 'native' shields. The coloured bands are formed by the interference of the partial waves emanating from the region round the 'boss,' and there is no difficulty in calculating their spacing and intensity.

Though the phenomenon just described is not strictly a mirage, its origin is analogous, both depending on the curvature given to a wave surface in passing through a medium in which the refractive index is a variable.

(2) *Hot Plate*.—Another experiment showing a true

mirage may be made by substituting a thin flat plate for the wire and placing a collimeter in front of the point source of light. Between the collimeter and the plate place a straight thin wire at right angles to the axis of the beam, and parallel to the plane and the plate, and examine the image of the wire by a telescope instead of using only an eye-piece. When the plate is cold the image of the wire is straight and well defined, and the plate seen edgewise out of focus. On heating, the appearance is that shown in Fig. 5 (a), and if the wire is actually in the plane of the plate the mirage image forms a complete loop as in (b).

In natural mirage it is not to be expected that the variation of the refractive index should be uniform as in the diffusion layers of liquids in a tank, and many of the odd effects which are occasionally reported as having been seen when natural mirage is present are due to these irregularities. Such effects can be reproduced artificially by slightly disturbing the fluid in the tank or by introducing fresh fluid at any desired level.

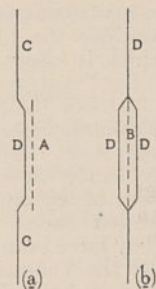


FIG. 5.—(a) Vertical wire C at a small distance from the plane of the hot plate A bent by mirage over nearly the whole depth of the plate. (b) Vertical D wire in the plane of the plate. Mirage causes the image to form a complete loop round to plate B.

A. MALLOCK.

9 Baring Crescent, Exeter.

Racial Zones and Head Indices.

In the issue of NATURE of April 7, p. 532, there is a lengthy review of my recent book, "Environment and Race," by Dr. Haddon. It is gratifying to find that so distinguished an anthropologist has many pleasant things to say about the book, but he raises one or two problems which I cannot have made clear in my discussion of racial zones.

In the first place, I would point out that the head indices given for Central African negroes were based on various authorities. Deniker gives 69.8 for the skulls of Wolofs. Many of the Guinea and Central African negroes are given as 74 or 75 as Dr. Haddon states, but practically all are lower than any quoted for the European zones to the north. The higher indices from the Cameroons and Congo basin can, I think, be fairly explained by the prevalence of a substratum of broad-headed negrito stock. I show them clearly on my map (p. 103) with many outlying negritoid tribes (marked by crosses) just where Dr. Haddon's high indices occur. To quote p. 106, "The pygmies vary considerably in cephalic index, but it seems in many cases to be 79 or 80. Their habitat extends across Central Africa." I specifically object in the book to any connexion between the broad-headed negrito in Central Africa and the Alpine races (p. 224), and I prefer to postulate a separate negrito stock which was thrust to the ends of the Old World by more progressive and later-evolved races. Thus it is not correct to say that on my theory negroes with an index of 80 "should be . . . early Alpines." It seems to me that the negro folk have head indices averaging around 73 or 74, the Hamitic folk around 75 and 76, and the Nordic around 78 and 79, etc., and the general principle of zoning is not invalidated because variations from the general average are common enough.

I feel that many of my critics disbelieve in the cephalic index as a test of race. I may mention that I consider (p. 41) the section and colour of the hair and

the nasal index as well as the cephalic index in my conclusions. My generalised map of race migrations was published in December 1919 by the *Geographical Review*. It is reproduced with only minor changes in my recent book (1927). I ask anthropologists to consider the present map of head indices (Fig. 1), which is essentially that given by Biasutti (plate vii) in his "Antropogeografia Generale" (Florence 1912). I first saw the map in 1922, and I have redrawn it on the polar projection to show the corridors of migration from Asia. My theory of migration zones is, I think, as clearly shown in Biasutti's map as in the frontispiece of my own book. There is the belt of narrow-headed races occupying Africa, India, Australia. They have been thrust away from the Bering Corridor into the Yenesei Valley and Japan. In America they are found only in the extreme east in the Hudson Bay region and in Brazil.

In Central Asia and along the main corridor to Europe are the broadest-headed races, which I call 'late Alpine.' The same types occur down the corridor in the west of the Americas. May I quote

in anything anthropological save the Australian aboriginal. I am the more grateful for its kindly reception.

University of Sydney,
May 15.

GRIFFITH TAYLOR.

EXPERIENCE has shown that it is often dangerous to place too great reliance upon averages when dealing with distributions, and this is particularly the case with the head index. In a map of the world on a very small scale, it is impossible to avoid broad generalisations which mask important racial movements; as an example, one has only to compare Arabia and India in Prof. Griffith Taylor's diagram of Biasutti's pl. vii. with the original.

The broad facts of a zonal distribution of the head index are clearly brought out in Griffith Taylor's maps, but it appears to me that they are apt to produce a wrong impression on those who have not made a study of human races and their distribution. The pleasing simplicity of this presentation is a snare, as

the problem is really a very complex one. Perhaps I should not have referred in my review to 'early Alpines,' since Griffith Taylor had left a loophole for brachycephaly in Central Africa as being due to a Negrillo element on p. 106, though on p. 225 he refers to this stock as "comparatively narrow-headed as in Africa." I would like to take this opportunity to say that I consider the polar projection maps of Griffith Taylor to be of very great value in showing the corridors of migration by land. A. C. HADDON.

The Reflection of X-rays from Glass and Quartz.

It is well known from the work of Compton and others that X-rays can be reflected at glancing angles up to about 40° , and Holweck claims to have observed reflection at $16^\circ.2$.

We have obtained evidence of reflection of X-rays of about 50 Å from glass and quartz up to glancing

angles of 45° , the maximum observable in the spectrometer used. The X-rays from a target upon which electrons from a Wehnelt cathode are incident, are reflected from the glass or quartz plate in a vacuum spectrometer on to Schumann film. This reflecting plate is mounted in the place of the crystal of the spectrometer. Copper and carbon targets, with difference of potential between cathode and target of 10,000 and 375 volts respectively, have been used.

The photograph obtained with the reflected rays shows a laterally inverted slit image of the focal spot, and the angle of incidence is accurately equal to the angle of reflection.

The ratio of the intensity of the incident to the reflected beam with the carbon target is about 2 to 1 up to angles of 35° . Above 35° the intensity of the reflected ray diminishes.

The question arises whether the radiation reflected is X-rays, or ultra-violet light in the Millikan-Lyman region, or cathode rays. As the photographic film is enclosed and placed opposite the slit (0.05 mm. wide) in a metal box which is at the potential of the negative end of the filament of the cathode, the rays cannot be cathode rays.

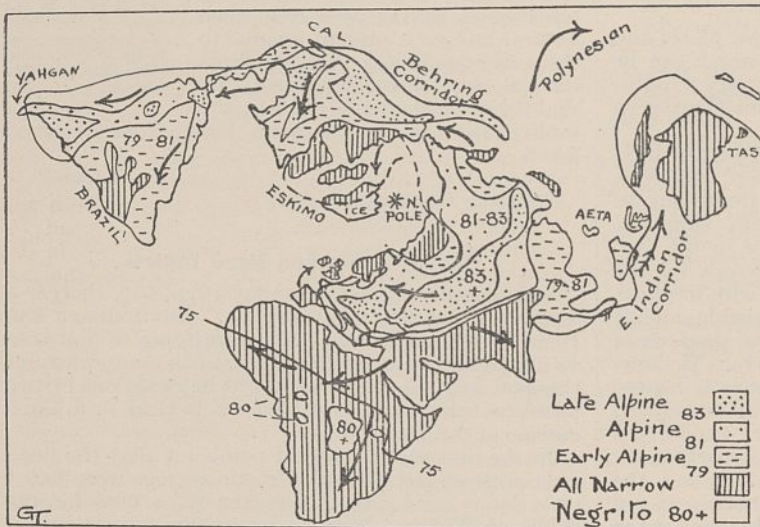


FIG. 1.—Distribution of head index (after Biasutti). The migration arrows and the isokeph for 75 in Africa added.

Dr. Maret's review in which he says of this 'migration-zone' theory that it is "a working hypothesis of singular breadth and completeness"? What alternative is there to my theory which will explain these zones? As I point out in my book, it is from the ethnological fossil record (*i.e.* in archaeological strata, etc.) that we shall learn the evolution of the races of man. I advance evidence to show that the order of these zones is repeated in the ethnological strata, where they have been investigated. Hence the Alpine races appear to be evolved more lately than the Mediterranean or negroid races.

Finally, I may perhaps be permitted to mention that it was partly due to a discussion with Dr. Haddon on our journey to Broken Hill in 1923 that I relegated most of my brief and specifically 'tentative' account of culture to an appendix. One form of culture, language, I have discussed more fully; and I have tried to show how and why language zones and racial zones do not agree (p. 162).

It can be but rarely that a text-book has been written under such disabilities as affected that under discussion. When preparing the book in Australia (with the exception mentioned above) I had never come in contact with any expert who had an interest

The radiation (1) is absorbed by glass and fluorite; (2) penetrates aluminium foil 0.0006 mm. thick; (3) has an intensity (as measured by the action on the film) which is determined by the current in the tube at constant potential. (1) excludes the region from about 8000 Å. to 1200 Å. of the spectrum; (2) excludes the Millikan-Lyman region; and (3) is consistent with the hypothesis that the radiation is X-radiation which is emitted according to the usual laws. With 375 volts potential difference and a carbon target the radiation will consist mainly of the *K* line of carbon of 45 Å.

The results obtained do not appear to be reconcilable with the Lorentz dispersion formula.

If these preliminary observations have been correctly interpreted, X-rays can be reflected from spherical surfaces and brought to a focus. This makes possible new methods for the study of long X-rays.

T. H. LABY.
J. SHEARER.
R. BINGHAM.

University, Melbourne,
June 26.

A Cartesian Diver Experiment.

MOST of us are familiar with the lecture-table experiment known as the Cartesian Diver. A variation of this is shown in Fig. 1*a*. In this apparatus the diver is replaced by a test-tube *T* floating upside down in the water, being buoyed up by just the right quantity of air, *A*. The tall jar is nearly filled with water, and then capped by a rubber membrane tied on tightly. When the membrane is pressed in, the pressure of the air just below it is communicated through the water to the air, *A*, within the test-tube (thus illustrating Pascal's principle). This lessens the volume of the air, and thus its buoyant force (thus illustrating Archimedes' principle), and consequently the test-tube sinks. The tube may therefore be caused to float or sink or remain stationary in the water by suitable pressure on the rubber membrane.

In the further modification which I am about to describe, the rubber membrane is replaced by an india-rubber stopper, but the change of pressure may be produced in another way. A bottle (Fig. 1*b*), about 9 in. high, of oval cross-section (such as is sold with patent medicines), is filled with water. In it is placed, upside down, a little glass tube (a small phial or specimen tube), just buoyed up with the right amount of air so that it floats.

A rubber stopper is inserted in the neck of the bottle, either eliminating all the air or leaving in just a bubble. A slight adjustment of the stopper makes the little tube either sink or rise, as before. The interesting point now is that if when the tube is floating, the bottle is grasped in the hands and squeezed hard in the directions *BB*, the tube sinks. Also that if when the tube is at the bottom, the bottle is squeezed hard in the directions *AA*, the tube rises.

The phenomenon thus illustrates the change of volume brought about by deforming the cross-section of the bottle. Squeezing at *AA* makes the cross-section more circular, thus increasing the area;

squeezing at *BB* makes the cross-section more elliptical, thus decreasing the area.

The bottle experiment was brought to my notice by one of my students, Mr. A. E. Allin, and it deserves a wider acquaintance.

JOHN SATTERLY.
University of Toronto.

The Spectrum of Ionised Sodium.

WITH reference to the interesting and important note by O. Laporte in NATURE of June 16, p. 941, the pairs of differences in the wave numbers which I found in the Na II spectrum do not appear to be accidental. For example, using Laporte's notation:

$$\begin{aligned} p_5 - p_4 &= 218 \\ p_6 - p_5 &= 697 \\ p_8 - p_4 &= 2467 \\ p_{10} - p_2 &= 7285 \end{aligned}$$

and it is probable that the other pairs of differences will be found as differences between the values of the *s'*, *d*, and *d'* terms, which, from the preliminary analysis of Laporte, appear to resemble in number those found by Paschen in the analysis of the Ne I spectrum. Mazumdar (*Indian Journal of Physics*, p. 345; 1928) has noted, previously, that the frequency differences between the four lower levels 3P_2 , 3P_1 , 3P_0 , 1P_1 are respectively, 765, 592, and 2481 cm.⁻¹, and he has arranged the multiplets from the combinations $6L_2 \leftarrow 5L_2M_1 \leftarrow 5L_2M_2$ and $5L_2(M_2 \leftarrow M_3)$, but in his classification *SPD* terms correspond to the *p* terms of Laporte.

It is to be expected that the Na II spectrum will yield on analysis series similar to those found by Paschen for Ne I, but more experimental work in the Schumann region is required before any such analysis can be completed.

F. H. NEWMAN.

University College of the
South-West of England,
Exeter, June 23.

Monomolecular Films.

WE have read with great interest the letter of Messrs. Sheppard and Keenan in NATURE of June 23 (p. 982). Some recent experiments we have made with monomolecular films of the elastic jelly of vulcanised triolein lend support to the second of their two suggestions to account for the very low values for the film thickness of cellulose esters spread on mercury. They suggest that the low value of the thickness represents the thickness of a polymeric chain or sheet.

We have examined vulcanised triolein, and a series of polymerised products of increasing molecular weight obtained from it (P. Stamberger, *Rec. Trav. Chim. Pays-Bas*, 46, 837; 1927). Increasing degree of polymerisation is paralleled by change from a viscous liquid to an elastic solid. We have measured the thickness of films on water of products containing one, two, and at least seven molecules of vulcanised triolein. The latter product is a fairly elastic solid. The thickness of the films of all these products is practically the same, namely, about 14-16 Å. at 16° C. The value for triolein is 13.0 Å. From these measurements, and measurements on the vulcanised fatty acids obtained by saponification, we conclude that in the polymerised products the molecules are joined side by side in a definitely oriented manner in long chains, leaving the polar groups unaltered. Full details of this work are shortly to be published.

B. C. J. G. KNIGHT.
P. STAMBERGER.

Chemistry Department,
University College, London,
June 27.

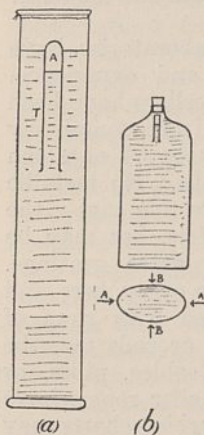


FIG. 1.

The Geophysical Institute at Bergen.

By Prof. D'ARCY W. THOMPSON, C.B., F.R.S.

THE little northern town of Bergen, sea-port, fishing-haven, market town, has done more for science in the last two or three generations than many—not to say most—university towns. Its Museum, famous both on its zoological and its archaeological sides, is the focus of a number of institutions, libraries, museums, and laboratories, which form among them a real academic community. Prof. Kolderup, the mineralogist, is the present director of the Museum, with such men as Prof. Brinkmann and Mr. James Grieg to help him on one side, and Prof. Haakon Shetelig (a well-known authority on Runic inscriptions) on the other.

I remember the Museum forty years ago, when Danielsson was director, and Fridtjof Nansen had charge of the zoological collections—Danielsson who, with his friend Koren (a medical practitioner), had added a host of beautiful deep-sea things to the European fauna, and Nansen, who had just discovered (almost simultaneously with Cunningham) the hermaphrodite nature of the Hagfish and had written his beautiful memoir on *Myxostoma*, a curious parasite of the Feather-stars. Some few years before, the Bergen fjords had been explored by that great naturalist Michael Sars, parish priest on a neighbouring island, and by his young son George Ossian Sars, afterwards not less famous than the father; of whom the elder was the pioneer of all that deep-sea exploration which captivated Wyville Thomson and Carpenter and their friends, and culminated at length in the *Challenger* Expedition, while the younger laid one of the foundation stones of our scientific study of the fisheries by his discovery of the multitudinous eggs of the cod floating transparent and invisible at the surface of the sea.

For the last thirty years or more the work of Norwegian geophysicists and hydrographers has been no less important than that of their brother naturalists; indeed in several cases, as in Nansen's own, one and the same man has been distinguished both as naturalist and as physicist. Oslo has played its part in this work, but it is Bergen that has done the lion's share; and last month, on June 7, there was opened in Bergen a new and splendid Geophysical Institute, built wholly at the cost of Bergen men, without a penny of subsidy from the State. The chairman of the inaugural meeting was Mr. Johan Lothe, the leading apothecary in the town, president of Bergen's Museum, a generous donor to the new Institute; the Prime Minister, Mr. J. L. Mowinckel, a Bergen shipowner, was also there, whose munificent contributions to the new building had been larger still. Many and many an opulent British town might learn the A B C of civic pride and patriotism from the town of Bergen.

The new Institute is a handsome building, set in a fine avenue of old trees and built on a bluff commanding an extensive view over the fjord and the islands and out to sea. It consists of

three main storeys, with ample cellage below, and a central tower containing three more flats in which the meteorologists have their quarters. Here they not only receive their weather reports from the usual network of wireless stations, but all the while they keep watch on the sky and draw their forecasts largely therefrom, after the manner of the Norwegian school of meteorologists. Dr. Jacob Bjerknes, who represents the third generation of his distinguished family, is in charge of the meteorological part of the Institute.

The ground floor contains chemical laboratories and the main part of the physical laboratories: these being under Prof. Helland-Hansen's charge. The work to be carried on here consists of geophysical investigations of various kinds, particularly studies of wind and water-currents from the dynamical point of view, that is to say, in relation to, or in verification of, the theoretical work of V. Bjerknes, Walfrid Ekman, Sverdrup, Hesselberg, and Helland-Hansen himself. The *Armauer Hansen*, a small but very seaworthy vessel, is at hand for the purpose of these investigations; and it is characteristic of the Institute that all its staff are travellers and explorers as well as laboratory men. The *Armauer Hansen* is a little yawl of 58 tons burden, with a 40 h.p. motor to work the winches and to drive the vessel in case of need; and with this little boat the Bergen oceanographers have surveyed the whole north-eastern Atlantic as far as Rockall, the Azores and Madeira, again and again.

The fittings of the physical laboratories have been planned with great care and experience. No less than five rooms and two cellars have been arranged for magnetic work, and are completely enclosed in a Faraday cage, the network of which is hidden in the plaster of the walls. No metallic circuits of any kind enter or leave this cage; the iron window-frames form part of it, but may be supplemented if need arise by extra gratings. Many small 'gadgets' strike one every here and there. The ceilings are all fitted with rows of screw-sockets, into which hooks or rods may be screwed for the suspension of cables, pipes, or apparatus of any kind. The smaller rooms have their walls covered with jute, on which charts may be pinned. The furniture, desks, tables, drawers, etc., is all standardised and interchangeable. I was struck by the beauty of the woodwork everywhere.

The chemical laboratories will be employed largely in the titration of water samples for chlorine and for oxygen; one or two rooms are arranged for work at constant temperatures, the thermoregulators being controlled by bi-metallic rods. A lift brings up the water-samples from store-rooms in the basement. The experimental tank is placed in the cellage; it is built of reinforced concrete, and is 15 m. long by 1.2 m. broad, and 1 m. deep. Three pairs of large glass windows are

let into its sides for the study of sub-surface waves, vortices, and the like; and an electric tramway for the propulsion of current meters, etc., runs along overhead. Another and more unusual possession of the Institute is a disused railway tunnel, which runs for some 140 m. at a depth of 15 m. below the building. It has a constant temperature of 10°C. , a little above the mean temperature of Bergen; and in this long, calm and uniformly heated tube it is hoped that various important aerodynamical experiments may be carried on.

The laboratories on the next floor are for Dr. H. U. Sverdrup, the well-known physicist and explorer, and for Dr. Krogness. Dr. Sverdrup will have his hands full for some few years to come with the observations made on his recent expedition on the *Maud* to the Siberian coast and Arctic Ocean. He and his colleagues believe that the work of this expedition has been of the very first importance on the geophysical side, next after the classical results of Nansen on the *Fram*; and they think that, profiting by all recent experience and using every modern method and device, they have brought home in the *Maud* the finest oceanographical material ever collected by any expedition. The scientific results of the *Maud* expedition are to be brought out as a separate publication of the Geofysisk Institut; and meanwhile her splendid outfit of apparatus makes a considerable part of the new laboratories' equipment.

While Dr. Sverdrup concerns himself chiefly with theoretical meteorology, Dr. Krogness occupies himself with terrestrial magnetism and cosmical physics. He is about to work up the magnetic observations from all over Norway in his new laboratory, and to undertake for the first time a magnetic survey of the whole country. In this work he is associated with a special commission including Prof. Störmer of Oslo, Prof. Saeland, Rector of the University there, and Prof. Lars Vegard, all three well-known students of terrestrial magnetism, while Dr. Störmer is famous for his mathematical studies of the aurora, for his calculation of the orbits of the cathode rays coming from the sun and of the influence of the earth's magnetism on their paths. Dr. Hesselberg, director of the Meteorological Institute in Oslo, is also associated with these investigations.

Going back for a moment to what I have been saying about the theoretical aspect of Norwegian oceanographical work, a beautiful example of the relation between observed fact and dynamical calculation is not far to seek, apart from the well-known and indispensable theorems due to V. Bjerknes. Recent cruises of the *Armauer Hansen* have added much to our knowledge of the course of the great North Atlantic Current popularly known as the Gulf Stream; and in a recent number of the *Geofysiske Publikasjoner*, Helland-Hansen and Fridtjof Nansen together have not only described its course and branching, but also have brought these phenomena into line with a beautiful theorem of Prof. Walfrid Ekman's. This theorem, published in the *Arkiv för Matematik*

about five years ago, is an extension of, or corollary to, the well-known theorems which show how rotation of the earth influences the direction of an ocean current—a matter which one was apt to think had been fully explained. Coming from the westward, the great current reaches mid-Atlantic far to the west of the Bay of Biscay and about half-way between Rockall and the Azores. Here it swerves somewhat abruptly to the southward and presently divides into two branches (see Fig. 1); one, turning sharply northward towards the Porcupine and Rockall Channel, passes thence onwards into the Norwegian Sea; while the other

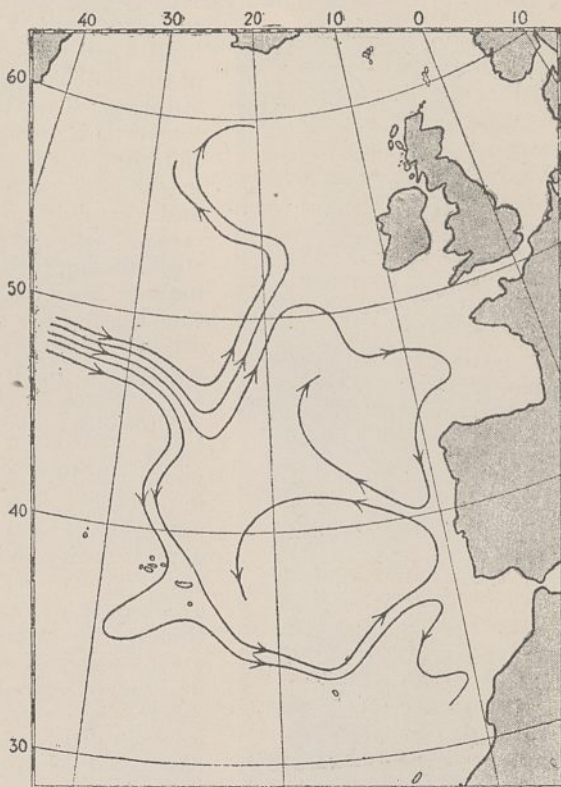


FIG. 1.—Skeleton-representation of the general sub-surface circulation of the eastern North Atlantic. From *Geofysiske Publikasjoner*, Vol. 4, No. 2.

and lesser branch continues to bend southwards towards the Azores, and then flows westward with more and more devious windings to Madeira and the Portuguese coast. Ekman's dynamical theorem tells us that a current flowing from a shallower to a deeper sea will (in the northern hemisphere) tend to be slewed to the left, and vice versa; this law holding good even though the depths be very great. Now there is a well-known 'Longitudinal Ridge' running north and south, midway through the crooked river-channel of the Atlantic; again, from the Azores to Madeira, the bottom stands somewhat higher than in the basins to the north and south, while between Madeira and Portugal soundings are variable and the topography complicated. Putting two and two together we see (or rather we are shown) how the great current bends southward (*i.e.* to the right) just when, and just because, it reaches

the comparatively shallow water over the Longitudinal Ridge. Next, that part of the current which is first to cross the ridge is sharply deflected to the left when (and because) it reaches the deep water on the eastern side, and so it shapes its course northward towards the Porcupine Bank and the seas beyond; while the other and lesser portion of the great current is slewed more and

more to the right as it follows the shallow waters towards the Azores. Passing Madeira and approaching the Portuguese coast, the course of the current becomes extremely complicated; and "it stands to reason" (as our authors say) that it is here closely following, in all its constant twists and turns, the ups and downs of the complicated topography of the bottom.

Heterogeneity of Steel Ingots.

WHEN a mass of molten steel, originally of uniform composition, solidifies, the analysis of the resulting ingot shows variations from point

to point due to local segregations of the various constituents. The extent of this variation differs widely in different cases, and certainly increases with poor steel-making technique. Even with the best of conditions, however, segregation inevitably occurs, and the Iron and Steel Institute appointed in 1924 an important committee to investigate this point and to discover, amongst other things, to what extent segregation must be considered to be inevitable even with the very best steel-making practice.

The first report of this Committee was published in the *Journal of the Iron and Steel Institute*, vol. 113, in 1926, and dealt in an exceedingly able manner with segregation in plain carbon steels which were free from blow-holes. It was shown that the ingot could be divided up into

axis. Outside this are found a series of segregated zones of Λ shape separating the steel in the centre from another purer region under the skin. The most highly segregated field occurs at the top of the ingot just below the cavity in the feederhead, and from this the Λ segregates descend somewhat as do the fangs from a tooth. Finally, there is a series of V-shaped segregates extending down the axis of the ingot which may be connected with similarly shaped and situated flaws, due to contraction in the solid state. Fig. 1, which represents the sulphur print of an ingot of a nickel-chromium steel weighing 49 tons, shows these segregations clearly.

In a second report, recently published, the whole question is carried much further, and again comprises an account of some extremely careful work. It considers, first, segregation in sound alloy steels, and, secondly, segregation in ingots of carbon steel which had been deliberately produced highly charged with gas. This, on the solidification of the metal, had been liberated in part and produced blow-holes.

Dealing in the first place with the alloy steels of the nickel, nickel-chrome, and nickel-chrome-molybdenum types, ingots from 15 cwt. to nearly 120 tons have been examined and, generally speaking, the results obtained are closely similar to those given by the plain carbon steels. It is shown again that the degree of segregation normally increases as the size of the ingot increases. Nickel, although it does itself segregate, does so only to a minor degree, and in, for example, an ingot weighing roughly 3 tons, the nickel content in the highest analysis was 3.16 per cent, and in the lowest 3.05 per cent. There is also some reason to believe that the presence of this element has an influence in decreasing the extent of segregation of other elements, and taking, for example, a nickel and a plain carbon steel ingot of roughly similar size, the figures given below may be cited.

Element.	Nickel Steel Ingot.			Carbon Steel Ingot.		
	Highest (per cent).	Lowest (per cent).	Range (per cent).	Highest (per cent).	Lowest (per cent).	Range ¹ (per cent).
Carbon	0.32	0.28	13	0.43	0.32	32
Sulphur	0.049	0.024	59	0.047	0.032	37
Phosphorus	0.032	0.022	29	0.055	0.039	37
Nickel	3.16	3.05	3.5	nil	nil	..

¹ Calculated on mean composition of ingot.

Although there is a slightly greater segregation of sulphur, in the nickel steel ingot the segregation of both carbon and phosphorus is reduced.

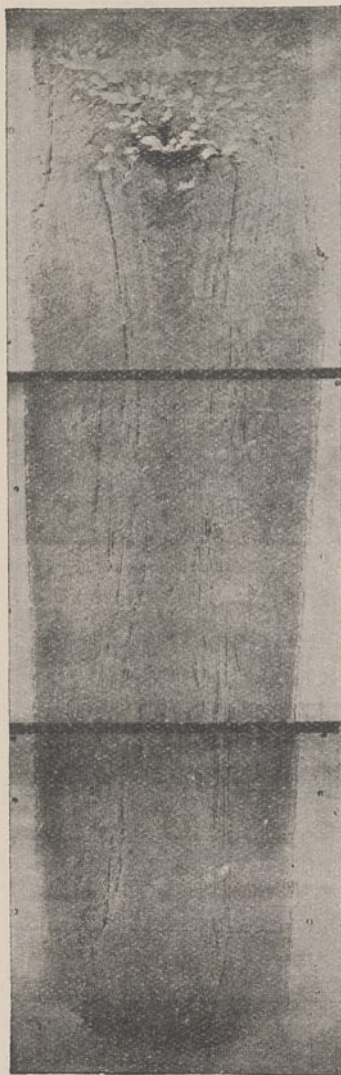


Fig. 1.—Sulphur print of an ingot of nickel-chromium steel showing Λ - and V-shaped segregations. From the Second Report to the Iron and Steel Institute of the Committee on the Heterogeneity of Steel Ingots.

zones purer than the average, and others in which definite segregation was to be detected. The lower part of the ingot, for example, is relatively very pure, and a region, shaped something like a sugar-loaf, extends upwards from the base along the central

A point of very considerable interest is raised as a result of analyses which have been made on two similar ingots of a nickel-chrome steel weighing 2 tons 4 cwt. each. These ingots were prepared from the same electric furnace heat and differ only in the temperature at which they were cast and the speed of pouring. Ingot *B* was cast at an average temperature of 1590°C ., and *D* was poured at 1550°C . The time of pouring of *B* was 3 min. 40 sec., while *D* was poured very much more rapidly in 2 min. 10 sec. The amount of segregation in ingot *B* was very distinctly less than that of the other ingot *D*. Expressing the maximum degree of segregation as the percentage difference of the maximum and minimum figures when compared with the average for the whole ingot, this range was for carbon 14 per cent in the case of ingot *B* and 24 per cent in the case of *D*. Manganese, which segregates only to a minor extent, showed no difference in the two ingots, the range being 7 per cent for each. In the case of silicon the range was 7 per cent for ingot *B* against 15 per cent for ingot *D*. The same phenomenon is shown for sulphur, phosphorus (where it is particularly marked), nickel, and chromium: the sulphur figures being 12 per cent and 25 per cent: phosphorus 7 per cent and 33 per cent: nickel 2 per cent and 3.5 per cent: and chromium 3 per cent and 4 per cent.

Another case of very considerable interest from the point of view of armament and special engineering material was a 119-ton ingot of nickel-chrome-molybdenum steel. Compared with a plain carbon ingot of similar dimensions, it is shown that the segregation of carbon, sulphur, and phosphorus has not been materially affected by the alloying elements in this size of ingot. Segregation of all three special elements is observed, nickel to a minor extent, the maximum variation being only about 5 per cent of the mean analysis; chromium to a considerable degree, about 30 per cent, and molybdenum to a very marked extent, giving a range of composition of 70 per cent. The regions in which these special elements segregate are roughly the same as those selected by the elements in the plain carbon steels.

The report then passes on to the consideration of heterogeneity in steel ingots which had not been 'killed,' that is to say, which were made from steel supersaturated with gas. The Committee points out that such ingots are representative of the great tonnage of steel produced for the manufacture of plates, sections, and other general purposes. Such ingots are chiefly characterised by the facts that the steels have low carbon and silicon contents and are cast in moulds which are not provided with feeder-heads. During the freezing of the liquid steel, there is a liberation of gas which results in the production of blow-holes in certain zones of

the ingot, and it is the influence of this factor in modifying the degree and form of the heterogeneity to be found which has been considered. Owing to the volume of the blow-holes, the 'pipe' or central shrinkage cavity of the 'killed' ingot does not occur, and the fact that the small blow-holes in this class of material may weld up during the rolling process causes a much higher yield of marketable material to be produced. In the case

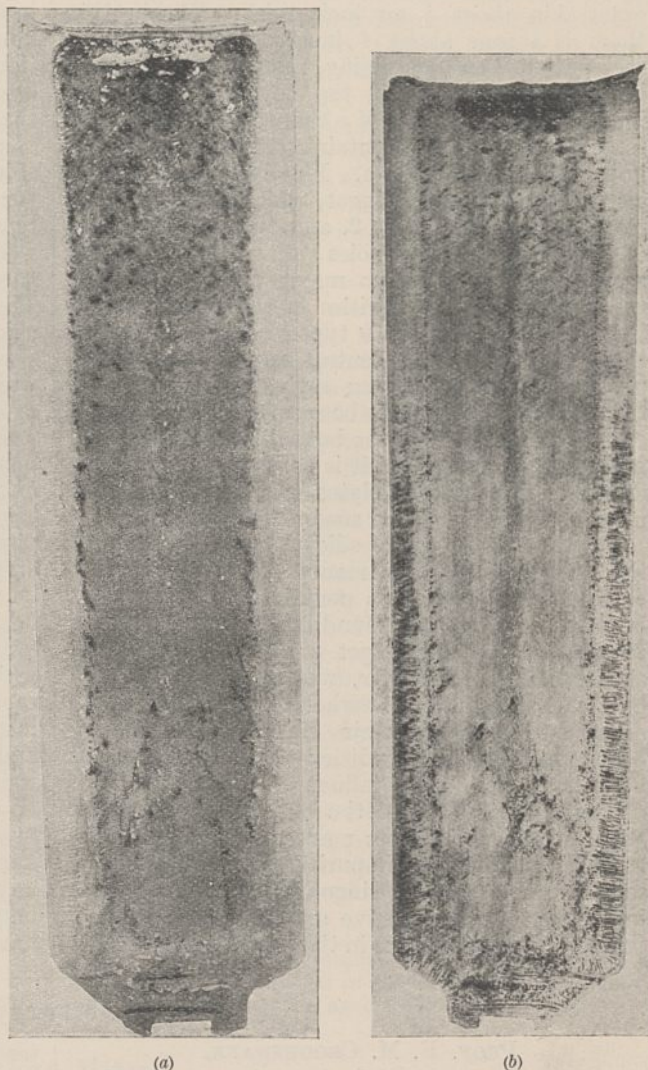


FIG. 2.—Ingot of non-piping steel. (a) Sulphur print; (b) macro-etching. From the Second Report to the Iron and Steel Institute of the Committee on the Heterogeneity of Steel Ingots.

of steel required to withstand the most severe conditions of surface, the greatest precautions must be taken to reduce the gas content to a minimum, but it is neither necessary, nor economically practicable, to carry out the degasification to this degree in steel for the more common purposes. In fact, it is sometimes found to be actually desirable, in order to produce certain qualities in the finished product, to cast the steel while it is highly charged with gas.

As an example of one of the more extreme cases

may be quoted an ingot of steel intended for the production of weldless tubes by the Pilger process. This ingot, weighing just above 3 tons, was made by the basic Siemens process and was of the following average composition: Carbon, 0.064; manganese, 0.35; silicon, 0.012; sulphur, 0.039; phosphorus, 0.010 per cent. The sulphur print and the macro-etched structure are shown in Fig. 2 (a) and (b). It will be seen that four zones may be distinguished. There is, first, a thin solid outer skin about $\frac{1}{2}$ an inch thick. Within this there is a zone about 4 inches thick free from segregation but containing numerous elongated blow-holes, especially in the bottom half of the ingot. Zone 3 consists of a thin envelope of highly segregated material containing numerous blow-holes of globular form. Finally, there is the central portion of the ingot, which appears to be more impure than zone 2, and the upper portion of which contains blow-holes both with and without segregates. There is no major pipe cavity, but there are shrinkage cavities in the centre of the ingot and traces of the ∇ type of segregation. In the lower half of the central zone a particularly unsound area containing segregated regions of rather peculiar form is to be seen. An explanation of this unsoundness of the bottom of this ingot has not yet been found, but it is possible that the condition of the bottom plates on which the ingot mould had rested played some part in it.

Except in the case of silicon, the magnitude of the segregation phenomenon for the various elements in these steels containing blow-holes is of the same order as is found in the 'killed' piping steels. In the tube ingot a high value for the silicon content, however, was detected near the bottom of the ingot, but whether this would occur normally is still uncertain, since, as has already been mentioned, the condition of the bottom plates may have had some influence. Concerning the general distribution of the elements there is in these ingots, as in those made from piping steels, a concentration of the impurities (excepting silicon) in the upper parts of the ingot, though there is little indication of the negative segregation of carbon, sulphur, and phosphorus in the lower central region.

All the ingots show evidence of an increased silicon content in the lower middle portion to an even more marked degree than do the ingots of the 'piping' type dealt with in the first report. The ingots, further, contain ∇ segregates near the central axis, though these are not so distinct as they are in the piping steels. The tube steel did not show the Λ segregate, though in the case of 'semi-killed' ingots this is again found, confined, however, in general, to a very narrow zone, except in the case of two ingots which had been cast at a low temperature. A distinctly interesting observation was made in connexion with an ingot weighing 3 tons 6 cwt. of a 'free-cutting' steel produced by the basic open-hearth process. The composition of this material was carbon 0.12, manganese 0.66, silicon 0.03, sulphur 0.113, and phosphorus 0.098 per cent respectively. Although the silicon content is very low and no additions of aluminium were made, the ingot showed the typical structure and features of ingots of 'killed' steel. The liberation of gases which is typical of low silicon, 'unkilled' steel has in this case been prevented by the high content of sulphur, an element which evidently acts as a powerful deoxidising agent.

The present report concludes with interim statements of work which is being done in the University of Sheffield on changes of the density of steel in the neighbourhood of the melting point and the viscosity of molten steel, and also researches being carried out at the Royal Technical College, Glasgow, on the freezing and melting ranges of the steels dealt with in the two reports and on the sulphides present in these steels. The amount of work which has been carried out for the purpose of these reports by the steel-making firms and metallurgical institutions of Great Britain is extremely great, and the value of the work when it is complete, both to the manufacturer of steel and to the user, cannot be over-estimated. As an example of a scientific investigation of a point of practical metallurgical importance, it would be difficult to call to mind any previous piece of work of this magnitude carried out with anything like the care and industry which has been shown in the present case. F. C. T.

Obituary.

PROF. E. M. CROOKSHANK.

THE sudden death of Prof. Crookshank on July 1 removes one who was a pioneer of bacteriology in Great Britain. He came of a family of soldiers, but at an early age showed a liking for scientific work, and after school days was first a pupil of Sir Ray Lankester at University College, whose teaching doubtless influenced his choice of career. Obtaining a science exhibition at King's College, London, he entered there as a medical student, and finally graduated as M.B. with honours in the University of London. During his training at King's College, Lister arrived in London to become surgeon to King's College Hospital, and Crookshank was one of his dressers and afterwards house surgeon at the Hospital. He thus early became imbued with the

teaching of Lister and acquainted with the germ theory of disease. In consequence of his experience under Lister he was selected for special duty in the Egyptian Expedition of 1882, was present at the battle of Tel-el-Kebir, and received the medal and Khedive's star for his services. He wrote a report on the antiseptic methods employed in the campaign and gave valuable evidence before the Royal Commission on Medical Services in Egypt.

Following this, Crookshank decided to take up bacteriology as a career, and proceeded to study in Paris under Pasteur, and afterwards in Berlin under Robert Koch. Returning to London, he published in 1886 his "Manual of Bacteriology," which passed through four editions, was translated into French, and was the standard text-book of bacteriology at

the time in England. It was illustrated with many beautiful coloured plates, drawn, some by himself and others by Mrs. Crookshank. He was elected at about this time to a professorship of bacteriology in King's College, London, and founded there the first laboratory of bacteriology to be established in Great Britain.

Crookshank now devoted himself to research and educational work. He studied photomicrography, and in 1887 published a volume entitled "Photography of Bacteria." Many of his photomicrographs of this early period are excellent, and scarcely to be bettered now. In 1885 and 1886 he was studying the malaria parasite and trypanosomes. He was one of the first to recognise and confirm Laveran's work on the malaria parasite, and also confirmed the work of Evans on the trypanosome of surra, a disease of horses; and he published a paper in the *Journal of the Royal Microscopical Society* (1886) on the trypanosome of the rat, and his study of this parasite left little for later investigators to describe as regards its morphology and structure. Crookshank now in quick succession undertook researches on behalf of the Government, and furnished reports to the Agricultural Department of the Privy Council on scarlet fever and the Hendon cow disease (1887); anthrax, particularly in swine (1888); tuberculosis and actinomycosis in cattle (1888). His investigation of the Hendon outbreak of disease in cows, also of a similar outbreak in Wiltshire, proved that the condition was one of cow-pox.

This doubtless directed Crookshank's attention to smallpox and vaccination, with the result that he published in 1889 a considerable work in two large volumes on the "History and Pathology of Vaccination." He surveyed the earlier literature, and for this purpose the old book shops of Leipzig and elsewhere were searched for early and rare tracts and treatises, of which he acquired a unique collection. His views on the subject were decidedly heterodox, and at the time gained few adherents, though his criticism of some of the then popular conceptions would now be admitted as sound. He also studied the bacterial flora of calf-lymph, and while isolating numerous species from it, definitely asserted that not one of them is peculiar to vaccine

lymph, and that the nature of the contagion is unknown.

With the exception of two papers on the chemistry of Koch's old tuberculin, this was Crookshank's last work of scientific importance, and in 1901 he resigned his professorship, being elected emeritus professor, and retired to his estate near East Grinstead. Here, while taking his share in local interests and becoming a Justice of the Peace, he maintained to the last a keen interest in scientific work and took a deep and active interest in the Royal Veterinary College, where he had lectured in early years, and of which he was a governor for nearly forty years, and had much to do with the recent developments in that institution.

Crookshank travelled much, was a keen fisherman, a good shot, and a skilled hunter of big game. Within the last year he had the good fortune to find and excavate some interesting Roman remains on his estate.

R. T. HEWLETT.

As a result of a motor-cycle accident near Aberdeen on July 2, Mr. Alexander Reid has died at the early age of twenty-two years. A young man of great personal charm and scientific promise, he took his degree with honours in mathematics and natural philosophy two years ago at the University of Aberdeen. Since then he has been engaged in teaching and research. His work on the diffraction of cathode rays through thin films of celluloid, a preliminary account of which appeared in *NATURE* a year ago, has attracted wide interest. By a melancholy coincidence his definitive paper appeared in the *Proceedings of the Royal Society* within a day or two of his death. His remarkable success in the short time allowed him makes his early death peculiarly tragic, and his lovable nature had endeared him to all who knew him.

WE regret to announce the following deaths:—

Sir Frank Sly, K.C.S.I., formerly Governor of the Central Provinces, who took a prominent part in the development of agricultural research in India, on July 16, aged sixty-two years.

Sir George Wills, Bart., president of the Imperial Tobacco Company, a munificent benefactor of the University of Bristol and of the Bristol Museum and Art Gallery, on July 11, aged seventy-four years.

News and Views.

MANY scientific workers will remember the disappointment caused at the Oxford meeting of the British Association by the exclusion of a film of Chilian and Peruvian birds with which Mr. R. C. Murphy, of the American Museum of Natural History, had intended to illustrate a lecture. This year two similar incidents have occurred. Mr. Beebe, the eminent naturalist, was obliged to pay full duty on a film of a microscopical subject which he introduced for the purpose of exhibition to a learned society, and Mr. Wright, the distinguished American astronomer, who wished to use a film to illustrate a lecture before the Royal Astronomical Society, not only had to pay duty on his film, but was also put to a good

deal of trouble by the Customs authorities. On hearing of Mr. Beebe's experience, the Association of Scientific Workers communicated with the Financial Secretary of the Treasury asking, either that special concessions should be granted as a matter of courtesy to accredited scientific workers wishing to introduce such films from abroad, or that the Finance Act be so amended as to allow for their importation without payment of duty. Independently, Captain Ian Fraser moved an amendment to the Finance Act of 1925 in the House of Commons on July 3 to the same effect. No decision has yet been reached, but, replying in the House of Commons to a question put by Sir Harry Brittain, the Financial Secretary to the Treasury

stated that his attention had been directed to the case of a distinguished American astronomer being subjected to considerable inconvenience and trouble in passing through the Customs two cinematograph films showing the successive phases of the planet Jupiter during its rotation, one for the purpose of illustrating a lecture, and the other for presentation to the Royal Astronomical Society. Some of the difficulties experienced were due to the importation of the films in passengers' baggage, necessitating their removal from Victoria to the Endell Street bonded film store. In view of this case, however, the possibility of shortening the procedure as regards films of a non-commercial character was being examined. Furthermore, the Chancellor of the Exchequer had promised that the practicability of an exemption for scientific films would be further considered.

SINCE the leading article in this week's issue on "The Origin and Progress of Mankind" was written, we have received Prof. H. F. Osborn's latest contribution to the discussion on the ancestry of man, an article entitled "The Influence of Bodily Locomotion in separating Man from the Monkeys and Apes," in the May number of the *Scientific Monthly*. By quotations from the writings of Darwin, he shows how closely that far-seeing naturalist's views coincide with the opinions, based on the vast amount of evidence since accumulated, of "the highest British authority (Sir Arthur Keith) and the highest American authority (Dr. W. K. Gregory)," that man's descent is to be traced to a primitive ape-like form more closely resembling the chimpanzee than man, but less specialised in ape-like habits than the orang. He proceeds to analyse the influence of bodily locomotion in changing the proportions of arms and legs relatively to the body, and in altering the characteristics of hands and feet, and is able to group this development in a series of "progressive arboreal stages." A close study of these stages leads him to the conclusion that while "the theory of arboreal ancestry of the human type is well established, both by the proportion of the limbs and possibly by the inturning of the soles of the feet, also to a less degree by the spread of the big toe," yet "the structure and proportions of the limbs, the hands and feet, taken together, do not harmonise with the brachiating ape theory, but to my mind suggest rather the taking off of the human stock from the second progressive arboreal stage, namely, arboreo-limb-walking stage." That is to say, Osborn regards the ancestral form of man as belonging to the type of creature which, while habitually terrestrial in habit, yet sought its food in trees and developed a tree-walking habit. "Derived from this stage, the pro-Dawn Man would conserve all the potentiality of future application of the hand to flint-making and, ultimately, to the arts and industries by which man has arisen."

EIGHT of the crew of sixteen of the wrecked airship *Italia* have been rescued, and two, Dr. Malmgren, the Swedish meteorologist, and Signor Pomella, an Italian engineer, are believed to be dead. Apart from General Nobile, who was rescued by a Swedish aero-

plane on June 23, the survivors owe their safety to the Soviet ice-breaker *Krassin*, which found them on July 12. They include Majors Zappi and Mariano, who with Dr. Malmgren had left the wrecked party to walk westward towards the relief ships, and Lieut. Viglieri, who remained in charge after General Nobile's rescue. There is no news of the six men who were carried away in the wreck of the airship, and the likelihood of their being alive is small. It is reported that the *Krassin* will continue the search. She has already picked up her airmen, who damaged their machine after discovering the position of Majors Mariano and Zappi. At the time of writing there was no news of Capt. Amundsen, Lieut. Dietrichsen, and Com. Guilbaud, who left Tromsø in a seaplane on June 18. It is possible that they have found the missing Italians and are encamped with them awaiting a ship. Several aeroplanes are searching for them. Aeroplanes have picked up two men who were trying with dog sledges to reach Lieut. Viglieri's party, and the third member of this search party has reached the *Braganza* safely.

SOME details about General Nobile's first flight in May of this year are given by a *Daily News Bulletin* issued by Science Service of Washington, D.C. The aim on that occasion was to explore Nicholas or Northern Land, or at any rate to determine its western limit. The course of the *Italia* was north of Spitsbergen and Franz Josef Land, reaching about lat. 82° N. in long. 70° E. From there the course was south-eastward to lat. 79° 16' N., long. 91° 40' E. No new land was sighted and the western end of Nicholas Land was not seen, but the nature of the pack in the vicinity of the easternmost position reached is said to have led General Nobile to believe that land was not far distant. The return course to Spitsbergen was via the north of Novaya Zemlya and then across North-East Land. The course of the *Italia* on its way eastward crossed the reputed position of Gillis or Giles Island, reported so long ago as 1707. No sign of that land was seen. It has, however, long been supposed that Giles's discovery is identical with White Island in about 80° N., and that it was misplaced at a comparatively recent date.

THE direction of the prevailing wind in the North Atlantic is east or north-east above latitude 30° and south or south-west below latitude 30°, a fact known and applied by sailing-ships since the voyage of Columbus. Its importance for trans-Atlantic flights is even more vital, as appears from the series of successful easterly flights and the disastrous record of the westerly attempts by the northern route. The Italian pilots, Captain Arturo Ferrarin and Major del Prete, in their flight starting on July 3 from Rome to Brazil, in establishing a new record of geographical distance covered in a single stage, no doubt took intelligent advantage of the elementary principle involved. For strict comparison of these geographical flights, an accurate knowledge of the velocity of the wind, from point to point during the flight, is required, but making full allowance for favourable winds, a flight of 8000 kilometres from Rome to Brazil is a great feat of skill and endurance, and a severe test of engine and aeroplane design.

A PLEA for regional planning in the Lake district, with the view of preserving its scenic features, is made in a pamphlet entitled "Safeguarding Lakeland," by Mr. E. J. L. James (*Whitehaven News*, Ltd., price 1s.). The danger that threatens the Lake district is the outcome of the use of the motor-car. There, as elsewhere, the motor-car leads to ribbons of urban growth spreading along the great roads, and to the construction of new roads for the same purpose. Ill-designed and badly placed houses are liable to spoil scenic features, while the straggling and unregulated growth increases the difficulty and cost of public services. Mr. James pleads for preparation without delay of a regional plan for the whole of the area, and embodies his suggestions in a map which shows that such a plan is under way only in the southern part of the Lake district, where several authorities have it in hand. He discusses at length the advantages of such a survey and the urgent need of some action if this unique part of England is to be preserved. It is a proposal which deserves to receive wide support. An appendix gives a list of the properties in the Lake district owned by the National Trust.

NOTICE has been recently directed to the valuable Benmore estate, situated six miles from Dunoon, on the Firth of Clyde, in Argyllshire, by a further gift to the nation by Mr. Harry G. Younger. In 1925, Mr. Younger presented the Benmore estate to the Forestry Commission on behalf of the nation, reserving the mansion house and certain other properties to himself. The estate thus donated covers an area of 10,000 acres and includes considerable areas of woods and plantations, containing a variety of conifers, thus forming a very valuable centre for the conduct of forestry research work. It is also proposed to utilise it as a practical training centre for forestry students. The latter objects have become practicable by the recent gift by Mr. Younger of the mansion house and the residue of the estate, with the exception of Eckford House, the River Eachaig, and certain villages. It is now hoped that the Forestry Commissioners will be able to provide accommodation for research workers and students on the estate itself. The forestry value of Benmore is very considerable; but it has also botanical values of no mean order. Soil, climate, and shelter are all excellent, as is well shown in the arboretum and gardens, where the owners have experimented for more than half a century with a variety of exotic timber trees, especially conifers and herbaceous plants. The arboretum is said to be the largest in Britain; it is believed that there is a proposal to make Benmore, in time, the national botanic garden of Scotland. A memorial to the late Sir Isaac Bayley Balfour, of the University of Edinburgh, and King's Botanist in Scotland, has been under preparation in Puck's Glen. A rest house is being erected, which will be formally opened to the public on the occasion of the visit to Benmore of the British Association at the Glasgow meeting in September next.

AN appeal is being made for contributions towards the fund to supplement the money which the Trustees of the British Museum have been able, out of the

moneys supplied by Parliament, to provide for the exploration of the deposits in Tanganyika Territory and other parts of East Africa containing the fossil remains of dinosaurs. The Trustees have been able to maintain an expedition for four years, but now find themselves compelled to close it down on Dec. 31, unless the present appeal meets with substantial success. A beginning was made in 1924 with the collection of specimens at Tendaguru, under the leadership of Mr. W. E. Cutler. He was accompanied by Mr. L. S. B. Leakey, who had to return to England the following November in order to resume his studies at Cambridge. At his own request, Mr. Cutler continued the work alone, and unhappily contracted malaria from which he died on Aug. 30, 1925. The work was carried on by Mr. F. W. H. Migeod with the assistance of Major T. Deacon until the close of 1926, when they returned to England. Early in 1927, Dr. John Parkinson was appointed leader, and he left for Tendaguru accompanied by Major Deacon. During the rainy season in Tanganyika, Dr. Parkinson visited various sites in Kenya. He has, unfortunately, contracted amoebiasis and has to return to England for treatment. Major Deacon has been left in charge of the operations at Tendaguru. As the result of the expedition upwards of 500 cases of specimens have reached the Museum, but there has not been time to work out many of the specimens or even to unpack them all. The fund for which the appeal is now made is under the management of Lord Rothschild, Mr. C. Tate Regan, Dr. W. D. Lang, and Dr. G. F. Herbert Smith (honorary secretary), to whom contributions should be sent at the British Museum (Natural History), South Kensington, S.W.7.

THE following elections to Beit Memorial Fellowships for medical research have been made, the place of research being given in brackets:—*Senior Fellowships* (£700 per annum): Fourth year fellows elected to Senior Fellowships: Dr. A. S. Parkes (Department of Physiology and Biochemistry, University College, London), on the proportion of the sexes; Dr. Honor Bridget Fell (partly in laboratories on the Continent and in the United States), for experimental studies on the differentiation and dedifferentiation of animal tissues.—*Junior Fellowships* (£400 per annum): Dr. J. H. Quastel (The Biochemical Laboratory, University of Cambridge), for (1) extension of work on the chemistry of bacteria, with special reference (a) to pathogenic bacteria, (b) to the correlation of variations in antigenic properties of bacteria by changes in environment; (2) a revision and extension of work on the chemistry of complement fixation, attempting to define the nature of the complement of blood. Dr. P. W. Clutterbuck (The Lister Institute of Preventive Medicine), for the continuation of investigations of the nature and function of the succinoxidase system of muscle; investigation of the enzymic systems concerned in carbohydrate metabolism (a) by variation of the conditions, (b) by separation of the enzymes by means of adsorption and similar methods, (c) by isolation and examination of final and intermediate products. Mr. B. H. C. Matthews (Physiological Laboratory, Cambridge), to study (a) conduction in

sensory nerve fibres, with special reference to specific 'pain' fibres; (b) the characteristics of sensory end organs by observations on action potential recorded by means of an oscillograph system invented and made by himself. Mr. D. R. McCullagh (Sir William Dunn Institute of Biochemistry, University of Cambridge), for studies in carbohydrate metabolism, with the view of discovering the nature, distribution, and physiological significance of this factor and its effects on the alcoholic and lactic fermentations of glucose by the unicellular organisms, and to study the variations in the fat content of muscle under various conditions. Dr. W. R. Aykroyd (Lister Institute; also in Newfoundland, by personal investigations among settlements and inquiries among doctors), for an inquiry into deficiency diseases and their relation to diet, to investigate social and other factors which may account for the relative immunity of women and children to beri-beri in Newfoundland, to see if infantile beri-beri exists there, and to determine the relation to diet and vitamins of functional stomach disorders widespread among Newfoundlanders.

MRS. WALCOTT has given to the National Academy of Sciences, Washington, the sum of 5000 dollars to provide an honorarium and medal in memory of her husband, the late Dr. Charles Doolittle Walcott. The award is to be made every five years from 1932 onwards to a person of any nationality of either sex, between the ages of twenty-one and forty-eight years, who shall be deemed to have published important contributions to knowledge of Precambrian life. If there appears to be no worthy candidate at any period, the fund shall accumulate to be given at the next award. The selection of recipients will be made by five trustees, of whom two are to be members of the National Academy of Sciences, the third will be the Secretary of the Smithsonian Institution, and the others will represent the Institute of France and the Royal Society of London respectively. Geologists will welcome this valuable encouragement to the continuation of the important researches of the late Dr. Walcott, to whom we owe the greater part of our knowledge of Precambrian life.

A DISCOVERY of considerable interest, announced in the *New York Times* of July 5, has been made by the McCracken-Stoll expedition to the Aleutian Isles. At the top of almost unscalable cliffs, which it took five hours' hard climbing to reach, the party discovered a burial containing the bodies, with funerary furniture, of three adults and one child which, owing to climatic conditions, had been perfectly preserved. They were in a wooden vault fashioned of well-shaped and mortised drift logs fastened together by bone nails. The vault was lined with well-cured otter skins. All the bodies were wrapped, but one, evidently that of a person of importance, was more elaborately covered than the others, in tanned sea otter skins over a shirt of bird skins, with a cere-cloth of skins, and a further covering of artistically woven grass fabric. Over all was sea lion intestine sewn with animal sinew. The upright method of interment, the situation, and the possible high antiquity of the remains, make this a

find of considerable interest to ethnologists. It may indeed be, as Dr. Clark Wissler is said to have suggested, a vestige of a migration of Mongoloids, hitherto untraced. For discussion of this and other questions of moment we must await a further and expert examination of the remains.

THE international and dominion delegates to the International Conference on Cancer, numbering 110 and representing eighteen foreign countries and six British Dominions, were received by the King at Buckingham Palace on Monday, July 16. In replying to the address presented by Sir John Bland-Sutton, past president of the Royal College of Surgeons and president of the Conference, His Majesty welcomed the delegates and said: "This large and distinguished assembly is a happy omen for the final success of the Campaign, for they will have opportunity of looking from every angle at this great and complex problem, of contributing to the general knowledge any light upon the subject gained by individual experience and of discussing and comparing the various practical methods for combating the disease. In struggling against so powerful and insidious an enemy, there is need for the most efficient staff work and the closest co-operation between all arms of our forces." Several members of the Grand Council of the British Empire Cancer Campaign, which convened the Conference, were also received by the King. The remainder of the week was devoted mainly to the discussion and examination of scientific and technical work on causes and cure of cancer.

THE annual report of the British Institute of Philosophical Studies has just been issued in connexion with the third annual general meeting held on July 16 under the presidency of the Earl of Balfour. The chairman of the Council, Prof. L. T. Hobhouse, in a foreword on the policy of the Institute, describes how special attention has been paid during the past year to the question of making the Institute a link between philosophic specialists and the general public. He maintains that a reasonable statement of the problems at issue and their implications is to be attempted, rather than a popular exposition of any one philosophical research. By way of illustration, he mentions the problem of induction, and he shows how it concerns everyone interested in science and everyone who accepts scientific authority. Reference is also made to the still deeper issue of perception and our relation to a reality external to ourselves. Prof. Hobhouse believes that, in its ideal, philosophy is synthetic, and that the constructions of physics, as of other sciences, should be integral to its fullest development. The members of the Council are very representative of those who are acknowledged authorities in various fields, and we welcome the work that the Institute is undertaking with regard to the relation of philosophy to modern thought and research. The membership roll now stands at about 1730, and during the past year 331 new members have been enrolled.

THE second session of the Institute of Chemistry of the American Chemical Society is being held at Evanston, Illinois, on July 23-Aug. 18. The pro-

gramme includes a long list of interesting addresses and discussions, and the names of the speakers are such as to offer promise of valuable first-hand information. Thus, to mention but a few examples, Dr. Gustav Egloff will discuss oil emulsions; Dr. C. L. Gabriel, vice-president of the Commercial Solvents Corporation, will discuss the large-scale fermentation process for producing acetone and butyl alcohol; Dr. H. E. Howe will consider "Chemistry in the New Competition"; and Dr. J. G. Lipman will discuss the influence of elements other than nitrogen, phosphorus, potassium, and calcium in plant nutrition. Of special interest is a series of lectures by Mr. Lloyd Van Doren on the rôle of patents in the industrial system, and the drafting of specifications and claims. Dr. C. E. K. Mees will give an illustrated lecture on the photographic image. Prof. H. N. Holmes will deliver a course of lectures on colloid chemistry, whilst Dr. H. A. Curtis will speak on the world nitrogen situation. Prof. B. S. Hopkins will direct a course of lectures on the methods of teaching and the content of elementary chemistry courses, and will in addition deliver a series of addresses on the discovery of the elements. Sir James Irvine will also take an active part in the proceedings. Between seventy and eighty scientific workers, prominent in one or other of the many branches of academic or industrial chemistry, are contributing their services, so that the success of the meetings should be unquestionably assured. The Institute held its first session last summer at the State College, Pennsylvania.

THE Physical Society held a provincial meeting in Bristol on Saturday, July 7, at the invitation of Prof. A. M. Tyndall. This took place in the new Henry Herbert Wills Physical Laboratory, and was attended by more than a hundred physicists from all parts of the country. The papers read at the meeting consisted of accounts of research work which is now being carried out at Bristol on the mobility of ions, magnetic properties of crystals, X-ray analysis of fatty acids, distribution of photo electrons from a nickel crystal, developments of statistical mechanics, etc. At the conclusion of the meeting the visitors had an opportunity, which was greatly appreciated, of inspecting the laboratory and witnessing various demonstrations which had been referred to in the papers. Prior to the meeting, the party was conducted to the Suspension Bridge, the Downs, Shirehampton, and the Avon Gorge; they also visited the main University buildings in Queen's Road. The president of the Society, Dr. W. H. Eccles, in thanking Prof. Tyndall, and through him the authorities of the University, for their courtesy and hospitality, referred to the gifts of the Wills family to the University. He expressed the opinion that the new buildings constitute one of the most striking contributions of industry to learning in the history of Great Britain.

A NATIONAL conference on maternity and infant welfare was held at the Guildhall, London, on July 4-6, under the auspices of the Central Council for Infant and Child Welfare. A long session was devoted to

discussions on maternal mortality, one of the saddest causes of death, which has shown little diminution, and averages in Great Britain some 5 deaths of mothers per 1000 births. In some European countries, notably Holland and Sweden, it is much less, being less than 3 per 1000. There was a general consensus of opinion that a reduction of maternal mortality might be obtained by better training of nurse-midwives, and by more efficient antenatal supervision of expectant mothers, with provision of panels of obstetric specialists for the help of practitioners in complicated cases. Prof. Beckwith Whitehouse, of Birmingham, referred to the low maternal mortality rate of 1.3 per 1000 births attained by the Queen's nurses in nearly 56,000 cases during 1927, obtained, he believed, by good training of the midwives, antenatal supervision, and surgical cleanliness. Dr. Eardley Holland, of London, said that in Sweden, where the maternal mortality is 2.5, the medical curriculum lasts nine years and the students receive four months' residential training in midwifery, and the midwives two years' training in a maternity hospital.

THE result of the ballot for officers for the year 1928-29 of the Institution of Electrical Engineers is as follows: *President*, Lieut.-Col. K. Edgecumbe; *Vice-presidents*, Mr. P. V. Hunter, Dr. A. H. Railing; *Hon. Treasurer*, Lieut.-Col. F. A. Cortez Leigh.

RECENT appointments to the scientific and technical departments made by the Secretary of State for the Colonies include Mr. A. S. Walford, to be agriculturist, Jeanes School, Kenya Colony, and Mr. H. Earnshaw, to be schoolmaster, Agricultural School, Nigeria. Mr. M. T. Dawe, who has for some years been Commissioner of Lands and Forests, Sierra Leone, has been appointed Director of Agriculture, Cyprus.

DR. G. T. BENNETT, Emmanuel College, Cambridge, writing with reference to the letter entitled "Square Roots and the Decimal System" in NATURE of July 7, p. 15, states that the square-root and cube-root formulæ given by Mr. C. E. Wolff are only special cases of Newton's rule for approximating to any root of any equation.

ARISING out of Sir J. A. Ewing's James Forrest lecture entitled "A Century of Inventions," published in NATURE of June 16, p. 947, and the subsequent correspondence (July 14, p. 56), Mr. E. Wyndham Hulme writes stating that the first work which mentions the steam engine on its title-page is D'Acre's "The Elements of Water-Drawing . . . with a philosophical discourse, and a new discovery of drawing water out of great depths by fier." London [1660]. Sm. 4to. There were two issues of this work, probably in the same year.

APPLICATIONS are invited by the Secretaries of the Royal Society for the Mackinnon and Moseley research studentships, each tenable for two years, with a possible extension, and each of the annual value of £300. The Mackinnon studentship is awarded for the purpose of furthering natural and physical science,

including geology and astronomy, and original research and investigation in pathology. The Moseley studentship is awarded for the furtherance of experimental research in pathology, physics, and chemistry, or other branches of science, but not in pure mathematics, astronomy, or any branch of science which aims merely at describing, cataloguing, or systematising. Forms of application, which must be returned by Oct. 8, are to be had from the Assistant Secretary of the Royal Society, Burlington House, W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A graduate assistant to teach in the Junior Technical School, and senior course evening classes of the Technical College, Barrow-in-Furness—The Director of Education, Town Hall, Barrow-in-Furness (July 23). A graduate assistant master, with special qualifications in electrical engineering, to take electrical and mechanical engineering subjects, and some mathematics, at the Dartford Technical College—The Principal, Technical College, Dartford, Kent (July 25). An assistant lecturer and demonstrator in mechanical engineering in the Faculty of Engineering of the University of Bristol—The Registrar, Merchant Venturers' Technical College, Bristol (July 26). A graduate assistant master for geography at the Smethwick Junior Technical School—The Director

of Education, Education Offices, 215 High Street, Smethwick (Aug. 4). An assistant lecturer and demonstrator in botany at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Aug. 4). An assistant lecturer in the Department of Electrical Engineering of the University of Birmingham—The Secretary, University, Birmingham (Aug. 11). A lecturer in physics at Auckland University College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Sept. 15); The Registrar, Auckland University College, New Zealand (Nov. 1). The Alfred Jones professorship of tropical medicine in the University of Liverpool—The Registrar, University, Liverpool (Oct. 1). A lecturer in agricultural chemistry and an advisory entomologist, in the University of Reading—The Registrar, University, Reading. An entomologist for service in India—"India," c/o Richardson and Co., 26 King Street, St. James's, S.W.1. A principal of the Chadacre Agricultural Institute, near Bury St. Edmunds, Suffolk—The Earl of Iveagh, 11 St. James's Square, S.W.1. A senior mathematical master at the Cheadle Hulme School, Cheshire—The Headmaster, Cheadle Hulme School, Cheshire. An aeronautical examiner, Air Ministry, Kidbrooke—The Secretary (I.G.), Air Ministry, Kingsway, W.C.2.

Our Astronomical Column.

MERCURY A MORNING STAR.—Mercury will reach its greatest westerly elongation on July 21 (distance from the sun 20°). During the last ten days of July the planet may possibly be glimpsed near the west-north-west horizon at about 3^h 30^m A.M. The elongation is not a very favourable one, as it does not allow Mercury to remain above the horizon longer than about 1^h 35^m before the sun rises. The twilight is always very strong at this season of the year, but the planet may be glimpsed on very clear mornings of the period stated by anyone who has fairly good sight and looks in the correct direction. On July 29 the planet's brightness will be equal to -0.5 mag., which is about the same as Procyon, though not so great as that of Vega, Arcturus, or Capella. The disc of Mercury is so small that its light usually fluctuates or 'twinkles' like a fixed star, and this effect is enhanced by the unsteady vapours floating about at the low altitude in which the planet is always observed.

MAGNETIC STORM AND AURORA.—A magnetic storm, accompanied by a display of the aurora borealis, took place during the night of July 7 and morning of July 8. The magnetic disturbance reached a maximum between 1^h and 2^h on July 8, at the time when the aurora was seen at Greenwich to be at its greatest intensity. The range in declination registered at the Greenwich magnetic station at Abinger exceeded $80'$, and this range occurred between 1^h and 2^h on July 8. About this time also, the horizontal force and vertical force traces went off the recording sheets. The ranges of these two elements exceeded 500γ during the storm. This magnetic storm is probably the largest recorded at Greenwich since that of May 13–17, 1921—it is certainly the largest since that of Oct. 15–16, 1926.

At the time of this recent storm there was a moderate-sized group of sunspots just past the sun's central meridian. Possibly spectroscopic observa-

tions which may have been made of this group will show it to have been unusual. There was a much larger group on the disc at the time, but this was a considerable distance east of the central meridian. The sun's general activity shown by spots has been increasing during the last few weeks.

A GENERAL CATALOGUE OF STELLAR PARALLAXES.—Prof. F. Schlesinger, who is recognised as one of the leading authorities on the determination of parallaxes by photography, has brought out a useful general catalogue of the parallaxes of 1870 objects, being all for which good determinations were to hand at the end of 1924. The probable errors of the results of various observatories have been rediscussed, and are in general somewhat larger than those given by the observatories themselves. Weighted means were formed, these being the quantities given in the catalogue, but individual values for many stars are given in the notes. There are 23 stars with parallax greater than $0.2''$, and 61 with parallax between $0.1''$ and $0.2''$. The former is probably not far short of the actual number, but the latter must be very incomplete, since we should expect it to be seven times the former. The adopted value for Betelgeuse is $0.017'' \pm 0.004''$; that for Arcturus is $0.080'' \pm 0.005''$; that for Nova Persei (1901) $0.011'' \pm 0.003''$, the trigonometrical value being practically the same as that deduced from the light-time of the illumination of the surrounding nebula. The reduction from relative to absolute parallax has been applied to the printed values, except in a few cases, mentioned in the notes. The reduction was made by the formulæ in Groningen Publications. The parallaxes of Cepheids and clusters are included in the catalogue; they are easily picked out, since they extend beyond the third decimal, and are preceded by a string of zeros. Proper motions are given (total amount and position angle), except for the Cepheids and other remote objects.

Research Items.

MAN'S SKULL IN THE LIGHT OF EVOLUTION.—The human skull is a product of evolutionary change, and this could not be more clearly shown than by tracing in a few clear-cut stages the history of the elements of which it is composed. Ten such stages are discussed by Dr. W. K. Gregory (*Internat. Jour. Orthodontia, Oral Surgery, and Radiography*, vol. 14, 1928). He shows how the gradual development of these stages is associated with improvements in the brain, enlargements of parts containing the sense organs, and modifications of the jaws and teeth, all accompanying or accompanied by changes in habits. Each and every one of the twenty-eight bones in the human skull is derived from bones present in the skull of certain Devonian air-breathing fishes. To the amphibians man owes the beginnings of his ear-drum, and the changes associated with it; to the first mammal-like reptiles his temporal fossa, zygomatic arch, and the dominance of the superior maxilla; to the higher mammal-like reptiles, the dominance of the dentary bone of the lower jaw, as well as the differentiation of his teeth into incisors, canines, premolars, and molars. The early mammals simplified the masticatory apparatus; the early primates increased the dominance of the eyes; the early anthropoids made the first serious success in shortening and deepening the face and pointed the way to an enlarged brain and cranium—on their account men walk the earth to-day with long faces and swelled heads. It is an interesting story made clearer by Dr. Gregory's series of text-figures.

NOOSE-TRAPS ON THE CONGO.—Some remarkable traps for catching fruit-eating bats from the northern bank of the lower courses of the Congo around Brazzaville and neighbouring districts are described and illustrated by Dr. Gerhard Lindblom in *Man* for June. These bats, known to the natives by the name of *n'gembo*, come out in swarms after sundown, habitually flying through forest glades and the depressions in mountain ridges, places which the natives accordingly choose as the sites of their traps. The trap consists of a framework of which the principal element is a long pole guyed with a rope, cross-pieces serving as rungs of a ladder for arranging the snares. Rows of supple lianas are attached to the frame-work with an arrangement of loops attached to a slanting pole. These loops serve as pulley blocks through which strings run down to a bottom cross-piece. By these strings the lianas are raised or lowered, and the arrangement is such that the lianas can be tightened up independently without entanglement. A specially interesting feature is that at the junction of the string and liana a bell is fixed which rings an alarm when a bat is caught. This bell consists of the shells of a large land snail (*kodia*) or of the nuts of the fan palm. The clapper is made of bone or hard wood. The bells of the different lianas are of different pitch, so that it is possible to distinguish in the dark by which of the lianas the catch has been effected. The snare is watched from a hut nearby, and the watcher hauls down the catch as soon as the bell sounds in order that the game may not be frightened away. The bats are eaten either roasted or boiled. Rites of magic import are performed both to secure an abundant catch and to scare away evil influence. At the beginning of each hunting season it is customary to crush between the teeth the skull of the animal first caught and then to eat the flesh—evidently a 'first-fruit' offering.

BIRDS OF BRAZIL.—Birds from Brazil find their way perhaps more frequently than birds of any

distant land to the museums of Great Britain, an indication of their attractiveness, but also of a considerable amount of collecting activity in the country. Nevertheless, it is true to say that the knowledge which modern ornithology demands of the avifauna is very scanty. In spite of the opportunities afforded by great variety of altitude, through which climatic conditions change from tropical to sub-tropical and temperate, scarcely any attempt has been made to define in detail the life-zones inhabited by the birds. Ernest G. Holt has made a substantial effort to right this omission with reference to the locality of the Serra do Itatiaya (*Bull. Amer. Mus. Nat. Hist.*, vol. 57, pp. 251-326). In a period covering four months he collected 559 birds, comprising with previous records a total of 187 species for the district. These ranged almost from sea-level to a height of 7800 feet, and an analysis of their altitudinal distribution showed that the tropical zone, embracing the foothills, was inhabited by 187 species; the sub-tropical zone, the region of tall trees extending roughly from 3000 to 6000 feet, by 62 species; and the temperate zone, the ridges, slopes, and rocky peaks above 6000 feet, by 12 species. The apparently small number of tropical zone species compared with those of the temperate zone, was due to the fact that the great bulk of the Serra lies above the tropical area. The distribution of each species is discussed.

IRISH CEPHALOPODS.—The *Proceedings of the Royal Irish Academy* (vol. 38, sect. B, No. 2, 1928) contains a description by Anne L. Massy of "The Cephalopods of the Irish Coast." This is a supplement to Nichols' list of cephalopods which was included in his "List of the Marine Mollusca of Ireland" (*Proc. R.I.A.* (3), vol. 5, 1900). This list contained seventeen species of cephalopods. In the present supplement there are thirty-two species, most of which have already been recorded, but without the detailed notes now supplied. The commonest Irish cephalopods are *Alloteuthis subulata* (Lam.)=*Loligo media* L., and *Loligo Forbesi* Stn. The *Helga* in forty hauls trawled 1070 specimens of the latter species, and in ten hauls 500 *Alloteuthis* were taken. The author follows Joubin in considering the short-tailed form, formerly identified as *Loligo marmoræ*, as the female of *Alloteuthis subulata*. The true *Loligo marmoræ* of Verrill, now called *Alloteuthis media*, is apparently not to be found in northern European waters. Among other rarities, a Rhynchoteuthis larva is described, the name apparently only applying to a larval form which belongs to the Ommatostrephidae, but to what genus it belongs is not known. This larva, taken at 290 fathoms off County Kerry, measures 3 mm. in length, has only the dorsal arms developed, each with one sucker, and is possibly identical with one taken by the *Terra Nova* in the North Atlantic, described by Massy in 1916.

PHOSPHATE AND SILICATE CONTENT OF SEA WATER.—In a paper of general scope, Dr. W. R. G. Atkins brings up to date and adds much interesting detail to his previous well-known and valuable work (*Jour. Mar. Biol. Assoc.*, 15, 1; 1928). Spring sunshine appears to be the important factor in bringing about the spring diatom outburst. While the bottom is the most important source of phosphate, it is regenerated to some extent throughout the water column, and perhaps more rapidly at the surface than at intermediate depths. Phosphate may be completely exhausted in the surface waters in spring. Silicate tends to follow the same seasonal variation as phosphate, but differences occur, which are no

doubt correlated with the varying nature of the phyto-plankton and its varying demands. Dr. Atkins devotes much attention in this paper to technique and possible sources of error, and even for this reason alone the paper is important.

TRICHURIS AND ASCARIS EGG-COUNTS.—C. Manalang (*Philippine Jour. Sci.*, vol. 35, No. 1, 1928) records observations on the relations between the number of ova per gram of formed stool and the number of female *Trichuris* and *Ascaris* harboured by their hosts (man). *Trichuris* egg-counts were made in four clinical and eighteen post-mortem cases, and the average number of eggs per gram of random stool, reduced to 'formed basis' (using Stoll's factor of 1, 2, and 4 for formed, mushy, and diarrhoeal stools respectively) per female worm from the cæcum, transverse and sigmoid colon in cases with and without intestinal pathology, was 669 and 310 respectively. The number of eggs per gram of stool in the cæcum per female worm was about equal to that in the transverse and sigmoidal stools combined. The average number of *Ascaris* eggs per gram of stool (as above) per female was found to be about 1420 for the five normal cases, and in six cases with intestinal pathology about 1460.

RHABDOPLEURA IN NORTHERN REGIONS.—Dr. C. Jan Van Hast gives an account of *Rhabdopleura* in a recent part of "Die Tierwelt der Nord- und Ostsee" (Lieferung XI, Teil VII, a2, Pterobranchia). *Rhabdopleura Normanni* is the only member of the Pterobranchia found so far in the area described, but it has a wide range, occurring in many parts of the Atlantic as well as in South Polar regions. It is, however, most common in the north near Bergen, and in the Shetlands, preferably at fairly great depths (100 to 400 metres) although it has been found in shallow water of only 5 metres. It is usually taken on a stony bottom attached to mollusks, ascidians, and other animals, and is probably much more widely distributed than is at present known, as it is so easily passed over.

CHEMICAL COMPOSITION OF THE WHITING.—H. O. Bull (*Jour. Mar. Biol. Assoc.*, 15, 1; 1928) has studied this subject with special reference to the changes in the liver at different stages of maturity. The amount of fat is low in the immature fish, but increases with age, and reaches its maximum soon after the gonads begin to ripen. It then decreases, to reach a minimum when the fish are spent. No significant changes occur in the muscle substance. Work of this kind is of undoubted value in connexion with the study of condition in fish, and might be usefully supplemented by a study of the vitamin potency of the liver oil at different stages of growth and maturity.

SCANDINAVIAN PHYTOGEOGRAPHY.—After some delay, the results of the International Phytogeographical Excursion to Norway and Sweden in 1925 have been published (*Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich*, 4 Heft). The interesting discussions during the excursion have caused many problems to be viewed at a new angle, and many correlations in plant ecology, formerly obscure, have been made clear. As we might expect, the various papers contributed deal with aspects and types of Scandinavian vegetation, though in places they are compared with foreign but similar associations. Papers of general interest in the volume are: Some Scandinavian vegetation problems, by Edward Rübel; comparison of the *Betula* associations in North Germany and Sweden by Friedrich Markgraf; contributions to our knowledge of the vegetation of

the Swedish lakes by Helmut Gams; the succession of plant associations in the Russian peat moors, and materials for the comparison of Scandinavian and Russian peat moors, by Wladimir Dokturowski; comparative considerations on the plant covering of the Scandinavian and Eastern Alps, by Friedrich Vierhapper.

PHYSICAL MAPS OF GREAT BRITAIN.—The Ordnance Survey has published two physical maps (price 1s. 6d. each), one of England and Wales, the other of Scotland, on a scale of one to a million. Each sheet is about 24 in. x 33 in. The network is a minimum error conical projection with rectified meridians and two standard parallels. The maps are layer tinted without contour lines. There are three tints of green up to 200 ft., and above that level browns, red, purple, and white. Altogether nine tints have been used for altitude. There are submarine contours in fathoms with a wide range of blue tints. Rivers and lakes and all names of water features are in blue. Other names are in black. Names have been used sparingly and confined entirely to physical features. The type is small but singularly clear. Numerous spot heights are given. The maps are beautiful examples of cartography and graphic and yet precise representation of the country.

TRIANGULATION IN EAST AFRICA.—A pamphlet, compiled by the Colonial Survey Committee and published by the Colonial Office, gives in collected form the triangulations carried out in East Africa, mainly as the work of various boundary commissions within the last thirty or forty years. The positions on the arc of 30th meridian have been recomputed. The data given are from Kenya, Tanganyika, Uganda, Nyasaland, and northern Rhodesia. A sketch map shows the present state of the triangulation of the 30th meridian in Africa. Between the Egyptian and Uganda arcs is a long stretch which is incomplete, and there is another gap between the Uganda and Rhodesian arcs. A second sketch map shows the state of East African triangulations.

THE JAPANESE EARTHQUAKE OF 1923.—Prof. A. Imamura, in a recent paper (*Japanese Journal of Astronomy and Geophysics*, vol. 5, No. 3; 1928), has studied the seismic history of the Kwantō district, in which the great earthquake of 1923 occurred. The earthquake record, which begins with the year A.D. 416, shows great non-local earthquakes occurred in nearly the same district in 818 and 1703. Further evidence is afforded by the existence of four beach-lines that are well marked by hundreds of deep narrow holes bored by the bivalve *Lithophaga nasuta*. Prof. Imamura connects the lowest beach-line with the earthquake of 1923 and the one above with that of 1703. Assuming the constancy of the rate of boring of the holes, the interval between the formation of the first and third beach-lines would be 1100 years, indicating that the latter was probably connected with the earthquake of 818. Similarly, the date of the fourth earthquake would be about A.D. 33. Thus, during the last two thousand years there appear to have been four great earthquake periods separated by long intervals of quiescence. Lastly, since the yearly number of earthquakes felt in Tokyo was 109 during the years 1903–22, 68 in 1926, and 65 in 1927, it is suggested that the Kwantō district is now approaching a dormant state that may last for a century or more.

ROCK PRESSURE AND FLOWING WELLS.—The Dakota Sandstone in the North Central United States is largely dependent for its water supply on

wells thought to discharge rainwater that percolated underground from the Rocky Mountains. This view is now rejected in contributions on the subject by W. L. Russell on "The Origin of Artesian Pressure," in *Economic Geology* (vol. 23, pp. 132-57; 1928), and O. E. Meinzer (*ibid.*, pp. 262-91). They both conclude that the water is discharged from isolated lenticular masses of sandstone in clay, and is forced to the surface by the weight of the overlying rocks. Under these conditions the future of the supply is less assured than on the theory of hydraulic migration, and the importance of maintaining the supply is leading to the proposal for laws to prevent waste. This case is of special interest, as the analogy with it was the main support to the theory that the flowing wells of East Central Australia are artesian wells. This view was rejected by Gregory ("The Dead Heart of Australia," 1906), who explained their discharge as due to rock pressure and to gas pressure due to the inflow of hot plutonic water into the water-bearing beds. American opinion is now supporting this interpretation, and Meinzer remarks that no one else appreciated the practical importance of rock pressure. The diminution in the flow of the Australian wells which was predicted on the rock and gas-pressure theory has happened, and has led to legislation to prevent the increase in the number of the wells or the waste of their water. It is now recognised that similar legislation is desirable in the United States.

PLIOCENE AND PLEISTOCENE TERRACES.—A Conference on the correlation of the Pliocene and Pleistocene terraces of north-western Europe has been arranged by the International Geographical Union now meeting at Cambridge. Attention has been directed to this question by the work of General Lamothe and Prof. Depéret. In preparation for this discussion a series of papers has been collected on Pliocene and Pleistocene terraces, and issued by the Commission of the Union dealing with this subject (Secretary to the Commission, University Museum, Oxford). The terraces of the Mediterranean basin, of the coasts of France and Spain, and of the British Isles are discussed, with contributions also on those of the Euphrates, Indo-China, Sierra Leone, and South Africa. If Prof. Depéret be correct, and the terraces are due to a general rise and fall of the sea, the terraces in different areas should be at the same levels. Prof. Depéret recognises that in parts of the Mediterranean the terraces have been tilted; but he claims that despite such exceptions the bulk of the raised terraces are due to the lowering of the sea and not to the rise of the land. The papers in this report show that the terraces are variable both in height and distribution. Thus a paper by Dr. Hume and O. H. Little points out the absence of modern raised beaches along the Egyptian-Mediterranean coast, though they are well marked at various levels on the Red Sea coast; a paper by Mr. V. A. Eyles shows the extent to which the Scottish terraces vary in height when followed along the coast. The nature and height of the terraces are still inadequately known. The studies included in the report give much detailed and precise information, and valuable summaries of the work that has been done on the coasts both of Europe and Africa.

THE COSMIC RAYS.—Some new measurements of the cosmic radiation are described by Prof. Millikan and Dr. Cameron in the June issue of the *Physical Review*, and are discussed by them in the *Proceedings of the National Academy of Sciences* for the same month. Improved experimental methods have been used at the Arrowhead and Gem lakes in California, and they now find that the absorption curves of the

rays in water indicate that at least three bands of frequencies are present, with absorption coefficients of 0.35, 0.08, and 0.04 per metre of water, the last corresponding to a wave-length of 8×10^{-5} A., or a generating potential of 150 million volts. Nothing important is present between the softest cosmic band and the hardest known gamma rays, and they conclude that there are no possible transformations capable of yielding rays of this enormous penetrating power except those accompanying the building up or creation of the abundant elements like helium, oxygen, silicon and iron out of hydrogen, or in the case of the last two, out of helium. Even then it is necessary to assume that the aggregation takes place in a single process, and not step by step, and by using Dr. Aston's recent accurate measurements of atomic weights in conjunction with the Dirac absorption formula, they show that the three bands, in order of decreasing frequency, agree closely with what would be expected on relativity theory from the annihilation of mass accompanying the formation of magnesium and silicon from hydrogen, oxygen and nitrogen from hydrogen, and helium from hydrogen, respectively; a small residual effect may be due to iron. "The whole work," in their opinion, "constitutes very powerful evidence that atom-building processes are continually going on, and that each event is broadcast in the form of the appropriate cosmic ray."

EXPERIMENTS ON TRANSMUTATION.—In 1907, Ramsay found that solutions of copper salts after exposure to radium gave spectroscopic evidence of the presence of lithium, and he suggested that transmutation of the copper had occurred. Repetition of these experiments by other workers using platinum apparatus failed to confirm this result, and it was thought that probably the lithium was derived from the glass apparatus originally employed. Further work on the effect of exposure to radium is described by J. N. Friend in the *Journal of the Chemical Society* for May. Barium sulphate, pure silver, and pure gold foil were exposed to radium, the spark spectra being afterwards examined and compared with those of an unexposed sample of the same material. No change was noticed except in the case of the gold, when two C calcium lines appeared and the copper lines of the blank became more intense. The experiments were repeated, using a silica tube instead of a glass one, but without consistent results. The changes in the spectra appeared to be due to the presence of impurities irregularly distributed in the original materials. (See also NATURE, July 14, p. 58.)

THE HEAT OF FORMATION OF MOLECULAR HYDROGEN.—The *Journal of the American Chemical Society* for May contains an account of an attempt made by F. R. Bichowsky and L. C. Copeland to determine the heat of association of atomic hydrogen by a direct calorimetric method. Hydrogen was admitted into a discharge tube, where it was partially dissociated into atoms, at a known rate of flow. It then passed through fine holes into a tube containing a platinum calorimeter on the surface of which the atomic hydrogen was catalytically associated, thus causing a rise of temperature. The mathematical theory for the rate of effusion of a gas through a small hole, previously given by Weide and Bichowsky, was used to deduce the percentage dissociation from the difference in pressure of the gas before passing through the holes, before and after the discharge. The value obtained for the heat of formation of molecular hydrogen was $105,000 \pm 3500$ calories. Previous values measured by indirect methods range from 90,000 to 107,000 calories.

The National Physical Laboratory, Teddington.

INSPECTION BY THE GENERAL BOARD.

ON Tuesday, June 26, the General Board of the National Physical Laboratory made its annual inspection of the laboratory. As is customary on this occasion, a large number of members of scientific and technical institutions, government departments, and industrial organisations were invited to be present. The visitors were received by Sir Ernest Rutherford, president of the Royal Society and chairman of the General Board; Sir Richard Glazebrook, chairman of the Executive Committee; and the Director, Sir Joseph Petavel.

The activities of the laboratory were well illustrated by an extensive programme of exhibits.

In the Duplex Tunnel a demonstration of wing flutter on a full scale light aeroplane wing was given. The critical speeds at which flutter occurs have been determined in the tunnel and compared with those calculated from the measured elastic and inertia constants of the wing with the help of aerodynamic data derived by the study of a model wing.

In one of the seven-foot wind tunnels tests were in progress on one of a series of symmetrical Joukowsky aerofoils to obtain data on profile drag at high Reynolds numbers. The aerofoil was supported between two stream-lined projections fixed to the tunnel walls and surrounding the supports, the latter being carried through the walls and linked outside to the roof balances by a suitable system of levers. By keeping the gap between the aerofoil and the projections as small as possible, three-dimensional flow at the wing tips was minimised. Measurements were made of the total force on, and the pressure distribution along, the centre section of the aerofoil, with the latter in the position of zero lift. Of interest also was a one-fifth scale model of a new projected variable density wind tunnel by the use of which it is expected that measurements on models of aircraft will be rendered more directly comparable with similar measurements on full scale machines. The tunnel is of the return flow type. To measure the lift or drag, a special form of balance has been devised, in which the balance arm carries a coil forming the movable element of a Kelvin balance. By previous calibration the relation between the current through the coil and the force on the balance arm can be determined. The position of the balance arm is indicated electrically by means of a bridge arrangement, the arms of which consist of two small electromagnets spaced on opposite sides of the balance arm and two windings on the iron core of a moving coil relay. Any movement of the balance arm disturbs the equilibrium of the bridge and produces a deflection of the relay.

In the Engineering Department apparatus for the study of phenomena accompanying fatigue in crystals of aluminium and iron was shown. Large single crystals of either metal can be subjected to reversed direct and torsional stresses, to single blow tensile impacts, and to slow cycles of repeated tensile loading. X-ray analysis permits the positions of the crystal planes with respect to the axis of loading to be determined, and X-ray spectrographic and photomicrographic examinations at frequent intervals during the tests allow the inclinations and nature of the slip bands to be determined.

Another exhibit of interest was apparatus installed for the purpose of determining the efficiency of motor-car transmission gearing. The gear box can float freely and the efficiency is determined by measuring the reaction of the gear box to the motion of the gear train. Apparatus for conducting tests on gear

wheels, in which small errors in radial alinement and in pitch of teeth are purposely introduced, was also shown, together with some of the gear wheels examined. In most of these failure had taken place by fracture of a tooth or of teeth near the root and not by abrasion.

Included in the exhibits of the Metrology Department was a new secondary standard barometer designed to give an accuracy between those of the primary and the working standards. To determine the barometric pressure measurement is made, by means of a specially designed micrometer, of the distance between two contacts. One of these consists of a fine platinum wire sealed in the top of the barometer tube and dipping in the upper surface of the mercury column. The other forms the lower end of the micrometer stem and dips into the lower surface of the mercury column. Contact with the mercury is indicated electrically, and the mercury levels can be adjusted by means of a stainless steel plunger supported in an auxiliary tube.

Apparatus for measuring the friction between pivots and jewels was also demonstrated. By means of this apparatus relations between the frictional torque and the load can be determined in terms of the radii of curvature and the elastic constants of the pivot and the jewel.

In order to facilitate the rapid melting of small charges of metals and alloys, a valve-operated high frequency furnace has been installed in the Metallurgy Department. Two thermionic valves, each capable of dissipating two and a half kilowatts at the anode, are employed, and are connected to the A.C. supply in such a way as to permit both halves of the A.C. wave to be utilised. The furnace was being used in connexion with experimental work to remove oxygen from electro-deposited chromium, in which it is found in the form of an insoluble oxide. Removal of the oxygen is effected by maintaining fragments of the metal at about 1400° C. or 1500° C. in the furnace, and at the same time passing over them a rapid stream of purified hydrogen which is circulated in a closed system containing the metal and a purifying train.

A new type of carbon resistor furnace developed in the Department was also on view. The action of the furnace depends on the contact resistance between a number of carbon pellets contained in a refractory and nearly air-tight sheath. The temperatures attainable are limited only by the power of the sheath to withstand the heat developed, and it is found that the pellets remain unchanged for a considerable period of time even when maintained at temperatures approaching 1500° C.

In the Physics Department an investigation was in progress to determine the heat of combustion of carbon monoxide at atmospheric pressure. Oxygen and carbon monoxide are fed from separate cylinders into a special burner fitted in a vacuum walled vessel furnished with flow tubes for the continuous circulation of water. The temperature rise of the water is measured by means of a pair of differential resistance thermometers. The calorimeter is calibrated by replacing the flame by a resistance coil in which a measured amount of electrical energy is dissipated as heat and carried over the cooling tubes by means of a stream of oxygen.

Apparatus for the determination of the thermal conductivity of furnace materials was also on view. The material under test rests on a metal plate heated from beneath by a number of electrical resistors, and on its upper surface is mounted a flow calorimeter

with guard ring. The rise in temperature of the water is measured by means of differential resistance thermometers and the temperatures of the upper and lower faces of the specimen are determined by means of a number of suitably disposed thermocouples.

In connexion with an investigation on cold storage, a vertical closed-circuit air channel has been developed to investigate the laws governing the transfer of heat between the air stream and pipes through which brine is flowing. The speed of the air is controlled and arrangements are being made to use single pipes or batteries of pipes in which a shielding effect comes into play. It is hoped to obtain the conditions governing the maximum transfer of heat with the minimum resistance to air flow. It will be possible to use either dry or moist air in the channel, and in the latter case to investigate the problems of hoar frost deposited on pipes. The presence of hoar frost seriously impairs the transference of heat from the air to the pipe.

A method of determining the acoustical absorbing powers of various materials by means of stationary waves was demonstrated in the Sound Division. One end of a smooth cylindrical tube is closed by a steel disc to which the material is cemented, the other end being open and facing a loud speaker producing a pure note of known pitch. Stationary waves are formed in the pipe and the relative intensities of the maxima and minima for various materials depend on their absorbing power. Measurements of their intensities are effected by means of an exploring microphone.

A recent addition to the Radiology Division consists of a constant voltage generator for X-ray tubes. A transformer, the secondary voltage of which is 100,000, is employed. Full wave rectification is obtained by means of four hot-cathode rectifying valves, and smoothing is effected by suitably disposed condensers and chokes. Power is drawn in at each half cycle, and the transformer is not subjected to any unidirectional magnetic field.

An important addition to the equipment of the Electrotechnics Department consists of new precision current transformers cored with 'permalloy.' By means of this alloy of nickel and iron, which has very high permeability and very small hysteresis loss at very low flux densities, it is possible to obtain currents in the secondary closely proportional to and nearly 180° out of phase with the current in the primary. This is of considerable importance in measurements of power in circuits carrying heavy alternating currents.

A new standard water-cooled tubular resistance capable of carrying 7500 amperes has also been constructed. In the design of this, the aim has been to make the resistance so far as possible independent of the method of connexion to the external circuit, so as not to interfere with the streamline flow of current.

In the High Voltage Building was to be seen the new power equipment for single, two and three-phase high voltage work up to 1,000,000 volts, together with apparatus developed for this work. Mention may be made of a new shielded parallel-plate air condenser of zero phase angle. Three plates are used, the centre one being the high voltage plate and the two outer ones being earthed. To avoid corona effects, the edges of the plates are curved, the degree of curvature being so adjusted that the potential gradient round the edges is not greatly in excess of that between the plates.

Among the exhibits in the Electric Standards Division was a screened bridge for the measurements of inductance, capacitance, and effective resistance at radio-frequencies. It is essentially a Schering bridge, consisting of two equal resistance arms and two

capacity arms, one of the latter being the unit under test. The bridge is balanced by means of variable condensers shunting each resistance arm. The complete apparatus consists of the bridge proper, a local source of radio-frequency supply to the bridge, a screened detector and amplifier, and a local screened oscillator to heterodyne the oscillations from the bridge.

Of interest also was apparatus for the study of the vibrations of quartz oscillators. Interference patterns are obtained when monochromatic light is reflected from the flat polished surface of the crystal after previous transmission through an optical flat. Any vibration of the crystal leads to blurring, except at the nodes, where the appearance of the interference bands remains unaltered.

The Wireless Division exhibited a new portable self-contained transmitter for use with wireless direction finders. It is operated by a 12-volt battery, the anode voltage of 300 volts being supplied by a generator operated by the battery. An Eccles two-valve circuit with interchangeable coils for wave-lengths from 30 metres upwards is used. A portable mast, adapted for mounting on a motor-car, completes the equipment. A small laboratory short-wave transmitter for wave-lengths of 5 metres and upwards has been developed for the study of wave propagation. In this oscillator two valves are arranged on the 'push-pull' principle with variable capacity coupling between the anode and grid coils.

The efficiency of light wells in building blocks is a matter of considerable importance in illuminating engineering, and a model light well has been constructed in the Photometry Division to permit such determinations to be made. The breadth and depth of the well are fixed, and seven different-sized sky openings can be provided by adjusting the sizes of the other two walls. A number of selected points are taken in the middle vertical line of one of these walls, and at each point the ratio of the illumination on the wall to that falling on the sky opening of the well is determined. By this means wells of different size and using paint of varying reflection factor can be directly compared. An artificial sky is provided in order to approximate to actual conditions, and the well is fitted with a matt black floor.

Mention should also be made of a precision illumination photometer of the Macbeth type. This embodies the usual Lummer-Brodhun photometer head, and is fitted with internal screens between the head and the comparison window to minimise the effect of stray light from the tube walls. The comparison lamp is enclosed in a small whitened chamber equipped with a window, in order to eliminate errors due to internal reflection in the comparison lamp bulb. The instrument operates on the inverse square principle, and its constant can be varied by the insertion of stops in front of the translucent window. Precise control of the comparison lamp current, an important item, is provided by including the lamp in a Wheatstone bridge circuit, of which it forms one arm.

In the William Froude Tank a self-propelled model of a merchant ship was run at intervals through a series of regular waves. The model, which was electrically driven, was fitted with self-recording mechanism, by means of which the propeller thrust, torque, revolutions, and time were automatically determined, while in the main carriage generally used for towing models, the pitching and rolling of the vessel could be recorded by means of a lever system operating suitable recording mechanism, once the speeds of the model and the carriage had been synchronised. The work forms part of a research on the influence of waves on the resistance and propulsion of ships.

The Empire Marketing Board and Scientific Research.

THE second report of the Empire Marketing Board, covering the period May 1927–May 1928, which has just been published by H.M. Stationery Office (price 1s.), is a further indication of the importance which the Home Government now attaches to scientific research in connexion with the development of the resources of the Empire. The Empire Marketing Board was established in 1926 for “the furtherance of the marketing of Empire produce in the United Kingdom,” and realised from the first that success depended largely upon the support given to scientific research and economic investigations and their extension to new fields. In last year's report the Board could only indicate its first approaches to the network of problems with which it was faced. Its tentative policy had still to be endorsed by the British overseas governments. It had still to stimulate those governments to create the necessary local machinery for the co-ordination of research and the application of newly won knowledge to the better production and marketing of Empire crops.

In the present report the Board is able to record substantial progress, and while it is true that the greater proportion of its grants for research is still being made to institutions in Great Britain—because their comparatively advanced stage of development fits them for undertaking research work of general application—in the past twelve months it has been able to extend its grants to other countries and to new fields of science. The Imperial Agricultural Research Conference assisted the Board in this direction.

Details are given in an appendix to the report of the new schemes which the Empire Marketing Board is committed to support. Provision has been made for a grant of £22,000 per annum towards the cost of a Colonial Advisory Council of Agriculture and Animal Health, and the formation of a Colonial Agricultural Service with a specialist wing for research work and an agricultural wing for administrative work, conditional upon five times this sum being provided by colonial governments. A capital sum of £18,500 has been provided for chartering and equipping two trawlers to carry out investigations, under actual sea conditions, into the handling of fish at sea with the object of improving methods of preservation. A new station is being erected at East Malling for cold storage experiments on a semi-commercial scale in connexion with fruit. £30,000 is to be expended on adequate accommodation for the Department of Entomology at the Natural History Museum, and £12,000 on the erection of a new building to house the Imperial Bureau of Mycology upon a site which will enable it to retain its close connexion with the Royal Botanic Gardens at Kew. The government of Southern Rhodesia is now a participant in the scheme for the investigation into the mineral content of natural pastures, with special reference to soil deficiencies and their effect on the growth and strength of live-stock. The Ontario Agricultural College at Guelph is receiving a grant on a pound for pound basis for poultry research. A Plant Breeding and Seed Research Station is being established at Palmerston North in New Zealand. The government of Sierra Leone is being assisted to establish an experimental fruit farm in connexion with bananas and grape-fruit, and the Fiji government is being encouraged to undertake an investigation aiming at the improvement of methods of cultivation, handling, drying, and grading of copra.

Among other new projects for which grants have been made are: a geophysical survey of certain areas

in Australia; the Great Barrier Reef Expedition; researches into the fundamental problems of sheep-breeding and determination of effective standards of raw wool to be carried out at the Animal Breeding Research Department, Edinburgh, and the Research Association for the Woollen and Worsted Industries, Leeds; an investigation into the nature of the variations in the vitamin content of cod-liver oils. The Empire Marketing Board is to be warmly congratulated on the manner in which it has disbursed its funds for the past two years.

University and Educational Intelligence.

MANCHESTER.—The following appointments have been made in the Faculty of Technology: Mr. H. V. Lowry to be lecturer in mathematics; Mr. Thomas Bevan to be lecturer in mechanical engineering; Mr. Horace Spibey to be assistant lecturer in spinning; Mr. N. W. Coe to be assistant lecturer in mechanical engineering.

MR. F. H. REID, formerly of Northampton Polytechnic and now head of the Engineering Department at Sunderland Technical College, has been appointed head of the Engineering and Building Trades Department of the Borough Polytechnic, London, S.E.1. He will succeed Mr. G. E. Draycott, who is retiring at the close of the current session after thirty-one years in south London.

THE Governors of Loughborough College, Leicestershire, invite applications for the award of five open scholarships in the faculty of engineering, each of the annual value of £75. The scholarships are open to British subjects situate in any part of the Empire, and are tenable at Loughborough College for the period of the full diploma course. Further particulars and application forms may be obtained from the College Registrar, to whom all forms of application must be returned not later than Mar. 28, 1929.

A NEW publication, *Wessex*, is not, as its name might imply, to deal at large with the area denoted by the name of the old Saxon kingdom resuscitated by Thomas Hardy. It is “an annual record of the movement for a University of Wessex based on University College, Southampton.” It has been produced by members of the staff, students and friends of the College, and in part is devoted to descriptive accounts of the work of its academic departments. The greater part of the first number, however, is taken up by articles of a more general interest, some, but not all, of a local flavour. While Mr. O. G. S. Crawford deals with “Wessex,” for example, Sir Mark Hunter discusses the ending of Shakespearian tragedy and Prof. E. W. Patchett reproduces a lecture on Faust. Two subjects, however, inevitably loom large, one the movement for a University of Wessex, on which Dr. C. G. Montefiore and Principal Vickers write, and the other Thomas Hardy, who was himself keenly interested in the movement. His life, work, and influence are here considered from many sides in a number of articles by personal friends and others. In the appeal for funds for the University, it is stated that a sum of somewhere about half a million will be required to provide building, equipment, and endowment—a very moderate sum when everything is taken into consideration and having in view the objects which it will be possible to achieve in an area which, at present, is but poorly served intellectually. Appeals to the purse of the public are numerous, but few are more worthy of support or more likely to repay the generous benefactor than this need of Wessex.

Calendar of Customs and Festivals.

July 23.

THE DEATH OF ST. BRIDGET.—On the eve of St. Bridget every farmer's wife in Ireland made a cake called 'Bairinbreac,' and the neighbours were invited to a feast. The custom has been compared to that of the Hebrew women of burning incense, pouring out drink offerings, and offering cakes baked with their own hands to a female deity. Certain clay cakes of various forms recently found in the excavations at Beisan are conjectured to be such offerings in their ceremonial guise.

July 24.

ST. MARY MAGDALEN.—It was usually a part of the marriage contract among the peasants of Provence that a husband should visit the shrine of St. Mary Magdalene in the Grotto of St. Beaume, near Marseilles, with his wife in the first year of marriage, and even if the visit were not stipulated, neglect was a slight on the wife. A visit to a prehistoric monument, a shrine, or in Ireland a saint's "bed," is a widespread cure or preventive of barrenness.

ST. DECLAN (fifth-sixth centuries), Bishop of Ardmore and Patron of Decies, reputed, but probably incorrectly, to have been a disciple of St. Patrick. At his birth a globe of fire blazed on the house in which he was born. At one time he and his companion were borne in a magic boat which crossed the sea without sail or oar. Not only were his black (? iron) bell, which had been sent from heaven, and his vestments conveyed over sea on a floating rock, but this rock preceded his ship as a guide to Ardmore, where it floated ashore and afterwards served as one of the objects in his cult. On one occasion as many as eleven hundred persons crawled under it on his feast day to be cured of diseases and especially pains in the back. The pilgrims then washed in and drank of his well, and finally carried away a handful of the earth from his grave, to which magical properties were attributed.

ST. BEOC, MOBHEOG, or DOBHEOG, especially associated with the Island of Saints in Lough Derg, where was St. Patrick's Purgatory, a cave, entrants to which suffered grievous pain, but saw wondrous visions. Monuments such as St. Patrick's Bed and St. Beoc's Seat, as well as popular pilgrimages attended by large numbers, point to an early cult. St. Patrick's Purgatory was specially mentioned in the legislation under Queen Anne suppressing well-worship and similar customs. Similar caves are frequently mentioned, for example, that in which Grania and Dermot took refuge, on the Hill of Howth, and the one at Baltinglass in which Croghan disappeared. The references are to the characteristically Irish underground structures known as *souterrains*.

ST. CHRISTINA, a maiden of Tyre, aged eleven, whose father Urbanus enclosed her in a high tower in which he placed gold and silver gods and twelve servant maids in order that she might consume her time in worship and be free from the attention of ardent lovers. But she came to adore the god of the heaven she could see through her windows. An angel from heaven bade her not to fear, made the sign of the cross on her forehead, and left with her a loaf of white bread. A similar story is told of Asenath, daughter of Potiphar, high priest of On, who, despising all men, lived in a high tower, worshipping her gods of gold and silver until she saw Joseph, who taught her of the true God.

The story of the maiden who is shut in a high tower to preserve her from the attention of undesirable lovers is familiar in the folk-lore of many countries. The lover reaches the maiden finally by scaling the tower, or sometimes in the shape of a dove or an eagle. Zeus visited Danae as a shower of gold. Sometimes the damsel is impregnated by a ray of the sun, just as Christina's angel came from heaven. The mention of the sun connects the story with the well-known primitive custom of confining girls at puberty in darkened huts or veiling them from the rays of the sun.

July 25.

ST. JAMES.—In the "Manuale ad Usus Sarum" of 1555, a blessing on the new apples is prescribed for this day in a formula which refers to the punishment which followed the eating of the forbidden fruit by our first parents, and asks that by this solemn ceremony we may be enabled to eat of the fruits of the earth without harm. The priest is then to asperge the apples with holy water.

The blessing or purification of the apples is not solely due to a primitive fear of doing anything for the first time. Both the sin of the forbidden fruit and the blessing are connected with the breaking of a taboo. The ceremony is intended to divert the consequences which in the Bible story are made to follow the infraction of the taboo. New crops are full of spiritual influence which may be, or indeed is, harmful to man. They must not be touched until they have been rendered harmless. Either they represent the deity of the crop himself or they lie so peculiarly in his province as to be sacrosanct until he has been propitiated. The taboo is removed by a sacrificial meal of the worshippers or, when the personality of the god has been dissociated from the material crop, by libations and offerings or by a purificatory ceremony. This is the idea underlying all first-fruit offerings, harvest thanksgivings, and purificatory or dedicatory ceremonies. While the rogation ceremony renews and builds up the spirit or power of the deity in the fields and the crops, the harvest festival, in one aspect at least, breaks it down.

The popular cult of St. James at the famous shrine of St. Iago de Compostella in Spain appears to be a survival of a pagan cult associated with the prehistoric monuments in the neighbourhood. St. James is also associated with the cult of Our Lady of the Pillar at Saragossa, whose image is said to have been set up by him. This may indicate what was once a joint male and female cult.

July 27.

THE SEVEN SLEEPERS, who, suffering persecution under Decius, were walled up in a cave and awakened 372 years (actually 180 years) after under Theodosius. There are many versions of this story current in medieval times, in some of which the pagan origin is clear. William of Malmesbury records a belief that the sleepers turn on their sides when sorrow threatens.

July 28.

ST. SAMSON of Dol, in Brittany, a Welsh saint who spent some considerable part of his life in Armorica. His anger at finding Bretons dancing around a stone pillar on a hill, even when he was told by their chief that they were not practising magic, but amusing themselves, indicates the importance of the stone monument as the centre of pagan cults in early Christian times. The saint marked a stone near by with a cross, a frequent method of dealing with such cult objects. A variant places this incident in Cornwall.

Societies and Academies.

LONDON.

Optical Society, June 14.—T. Y. Baker: The errors of a reflecting prism. A prism with two reflecting faces designed to fulfil a particular purpose in an optical instrument gives rise to errors due to (a) inaccuracy of manufacture, and (b) inaccuracy in mounting the prism in the instrument. The effects of these errors are investigated.—W. D. Wright: A trichromatic colorimeter with spectral primaries. A spectrometer system is used in which two spectra are formed from the same source. From one, three portions to act as primaries are reflected back through part of the dispersing system, so that the mixing of the three radiations is effected by neutralising the prismatic dispersion by which the colours were first separated. From the other, the test colour and a desaturating colour are selected and mixed in a similar manner, and the composite beams are then brought into a simple bipartite field. The Maxwellian method of observing the field of view has been adopted without the introduction of rotating parts into the system, and special precautions have been taken to remove stray light.—T. Smith: (1) The theory of aplanatic surfaces. The necessary and sufficient condition that an optical system should have a pair of aplanatic surfaces is that the eikonal of the system can be expressed as a homogeneous function of the first order in three variables. Methods are given for finding the equations of these surfaces when the eikonal is given and for finding the eikonal when the surfaces are given. In general, only one pair of aplanatic surfaces is possible, but in spherically symmetrical systems two pairs are found. (2) The primordial coefficients of asymmetrical lenses. An easily calculable system of sixteen magnitudes is constructed for the representation of the properties of asymmetrical lenses. All equations are expressed in matrix form and an account of the elementary properties of matrices is included. (3) Note on the use of lenses in series for sight-testing. The series arrangement enables a small number of lenses to be combined to give the correction for any regular defect of form. In general, effective powers are not simply additive, but under certain conditions the error made in regarding them as additive becomes small. With incorrect arrangements serious errors may be made.

Royal Meteorological Society, June 20.—J. Edmund Clark, I. D. Margary, R. Marshall, and C. J. P. Cave: Report on the phenological observations in the British Isles, December 1926 to November 1927. As frequently of late, early warmth, inducing also early bloom on fruit trees, was precursor of destructive cold spells in April, May, and even early June, when sunless drought prevailed as well. Then followed a wet, cool, sunless summer. On all coasts the sea was coldest in February, warmest in August; in the west and south colder in May than November. The mean flowering date was actually early, though after May practically all were late. The early migrants, on the other hand, were retarded two days; the later were a day early. The final results for farming were bad; in many parts, especially in north-east Scotland, disastrous. Only apples and raspberries gave a good fruit crop, but the exceptional wet coolness gave a wealth of herbaceous blossom. October was the only redeeming feature in the latter half of the year.—C. K. M. Douglas: On the relation between temperature changes and wind structure in the upper atmosphere. (*Mem.* No. 7, vol. 1.) Assuming that the

wind velocity is 'geostrophic,' it is known that the horizontal gradients of temperature in the free air can be deduced from the variation of wind with height at a given time, and the temperature changes due to purely horizontal movements readily follow. A comparison is made between the temperature changes thus calculated and temperature changes observed during the years 1920–25 inclusive. The correlation between observed and theoretical changes is a little less than 0.5, both for 6-hour and 24-hour time-intervals, but is higher for large temperature changes.—R. M. Poulter: Simple formulæ for computing relative humidity. Formulæ are given for the calculation of relative humidity from readings of dry and wet bulb thermometers without reference to tables. For air temperatures around 60° F. the 'relative dryness' of the air is given by

$$\frac{1000}{3} \times \frac{\text{depression of the wet bulb}}{\text{dry bulb reading}}.$$

The required relative humidity is given by subtracting this 'dryness' figure from 100. Slight modifications of the factor 1000/3 provide for a range from below freezing point to about 120° F. The formula can be adapted to Centigrade readings simply by adding 17.8 to the dry bulb reading before making the computation.

DUBLIN.

Royal Irish Academy, June 25.—E. T. S. Walton: On the motion of vortices near a circular cylinder in a stream of liquid. The cases of a single vortex and also of a symmetrically placed vortex pair near a circular cylinder in a stream of liquid are investigated. The equations of the paths of the vortices are given and their nature discussed.—J. Doyle and P. Clinch: (1) Further notes on the metabolism of conifer leaves. The groups of the Coniferales are characterised by definite pH values; Abietineæ, Taxodineæ, and Araucarineæ about 3.7, Cupressineæ and Taxaceæ, as a whole, about 5.1. *Sciadopitys* is an interesting exception in its group. No further relation could be established between pH and water-soluble pentosan content. The only oxidising enzyme demonstrable was peroxidase, which seems always present although sometimes masked by an inhibitor, the nature of which has to be analysed. It fades on standing and, though associated with tannin-like substances, seems of a different nature. Autoxidisable substances yielding peroxides are present, their oxidation being normally inhibited by tannins. (2) The catalase content of conifer leaves, with notes on its measurement. The catalase activity of a number of conifers shows a low summer level, rising to a maximum in December and January, and falling again in spring. These findings are directly contrary to those reported by Burge. The wide individual and seasonal variations lend no support to the use of catalase as an index of respiratory activity, although the seasonal variations correspond closely to seasonal variations in starch content already reported. A method is described in which the initial rate of a catalase reaction can be measured and fast reactions followed. The initial rate is proportional to catalase concentration over a wide range, and is proportional to peroxide concentration when dilute, becoming steady with increasing concentration. There is a latent period which varies both with catalase and peroxide concentration. Both at 20° C. and 30° C., variations in the early course of the action seem constant. The initial rate is fast, falls off rapidly, increases again, remaining steady for some time, once more falling off in the normal manner of an enzyme action.

EDINBURGH.

Royal Society, July 2.—J. R. Wilton: The lattice points of a circle. A great deal of interest has of late years centred round the arithmetical function $r(n)$, defined as the number of integer solutions of the equation $p^2 + q^2 = n$, so that, for example, $r(1) = 4$, the four solutions being $(0, +1)$ and $(+1, 0)$. In the great majority of cases the problems considered have been connected with the sum-function

$$R, (x) = \sum_{n=1}^{[x]} r(n)$$

which is evidently equal to the number of lattice points (i.e. points with integer co-ordinates) within and on the circle of radius \sqrt{x} , but excluding the centre (the origin). In the present paper a new formula is formed for the function $R, (x)$.—H. W. Turnbull and J. Williamson: The invariant theory of the quaternary quadratic complex (Part 2). The complete system. This communication illustrates methods proposed in the earlier part, by giving a list from which all possible invariants can be constructed.

COPENHAGEN.

Royal Danish Academy of Science and Letters, Jan. 20.—C. G. Joh. Petersen: Some biological principles. The true biology may, beside the mechanistic viewpoint, use the 'whole' in the provisional description. The physical qualities of the organisms do not belong to true biology but to psychology (v. NATURE, July 14, p. 68).

Feb. 17.—Jakob Nielsen: The fixed point problem in the representation of closed planes. Constant representation of planes of order 0 or 1 can be conceived as generalisations of analytical transformations, and the same applies to the related fixed point problem. For planes of higher order, this is no longer true, since the problem can at present only be stated from the topological viewpoint. The treatment is connected with fundamental problems of group-theory.

ROME.

Royal National Academy of the Lincei, Mar. 4.—L. Tonelli: The definition of the function of two variables with limited variation. In recent communications, Nalli and Andreoli have treated of the definition of the area of a surface, and have arrived at a definition of a pair of functions of two variables with limited variation. Moreover, by applying the general results obtained to the surface given in the form $z = f(x, y)$, they deduce a definition of the function of two variables with limited variation. The relation of such a definition to that given by the author two years ago is now considered.—U. Cisotti: An interpretation expressive of the conditions of Saint-Venant on infinitesimal variations.—N. Parravano and G. Malquori: The reduction of silver sulphide by means of carbon. The method recently used for the study of the equilibrium between sulphur and molybdenum trisulphide is now applied to measure of the pressure of carbon disulphide corresponding with the reaction $2\text{Ag}_2\text{S} + \text{C} = 4\text{Ag} + \text{CS}_2$ at 1015° and 1050° .—L. Rolla and L. Fernandes: Fractionation of neodymium-samarium mixtures. Crystallisation of the double nitrates formed with magnesium and with manganese furnishes an excellent method for the separation and purification of neodymium from samarium and vice versa.—A. Russo: The varying chromosomic equipment of the cells of Metazoa in relation to sex and the difference in category between mixed individuals and pure gametes in *Cryptochilum echini*. In metazoa, with

a greater amount of nuclear substance, determined by the presence of a chromosome or of several differential chromosomes, there corresponds the development of a female individual, whereas with less nuclear matter, depending on the lack or smallness of these chromosomes, there corresponds a male individual. Similarly, in *Cryptochilum* the difference in quantity of nuclear substances between the individuals of the two categories is the index of their different nature, only that it is determined during the conjugation of the gametes, since one-fourth of the micro-nucleus of the gamete A migrates to the gamete B, where a third mitosis takes place to furnish the mixed individual B with two nuclei, which are equal to one-half of those of the mixed individual A.—P. Nalli: The parallelism of Levi-Civita and certain possible extensions.—L. Fantappiè: The linear functionals of the functions of two complex variables (2).—L. Martinozzi: A new model of condensation hygrometer. Ranzi has directed attention to a source of error affecting hygrometric measurements made with condensation hygrometers of the types devised by Regnault, Chistoni, and others, in which the cooling is attained by evaporation of ether in the vessel containing the thermometer bulb. No matter what precautions are taken, the temperature of the bright surface may differ from that of the thermometer bulb by as much as 1°C . Such error may be avoided by making the thermometric body identical with the wall on which the dew is deposited. In the instrument devised by the author, the thermometer body consists of a bimetallic strip of silver and invar steel arranged cylindrically. One edge of the strip—along a generatrix of the cylinder—is fixed to a vertical aluminium column, while to the free edge is fastened by means of screws a rod, which, by a system of levers like that used in registering apparatus, moves a long index over a scale.—G. Todesco: A new method for observing very small double refraction. A highly sensitive method for observing slight double refraction of accidental, magnetic, or electrical origin is based on the use of a photo-electric cell, arranged to receive the light which, by interposition of the doubly refracting body between two crossed Nicols, emerges from the analysing Nicol. The use of such a cell not only renders it possible, owing to a convenient system of amplification, to detect extremely small variations in luminous intensity, but also removes the causes of error and uncertainty involved in naked eye methods, and gives a numerical result (galvanometer reading).—M. Pierucci: Influence of the electric charge on the conductivity of a metallic film.—G. Natta and M. Freri: X-ray analysis and crystalline structure of cadmium-silver alloys (3). Investigation of cadmium-silver alloys, rapidly solidified and tempered by the powder method, reveals a region of α -solid solutions of cadmium in silver, having the lattice of the latter, but deformed regularly according to Vegard's law up to 35 per cent of cadmium. The α -phase occurs in alloys with 0.45 per cent of cadmium, and the side of the elementary cell increases from 4.07 to 4.15 Å. A compound AgCd exists, which has a body-centred cubic lattice and forms with the components β -solid solutions, these being present in alloys with 47.55 per cent of cadmium; the elementary cell has a side increasing from 3.32 to 3.34 Å., and contains one molecule, the calculated density being 9.97 to 9.82. Alloys with 55 to 65 per cent of cadmium are composed of solid solutions of a new phase of complex structure similar to the body-centred; the elementary cubic cell of side 9.96 Å. contains 52 atoms, i.e. 4 molecules of the compound Ag_5Cd_7 . With 65.95 per cent of cadmium, a simple compact hexagonal structure appears, the side varying from 3.04 to 3.09 Å., and

the value of $c:a$ being 1.58; these are perfect solid solutions of cadmium and silver in AgCd_3 . Alloys with 95-100 per cent of cadmium are solid solutions of silver in cadmium, and have the lattice of the latter. The compound AgCd is dimorphous and is transformed below 420° into a compact hexagonal modification with $c:a=1.62$ and $a=3.01$ Å.—G. Scagliarini and E. Brasi: Additive compounds of halides of divalent metals with organic bases (5). Six compounds of mercuric halides with hexamethylene-tetramine have been prepared.—Giambattista Dal Piaz: The geology of the Grivola group.—G. Cotronei: Factors of morphogenesis in successive times of development.—E. Benedetti: Experiments on the amplification and detection of bio-electric currents by the use of thermionic valves.—U. D'Ancona: Preliminary notices on the larval states of Murenoids collected by Prof. Luigi Sanzo in the Red Sea and in the Gulf of Aden during the cruise of the Italian naval ship *Ammiraglio Magnaghi* in 1923-24.

SYDNEY.

Linnean Society of New South Wales, April 27.—F. H. S. Roberts: A revision of the Australian Bombyliidae (Diptera). (Part I.) Two subfamilies are dealt with, the Exoprosopinae and the Anthracinae. Five genera are placed in the former subfamily, one being described as new. Only one genus belonging to the Anthracinae occurs in Australia, namely, *Anthrac*. Altogether forty-six species are described, eighteen being regarded as new.—C. P. Alexander: Crane-flies (Tipulidae, Diptera) from Barrington Tops, N.S.W. Description of forty-five species taken at a height of approximately 5000 feet during January 1925. Twenty species and two sub-species are described as new.—Rev. H. M. R. Rupp: A review of the Australian species of *Corysanthes* (Orchidaceae). Recognition is sought for seven valid species of *Corysanthes* for Australia. The confusion between certain species in the past dates back at least to Hooker's time. The difficulties of determination are really confined to *C. fimbriata*, *C. diemenica*, and *C. pruinosa*. *C. undulata*, rediscovered in 1924 after being lost for ninety-one years, is clearly a valid species, and the remaining two are very distinct.—A. B. Walkom: Fossil plants from Plutoville, Cape York Peninsula. Description of a small collection of plants which indicate a Cretaceous age for the rocks in which they occur. Eleven species are described, three being new. Two are doubtfully referred to *Lycopodites*, the first record of the genus from Queensland rocks.

VIENNA.

Academy of Sciences, Feb. 16.—W. J. Müller and O. Löwy: The theory of passivity phenomena (2). The relation between passivity current-density and time. The curve is a straight line if time and current-density are plotted logarithmically. The surface layer for iron in ferrous-ferric sulphate or in normal sulphuric acid is ferrous sulphate heptahydrate. Experiments were made with protected, with free-hanging and with agitated electrodes.—S. Strugger: The influence of hydrogen ion concentration on the protoplasm of root hairs in *Hordeum vulgare*. A three-peaked curve was found with maxima for flocculation at pH 6.85-6.90, 7.00-7.05 and 7.35. The percentages of hairs with inhibited plasma streaming gave the same three-peaked diagram.—F. Urbach: On sols in crystals (1).—N. A. Puschin, and D. König: Equilibrium in binary systems containing urea as one component.—O. Gugenberger: Some new cephalopods from the Carnic-Noric mixed fauna of Feuerkogel near Aussee.

Feb. 23.—E. Steinach and H. Kun: The secretion of the male gonad and its dependence on the hormone of the frontal lobe (hypophysis or pituitary). Experiments on infantiles, eunuchoids and seniles. Rats were used. With rats the developmental action of the testicle secretion sets in relatively late, in the ninth or tenth week of infantile life. Tests were made with extract or hormone solutions from the pituitary of rats or cattle, applied by injection. Rats of the same litter were used as controls. The activating impulse for the testicle secretion comes from the pituitary. Pituitary extract provokes bodily and mental precocity.—L. Schmid and A. Waschkau: The constitution of anthochlor from yellow dahlias. Apparently a flavone, possibly 1, 3, 4-trioxyflavone; melting points agree with apigenin.—L. Schmid and M. Zentner: Dehydration experiments on sitosterin. Dehydration of cholesterol by palladium gives a similar but not identical hydrocarbon.—L. Schmid and G. Bilowitzki: Researches on plant sterines. Stigmasterin and sitosterin were found; in *Ulmus* chiefly stigmasterin, in *Ficus* sitosterin, in *Bardana* both sterins.—L. Schmid, A. Waschkau and E. Ludwig: Alkali compounds of polyvalent alcohols and carbohydrates.—L. Schmid and M. Zentner: Methylation of starch.—L. Schmid, E. Ludwig, and K. Pietsch: Cryoscopic determinations of the molecular weight of glycogen in liquid ammonia. A value of about 180 points to the presence of a hexose anhydride. A platinum resistance thermometer and mirror galvanometer were used.—R. Andreash: Rhodanine and related compounds. Rhodanine gives thiazol derivatives on reduction.—E. Göllnitz: Contributions to the theory of quaternions.—A. Kieslinger: Geology and petrography of the Kor Alps (6). Pegmatites of the Kor Alps.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 4, April).—Burton E. Livingston: Dynamic relations between plant and soil, with special reference to the supply of water and oxygen. The living plant and its environment are regarded as two members of a system, the former allowing material and energy to pass in or out and the latter supplying material and energy. The environment should be described in terms of its power of supplying or removing material and energy. Of the soil conditions, only its supplying powers for water, oxygen, and carbon dioxide have been studied. At Baltimore in summer, a square metre of absorbing root surface (lawn plants) requires 80 gm. of water and 3 mg. of oxygen per hour.—Cecilia H. Payne: On the distortion of the continuous background by wide absorption lines. The continuous backgrounds of the spectra of all stars with strong Balmer lines are distorted in the ultra-violet. Temperature measurements, therefore, should not be based on this region; the phenomenon also affects the colour indices.—E. Bodewig: A case of streaming in a valve. The pressure of water against a trap-valve as a two-dimensional problem.—S. Satina and A. F. Blakeslee: Studies on biochemical differences between sexes in *Mucors*. (5) Quantitative determinations of sugars in (+) and (−) races. The amounts of reducing and total sugars were greater in the (+) races of 74 per cent of the pairs tested and the non-reducing sugars in the (+) races of 66 per cent of the pairs. The amount of reducing sugars found is not sufficient to account for the reduction of potassium permanganate previously demonstrated for (+) races, but the difference of sugar content in (+) and (−) races is believed to be significant.—C. J. Davisson and L. H. Germer: Reflection of electrons by a crystal of

nickel. The electron beam is directed against a {111}-face of the crystals at various angles of incidence, and the intensity of scattering in the incidence plane is measured as a function of bombarding potential and direction. A sharply defined beam of scattered electrons in the direction of regular reflection is obtained whenever the speed of the incident electrons is within a certain range which varies with the angle of incidence. Within each range is an optimum speed giving maximum reflection. The phenomenon is analogous to the selective reflection of X-rays and in accord with the authors' earlier experiments on electron diffraction.—Arthur Edward Ruark: (1) The limits of accuracy in physical measurements. There appear to be definite limits to the accuracy of measurements of length, time, and momentum in single experiments. Statistical results seem to give more information than individual experiments, but they depend on the questionable assumption that the structure of particles is definite and independent of their past history and conditions. (2) A critical experiment on the statistical interpretation of quantum mechanics. The probability functions are considered as referring (a) to the average behaviour of a number of similar systems, or (b) to individual systems having a group effect, such as an atom existing in several quantised states at once. Counts of the γ -rays emitted by radium-B or -C would, in case (b), show that two or more γ -rays were emitted simultaneously from a single atom. Present experimental evidence is against this view.—David L. Webster: (1) Direct and indirect characteristic X-rays: their ratio as a function of cathode ray energy. Earlier work on this subject has been extended, the target consisting of a cadmium block plated with silver or wrapped in silver foil being replaced by a cadmium block with cylindrical surface across which was stretched the silver foil, under tension and backed by aluminium foil. The ratio of the intensity of the K_{α} lines of silver and cadmium gives a measure of the ratio of the direct to the total indirect rays. For silver this ratio is almost constant (1.83 at 35 kv. and 1.96 at 80 kv.), with a probable error of 10-20 per cent. This is not sufficient, however, to vitiate comparisons of line intensities as functions of cathode ray energy. (2) K-electron ionisation by direct impact of cathode rays. The probability of direct K ionisation in silver is 0.9 time the probability of an equivalent quantum emission in the continuous spectrum at all voltages; direct ionisation is not usually an internal photoelectric effect.—R. C. Gibbs and H. E. White: Analysis of spectra arising from quadruply ionised tin, Sn V.—Richard C. Tolman: (1) On the energy and entropy of Einstein's closed universe. Using expressions previously obtained which correspond to the first and second laws of thermodynamics, and assuming that pressure is not negligible compared with the energy density, an expression corresponding to entropy is obtained. (2) On the equilibrium between radiation and matter in Einstein's closed universe.—Oliver R. Wulf: Photochemical ozonisation and its relation to the polymerisation of oxygen. Earlier work, even going back so far as the observations of Dewar and Living in 1889, but more particularly that of Warburg, G. N. Lewis, and Wulf, points to the existence of a polymer of O_2 in oxygen gas; this molecule appears to be O_4 .—Linus Pauling: The shared-electron chemical bond. An extension of London's work showing that an antisymmetric *eigenfunction* symmetric in the co-ordinates of two electrons, which corresponds to a potential causing the two atoms to combine to form a molecule, can occur only if originally the spin of each electron be not paired with that of another electron in the same atom.

Official Publications Received.

BRITISH.

- Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1130 (Ae. 300): A High Speed Wind Channel for Tests on Aerofoils. By T. E. Stanton. (T. 2562.) Pp. 9+6 plates. 9d. net. No. 1136 (Ae. 306): The Theory of Pressure Capsules. Part 1: General Discussion; Part 2: The Complete Flat Disc without Control Spring. By A. A. Griffith. (T. 2541 and A.) Pp. 14+1 plate. 9d. net. (London: H.M. Stationery Office.)
- Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 35: Kraft Pulp and Paper from *Pinus insignis*. By L. R. Benjamin, J. L. Somerville, R. B. Jeffreys and W. E. Cohen. Pp. 32. (Melbourne: H. J. Green.)
- Empire Cotton Growing Corporation. Report on Cotton Breeding and Seed Supply in Nigeria. By F. L. Engledow and C. N. French. Pp. 32. (London.) 2s.
- Joint Board of Research for Mental Diseases: City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1928. Pp. 15. (Birmingham.)
- Colonial Survey Committee. Special Report on the Triangulations of Eastern and Central Africa, including Kenya, Northern Rhodesia, Nyasaland, Tanganyika Territory and Uganda. (Colonial No. 83.) Pp. 58. (London: H.M. Stationery Office.) 4s. 6d. net.
- Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum. Vol. 3, No. 4. Pp. 345-500. (Adelaide.) 10s. 6d.
- Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1131 (Ae. 301): Lift and Torque of an Autogyro on the Ground. By H. Glauert. (T. 2502.) Pp. 4+1 plate. 4d. net. No. 1132 (Ae. 302): On the Vertical Ascent of a Helicopter. By H. Glauert. (T. 2546.) Pp. 14+3 plates. 9d. net. (London: H.M. Stationery Office.)
- South Australia: Department of Mines. Mining Review for the Half-Year ended December 31st, 1927. (No. 47.) Pp. 72+7 plates. Geological Survey of South Australia, Bulletin No. 13: Pigment Minerals in South Australia. By R. Lockhart Jack. Pp. 70+5 plates. (Adelaide: Harrison Weir.)
- Liverpool Astronomical Society. Report and Proceedings, Sessions 1924-25 to 1927-28. Pp. 14. (Liverpool.)
- Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1927. Part 1. With Report of the Geological Survey Board and Report of the Director. Pp. iv+82. (London: H.M. Stationery Office.) 1s. 6d. net.
- Canada. Department of Mines: Mines Branch. Silica in Canada: its Occurrence, Exploitation and Uses. Part 2: Western Canada. By L. Heber Cole. (No. 636.) Pp. iii+59. (Ottawa: F. A. Acland.)
- Journal of the Royal Microscopical Society. Series 3, Vol. 48, Part 2, June. Pp. xvi+129-255. (London.) 10s. net.
- Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 39, Part 2, June 25th. Pp. 103-221. (London: Edward Stanford, Ltd.) 5s.
- Journal of the Chemical Society: containing Papers communicated to the Society. June. Pp. iv+1401-1740+x. (London: Gurney and Jackson.)
- International Geographical Union. First Report of the Commission on Pliocene and Pleistocene Terraces. Edited by Dr. K. S. Sanford. Pp. 123. (Oxford.)

FOREIGN.

- Japanese Journal of Physics. Transactions and Abstracts, Vol. 4, No. 4. Pp. 159-184+77-105. (Tokyo: National Research Council of Japan.)
- Meddelelser fra Kommissionen for Havundersøgelser. Serie Plankton, Bind 2, Nr. 2: Investigations on the Food of the Herring in Danish Waters. By P. Jespersen. Pp. 150. (København: C. A. Reitzels Forlag.)
- Mémoires de l'Académie des Sciences et des Lettres de Danemark, Copenhague. Section des Sciences, 5me série, Tome 12, No. 1: The Hydromedusa of the Danish Waters. By P. L. Kramp. Pp. 291. (København: Andr. Fred. Hest and Søn.)
- Société de Propagande coloniale. Bulletin Nos. 3 à 6: Trait scientifique et industriel des plantes textiles. Les hibiscus (Kétmie): culture et exploitation. Pp. 100. (Paris.) 15 francs.
- The Government of the Philippine Islands. Weather Bureau: Manila Central Observatory. Astronomical and Meteorological Conditions of the Eclipse of the Sun, May 9, 1929, in the Philippines. By the Rev. Miguel Selga. Pp. 24. (Manila: Bureau of Printing.)
- U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review (Supplement No. 30): Forest and Stream-Flow Experiment at Wagon Wheel Gap, Colo. Final Report, on Completion of the Second Phase of the Experiment. By C. G. Bates and A. J. Henry. (W.B. No. 946.) Pp. iv+79. (Washington, D.C.: Government Printing Office.)
- Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 173: The Principal Bulb Pests in Michigan. By Eugenia I. McDaniel. Pp. 23. Technical Bulletin No. 88: Investigations on Winter Wheats in Michigan. By E. E. Doon, H. M. Brown, A. J. Patten, O. B. Winter and G. H. Coons. Pp. 35. (East Lansing, Mich.)
- Reports of the Imperial Industrial Research Institute, Osaka, Japan. Vol. 7, No. 17: Dispersoidological Investigations, XII-XVI. By Prof. Dr. P. P. von Weimarn and Collaborators. Pp. 51+7 plates. 1.50 yen. Vol. 8, No. 6: Dispersoidological Investigations, XVII. By Prof. Dr. P. P. von Weimarn and Collaborators. Pp. 55+5 plates. 1.50 yen. Vol. 8, No. 13: Dispersoidological Investigations, XVIII-XXI. By Prof. Dr. P. P. von Weimarn and Collaborators. Pp. 80+10 plates. 2.20 yen. (Osaka and Tokyo: Koseikai Publishing Department.)
- Bulletin of the American Museum of Natural History. Vol. 57, Art. 6: Diptera of the American Museum Congo Expedition. By C. H. Curran. Pp. 327-399. (New York City.)
- Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 11, 1927. Pp. 232+vi. (Rochester, N.Y.: Eastman Kodak Co.)

Annalen van de Sterrewacht te Leiden. Deel 13, Vierde Stuk: Catalogue of 460 Stars for the Epoch and Equinox 1885-0, from Meridian Observations made at Leiden in the Years 1880 to 1897. Pp. 47. Deel 16, Eerste Stuk: Discussion of Observations of Jupiter's Satellites made at Johannesburg in the Years 1908-1926. By D. Brouwer. Pp. 99. Deel 16, Tweede Stuk: Orbital Elements determining the Longitudes of Jupiter's Satellites, derived from Observations. By W. de Sitter. Pp. 94. (Leiden.)

CATALOGUES.

Catalogue of Fine Chemical Products for Laboratory Use: including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. Pp. 130. (London: The British Drug Houses, Ltd.)
Bulletin des Publications nouvelles. 1^{er} Trimestre 1928. Pp. 56. (Paris: Gauthier-Villars et Cie.)
Nickel Steel. Series A, Paper No. 1: Nickel and Nickel-Chromium Steels. Pp. 8. (London: The Bureau of Information on Nickel, Ltd.)

Diary of Societies.

SATURDAY, JULY 21.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Ilfracombe), at 12.

MONDAY, JULY 23.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory, Cambridge), at 4.30.—Dr. D. R. Hartree: The Wave Mechanics of an Atom (with a Non-Coulomb Central Field. Part 3. Term Values and Intensities in Series in Optical Spectra.—E. B. Moullin: On the Period of Irregular Bars, with Special Reference to Ships.—W. H. McCrea: A Suggested Theory of Electric Conduction.—H. D. Ursell: Note on Pauli's Exclusion Principle.—S. L. Malurkar and J. Hargreaves: The Motion of a Particle in a Periodic Field of Force.—M. L. Oliphant: The Effects Produced by Positive Ion Bombardment of Solids: Metallic Ions.—To be communicated by title only.—J. E. Purvis: The Influence of Different Nuclei on the Absorption Spectra of Organic Compounds.—A. T. Starr: Slip in a Crystal and Rupture in a Solid due to Shear.—A. Dalek: Les données expérimentales relatives au mécanisme de la division cellulaire.—Dr. A. S. Parkes: The Physiology of Ovarian Activity.—E. M. Delf: The Influence of Ultra-violet Light on Plants.—E. N. Willmer: Tissue Culture from the Standpoint of General Physiology.—W. K. Slater: Anaerobic Life in Animals.—F. E. Lloyd: The Contractile Vacuole.

CONFERENCES.

JULY 23-26.

BRITISH PHARMACEUTICAL CONFERENCE (at Cheltenham).

Monday, July 23.

Reception by the Mayor of Cheltenham.

Tuesday, July 24.

Welcome by the Mayor of Cheltenham.

Address by the Chairman of the Conference.

Science Meetings.

Delegates Meetings.

Wednesday, July 25.

Science Meetings.

Delegates Meeting.

Thursday, July 26.

Visit to Malvern.

JULY 24-27.

BRITISH MEDICAL ASSOCIATION (Annual Meeting, at Cardiff).

Provisional Programme.

Tuesday, July 24.

At 8 P.M.—Sir Ewen Maclean: Presidential Address.

Wednesday, July 25.

At 10 A.M.—Discussion: Diseases of the Coronary Arteries. Dr. G. A. Allan, Dr. A. G. Gibson, Dr. C. F. Coombs, Prof. G. Hadfield, Dr. C. B. Perry, Dr. I. J. Davies, Dr. D. E. Bedford, and Sir John Campbell.

Discussion: The Diagnosis and Treatment of Spinal Cord Tumours. D. J. Armour, Dr. G. Riddoch, Sir Percy Sargent, and G. Jefferson.

Discussion: Unsuccessful Forceps Cases. Prof. W. F. Shaw, Prof. J. Hendry, and Dr. D. A. Miller.—Paper: Prof. R. Vaudesal: Myomectomy during Pregnancy.

Discussion: Autotoxemia as a Factor in the Causation of the Psychoses. Prof. W. Weygandt, Dr. E. Mapother, Dr. J. Porter-Phillips, Dr. Mary R. Barkas, Dr. A. Helen Boyle, Dr. D. F. Rambaut, Dr. F. A. Pickworth, and Dr. I. S. Wile.

Discussion: The Pathology of Encephalo-myelitis occurring in the course of Virus Disease and Exanthemata. Prof. H. M. Turnbull, Prof. J. McIntosh, Prof. J. C. G. Ledingham, Dr. M. H. Gordon, Dr. J. G. Greenfield, Dr. J. E. McCartney, Dr. S. P. Bedson, and Prof. G. Hadfield.

Discussion: Low Backache and Sciatica. W. A. Cochrane and P. J. Verrall.

Discussion: Chronic Splenomegaly in Childhood. Dr. R. Hutchison, L. E. Barrington-Ward, Dr. L. Findlay, and Dr. C. P. Lapage.

Discussion: Visual Efficiency and Working Ability. Dr. A. F. Fergus, Sir J. H. Parsons, and N. B. Harman.

Paper: Dr. T. H. Whittington: The Examination of the Eyes and Eyesight in Young Children.

Discussion: Chronic Ethmoiditis. Dr. R. Skillern and W. G. Howarth.

Papers: Dr. P. Watson-Williams: Case of Optic Neuritis due to Sphenoidal Sinusitis treated by Differential Exploration.—R. A. R. Wallace: The Ideal Treatment of Quinsy—Immediate Enucleation.

Discussion: The Relation between Trauma and Tuberculosis, especially from the point of view of Compensation and Accident Insurance. Dr. N. Tattersall, R. Milne, and Dr. O. May.

Papers on Factors in the Biochemistry of Tuberculosis: Dr. L. S. T. Barrell: The Therapeutic Value of the Heavy Metals.—Dr. J. C. Hoyle: The Serum Calcium in Experimental Tuberculosis.—Dr. W. H. Tytler: The Tuberculin-active Fraction of the Tubercle Bacillus.

Discussion: Ultra-violet Ray, and the General Public. Prof. W. E. Dixon and Dr. C. B. Heald.

Discussion: The Value of the Present Methods of Control of Infectious Diseases.—(a) The Control of Small-pox. Dr. L. J. Rajchmann, Dr. J. M. Martin, Dr. T. E. Hill, Dr. R. F. Garrow, Dr. R. B. Low, and Dr. C. K. Millard. (b) The Control of Scarlet Fever and Diphtheria. Dr. R. A. O'Brien, Dr. J. G. Forbes, Dr. B. A. I. Peters, and Dr. E. H. R. Harries.

Discussions: (1) Recent Advances in Diagnosis and Treatment of Human Helminthiasis. Lieut.-Colonel Clayton Lane. (2) Transmission of Kala-azar. Dr. C. M. Wenyon.

Discussion: Historical Aspects of Ideas regarding the Nature and Treatment of Dropsy. Dr. J. D. Comrie.

Papers: Dr. E. R. Williams: Welsh Physicians and the Renaissance.—Dr. J. D. Rolleston: The History of Scarlet Fever.—Dr. P. Diverres: The Welsh Physician in the Middle Ages.—C. J. S. Thompson: The History and Lore of Cinchona Bark.

Discussion: Recent Advances in the Medical Treatment of Gastric Diseases. Dr. A. F. Hurst and Dr. T. I. Bennett: Treatment by Diet and Drugs.

Thursday, July 26.

At 10 A.M.—Discussion: The Prevention and Treatment of Diphtheria. Dr. J. D. Rolleston, Dr. J. G. Forbes, Dr. E. W. Goodall, and Dr. J. McGarrity.

Discussion: The Diagnosis and Treatment of Sterility. Dr. A. E. Giles, Dr. S. Forsdike, and K. M. Walker.

Discussion: The Differential Diagnosis and Treatment of Cerebral States consequent upon Head Injuries. Dr. C. P. Symonds, Dr. C. Worster-Drought, W. Trotter, Dr. R. D. Gillespie, Dr. D. McAlpine, and Dr. G. Riddoch.

Discussion: Variations in the Intestinal Flora in Health and Chronic Disease. Prof. J. Cruickshank, Sir Thomas Horder, Lt. Sir Thomas Houston, Prof. J. H. Dible, Dr. A. F. S. Sladden, Dr. L. P. Garrod, and Dr. C. E. Dukes.

Discussion: Volkmann's Ischaemic Contracture, with special reference to Treatment. Sir Robert Jones, Bt., S. Middleton, and A. H. Todd.

Discussion: Chronic Nephritis in Childhood. Dr. J. C. Spence, Dr. H. T. Ashby, and Dr. N. B. Capon.

Discussion: The Etiology of Glaucoma. W. S. Duke-Elder, T. Henderson, and N. B. Harman.

Paper: A. H. Levy: Telescopic Spectacles.

Discussion: Drainage of Brain Abscess. Sir Percy Sargent and S. R. Scott.

Paper: E. D. Davis: Injuries of the Ear arising from Fractures of the Skull.

Discussions: After-effects of Surgical Procedures on Cases of Pulmonary Tuberculosis. A. T. Edwards and Dr. F. G. Chandler. Tuberculosis as seen by the General Practitioner. Dr. R. Cameron and Dr. A. E. Kennedy.

Discussion: The Teaching of Hygiene. Dr. W. W. Jameson and Dr. H. B. Brackenbury.

At 10 A.M. to 12 noon.—Discussion: The Fallacy of X-rays in Abdominal Diagnosis. H. J. Paterson, Dr. F. Herniman-Johnson, and Dr. A. F. Hurst.

At 12 noon.—Discussion: The Treatment of Gangrene. W. S. Handley, P. Turner, and E. G. Slesinger.

Friday, July 27.

At 10 A.M.—Discussion: Acute Nephritis. Prof. T. G. Moorhead, Dr. H. L. Tidy, Dr. T. I. Bennett, Dr. H. Gainsborough, and Dr. R. L. McKenzie Wallace.

Discussion: Pancreatitis. J. W. G. Grant and Dr. A. F. Hurst.

Papers: Prof. W. H. Chipman: Acute Conditions in the Lower Abdomen of the Female.—E. Williams: The Acute Pelvis.—Dr. G. G. Ward: Radium Therapy in Carcinoma of the Cervix Uteri: an Analysis of the Results obtained at the Women's Hospital in New York.—Dr. E. F. Murray: Radium in the Treatment of Carcinoma Cervicis and Intractable Menorrhagia.—Dr. J. Young, Prognosis and Treatment of the Albuminuria of Pregnancy.

Discussion: The Early Treatment of the Psychoses and Psychoneuroses. Dr. A. Helen Boyle, Dr. E. Mapother, Dr. R. D. Gillespie, Dr. Mary R. Barkas, Dr. R. G. Gordon, Dr. J. R. Rees, and Dr. I. S. Wile.

Discussion: The Falling Birth Rate in its Various Aspects.—(a) The Biological Aspect, Prof. F. A. E. Crew. (b) The Economic Aspect, Prof. W. J. Roberts. (c) The Medical Aspect, Sir Thomas Horder, Bt., and Lady Barrett.

Discussion: Urticaria. Dr. A. R. Hallam and Dr. H. W. Barber. Papers: Dr. H. C. G. Semon: Souttar's Steam Cautey in Dermatology.—Dr. J. E. M. Wigley: Thallium Epilation in the Treatment of Ringworm.—Dr. W. J. O'Donovan: Salvarsan III-effects and Fatalities.

12 noon.—Discussion: The Diagnosis of Ureteric Calculi. Prof. A. Fullerton, Dr. E. B. C. Mayrs, K. M. Walker, J. S. Joly, and H. Wade.

JULY 30-AUGUST 1.

INTERNATIONAL CONGRESS OF OTO-LARYNGOLOGY (at Copenhagen).